Hot Collar Tests

Phase A

Term ID	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	3	8.000	0.0520	0.0040	G	
	L	GROUND	3	8.001	0.0510	0.0050	G	
	SL	GROUND	3	8.000	0.0610	0.0060	G	

Phase B

Term ID	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	3	8.000	0.0510	0.0070	G	
	L	GROUND	3	8.001	0.0530	0.0080	G	
	SL	GROUND	3	8.000	0.0510	0.0090	G	

Phase C

Term ID	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	3	8.001	0.0540	0.0070	G	
	L	GROUND	3	8.000	0.0550	0.0060	G	
	SL	GROUND	3	8.001	0.0550	0.0070	G	

United Power Group, Inc.

Liberty Utilities
9 Lowell Road
Salem, NH 03079

August 21 & 24, 2018
Project No. U081837

Project Location:

Salem Depot Substation

Scope:

Perform testing and maintenance on the following equipment:

1. 9L2 Transformer
2. 9L2 Vacuum Recloser and Form 3 Controller
3. 9L2 Voltage Regulators

Remarks:

1. The 9L2 transformer test results were acceptable.
2. 9L2 Vacuum breaker and form 3 controller test results are acceptable for service.
3. 9L2 voltage regulator test results are acceptable for service. The C Phase regulator motor capacitor is temporarily wired in the controller. This will cause the regulator to get stuck in the 16L or 16R position. The regulator needs to be untanked to repair this issue.

Submitted by:

James Fazio

United Power Group, Inc.

				Page No.	2
Customer	Liberty Utilities	Date	8/21/2018	Project No.	U081837
Address	Salem, NH	Air Temp.	70F	Rel. Humidity	38%
Owner	Liberty Utilities	Date Last Inspection		1/22/15	
Address	Salem, NH	Last Inspection Report No.			

Equipment Location: Salem Depot Substation
Owner Identification: 9L2T

Nameplate Information

Manufacturer	GE	KVA	5000/5600/7000	Phase	3	Cycle	60		
Serial No.	G-859810	Type	Auto	Form		Class	OA/FA		
Primary Voltage	22.9kV	Delta		Wye	X	Rated Current	141	Amperes	
Secondary Voltage	7.62kV	Delta		Wye	X	Rated Current	245	Amperes	
Coolant	Oil X	Askarel		Air		Nitrogen		Other	
Coolant Capacity - Units		Main Tank	690UG	LTC		Switch			
Temperature Rise		Date of Manufacture		Impedance	3.40%				
No Load Tap Changer Voltages	24100/23500/22900/22300/21700								

Gauges and Counters	Measured	Maximum	Reset	Trip	Alarm	LTC	Measured	Max.	Min.
Oil Temperature						Tap	NA		
Wdg. Temperature	20C	60C				Counter	NA		
Pressure									
Oil Level	25C								

Visual Inspection			
Primary Connection	OK	Secondary Connections	OK
Tap Connections	OK	Leaks	NA
Gas Regulator	NA	Paint	Rust
Infra-Red Inspection	NA	Grounds	OK

Fans and Controls	Oil Temp.	Wdg. Temp.	Manual	Auto	Lubrication Date
Stage 1					
Stage 2					

Accessory Inspection	Alarm	Trip
Pressure Relief Device - Main Tank		
Pressure Relief Device - LTC		
Sudden Pressure Device		

Additional Tests

Remarks: All bushings need to be replaced.

Submitted By: JF

9L2T

Report Source **Two Winding Transformer**
Session Test Date 8/21/2018 8:17:24 AM

Nameplate - Two-Winding Transformer

Company	UPG	**Serial No.**	G-859810
Location	Salem Depot Substation	**Special ID**	Transformer - 92T
Division	Liberty Utilities	**Circuit Designation**	
Manufacturer	General Electric	**Configuration**	Y_Y
Year Manufactured		**Tank Type**	Other
Mfr Location	USA	**Coolant**	Oil
Phases	Three	**Class**	OA/FA
Oil Volume	690 UG	**BIL**	150 kV
Weight	18600.000 LB		
kV	22.9, 13.8	**VA Rating**	*, *, *, 5000.000, KVA

Test Date	8/21/2018	**Test Time:**	8:17 AM	**Weather**	Partly Cloudy
Air Temperature	21°C	**Apparatus**	*	**Humidity**	64 %
Tester	JF	**Work Order**		**Date Last Tested**	1/22/2015
Verified		**Test Set Type**	M4000	**Date Retested**	
Verification Date		**Set Top Serial #**		**Reason**	
Last Sheet #		**Set Bottom Serial #**		**Travel Time**	
Purchase Order		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Bushing Nameplate

Designation	Serial No.	Manufacturer	Type	C1 %PF	C1 Cap	C2 %PF	C2 Cap	Rated kV	Amps
H1-	15-292453	PCORE Electric Co.		0.65	458	*	*	25	400
H2-	15-292438	PCORE Electric Co.		0.65	469	*	*	25	400
H3-	15-291996	PCORE Electric Co.		0.63	461	*	*	25	400
X0-	15-292464	PCORE Electric Co.		0.65	456	*	*	25	400
X1	15-292475	PCORE Electric Co.		0.65	460	*	*	25	400
X2-	15-292452	PCORE Electric Co.		0.65	456	*	*	25	400
X3-	15-292445	PCORE Electric Co.		0.65	466	*	*	25	400

Overall Tests

	Insulation	Test kV	mA	Watts	% PF corr	Corr Fctr	Cap(pF)	FRANK™	Manual
1	CH+CHL	8.003	30.818	1.207	*	1	8174.7		
2	CH	8.002	30.813	1.203	0.39	1	8173.5	Good	

Bushing C1

ID	Serial No.	NP %PF	NP Cap	Test kV	mA	Watts	% PF corr	Corr Fctr	Cap(pF)	FRANK™	Manual
H1-	15-292453	0.65	458	8	1.725	0.099	0.57	1	457.63	Good	
H2-	15-292438	0.65	469	10.004	1.779	0.103	0.58	1	471.87	Good	
H3-	15-291996	0.63	461	10.004	1.742	0.097	0.56	1	462.13	Good	
X0-	15-292464	0.65	456	10.004	1.732	0.099	0.57	1	459.51	Good	
X1	15-292475	0.65	460	8.005	1.743	0.101	0.58	1	462.35	Good	
X2-	15-292452	0.65	456	8.002	1.731	0.101	0.58	1	459.06	Good	
X3-	15-292445	0.65	466	8.002	1.763	0.103	0.58	1	467.73	Good	

Insulation Resistance

				Core Ground Test	
Manufacturer	Megger			*	
Serial No.				*	
Connections		**Volts**	**1 min (Mohms)**	**10 min (Mohms)**	**PI**
Hi / Low to Earth		5000.00	42000.00	65200.00	1.55

Turns Ratio Tests

				Serial No.			**HV Winding**			**LV Winding**	
							Wye			Wye	
Connections				**H1 - H0**			**H2 - H0**			**H3 - H0**	
				X1 - X0			**X2 - X0**			**X3 - X0**	
Tap	**NP Volt**	**Tap**	**NP Volt**	**Cal**	**Ratio 1**	**Ratio 2**	**Ratio 3**	**Min. Lim**	**Max. Lim**	**FRANK™**	**Manual**
3	13220.000		7620.000	1.735	1.732	1.733	1.733	1.726	1.744	Good	

United Power Group, Inc.

VACUUM RECLOSER TEST AND INSPECTION REPORT

Page No. 4

Customer	Liberty Utilities	Date	8/21/2018	Project No.	U081837
Address	Salem, NH	Air Temp.	78F	Rel. Humidity	55%
Owner	Liberty Utilities	Date Last Inspection	1/22/2015		
Address	Salem, NH	Last Inspection Report No.			
Equipment Location	Salem Depot				
Owner Identification	Recloser 9L2				

Breaker Nameplate Data:

Manufacturer	McGraw Edison			Type	VSA		
Serial No.	2586			Type Operating Mechanism	Coil Spring		
Amperes	800	Age	1976	Interrupt. Rating	12kA	KV	15.5

Adjustment Checks	Mfr's Rec.	As Found	As Left
Latch Wipe		X	X
Latch Clearance		X	X
Stop Clearance		X	X
Prop. Clearance		X	X
Phase Checked	**A**	**B**	**C**
Contact Gap	X	X	X
Contact Travel	X	X	X
Contact Wipe	X	X	X
Erosion Indicator	X	X	X

Phase Test Data	A	B	C
5 KV Bottle Megohms			
5 KV Open CB	**B1**	**B3**	**B5**
Megohms to Ground	100,000+	100,000+	100,000+
Bushings not under	**B2**	**B4**	**B6**
test were grounded.	100,000+	100,000+	100,000+
5 KV Closed CB	**B1 & B2**	**B3 & B4**	**B5 & B6**
Megohms To Ground	100,000+	100,000+	100,000+
K = Number Entered Above X 1000			
Closing/Opening Speed	Visual OK		
Contact Rest. Microhms	241	233	236

HIPOT Tests Microamps 1 Minute Test			
Phase tested	1	2	3
37.5 KV AC. Bottle Test	P	P	P
37.5 KV Closed CB Test	P	P	P
Bottle Test is a Go No Go Test **(P = Pass) (F= Fail)**			
Closed Test Energize a Phase & Grd. All Others			

Specified Tolerances (If Applicable)	
Latch Wipe	NA
Latch Clearance	NA
Stop Clearance	NA
Prop. Clearance	NA
Contact Gap	NA
Contact Travel	NA
Contact Wipe	NA
Erosion Indicator	NA

Inspection and Maintenance:				
Checked Items:	Insp. Item	Found Dirty	Cleaned & Lubed	See Remarks
Vacuum Bottles	X			
Primary Stabs	X			
Ground Stab	X			
Structural Checks	X			
Mech. Conn.	X			
Charging Motor	X			
Closing Springs	X			
Opening Springs	X			
Operation Coils	X			
Auxiliary Devices	X			
Insulating Memb.	X			
Recloser Wiring	X			
Racking Device				
Heater & Lights	X			
Cubicle Wiring	X			
X = *Yes For This Entry*				
Counter Found	709			
Counter Left	712			

Remarks: Results are acceptable.

Submitted by: J Fazio Equipment Used: DLRO, Megger, HIPOT

9L2 - Recloser

Report Source **Vacuum Breaker**

Session Test Date 8/21/2018 10:22:51 AM

Nameplate - Vacuum Breaker

Company	UPG	**Serial No.**	2586
Location	Salem Depot	**Special ID**	Breaker 9L2
Division	Liberty Utility	**Circuit Designation**	
Manufacturer	McGraw-Edison	**Type**	OTHER
Year Manufactured	1976	**Class**	vacuum_breaker
Mfr Location	USA	**Mechanism Type**	
Interrupting Rating	12.0 kA	**Mechanism Design**	Coil Spring
Weight	*	**BIL**	110 kV
Total Weight	525 LB	**Control Volts**	125
Counter		**Amps**	800
kV	15.5		

Test Date	8/21/2018	**Test Time:**	10:22 AM	**Weather**	
Air Temperature	23°C	**Apparatus**	*	**Humidity**	54 %
Tester	JF	**Work Order**		**Date Last Tested**	1/22/2015
Verified		**Test Set Type**	M4000	**Date Retested**	
Verification Date		**Set Top Serial #**		**Reason**	
Last Sheet #		**Set Bottom Serial #**		**Travel Time**	
Purchase Order		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Overall Tests

Test Mode	Phase	Test kV	mA	Watts	FRANK™	Manual
GND RB	A	10.003	0.314	0.023		
GND RB	A	10.003	0.181	0.019		
GND RB	B	10.002	0.304	0.023		
GND RB	B	10.003	0.18	0.018		
GND RB	C	10.003	0.301	0.02		
GND RB	C	10.002	0.18	0.018		
UST RB	A	10.003	0.042	0.004		
UST RB	B	10.002	0.042	0.004		
UST RB	C	10.002	0.041	0.003		

Hot Collar Tests

ID	Serial No.	Test Mode	Skirt #	Test kV	mA	Watts	FRANK™	Manual
1	HC-SN-1	GND RB	1	10.009	0.028	0.014	Good	
2	HC-SN-3	GND RB	1	10.01	0.027	0.009	Good	
3	HC-SN-5	GND RB	1	9.999	0.027	0.013	Good	
4	HC-SN-7	GND RB	1	10.003	0.027	0.013	Good	
5	HC-SN-9	GND RB	1	9.999	0.027	0.013	Good	
6	HC-SN-11	GND RB	1	10.003	0.027	0.014	Good	

United Power Group, Inc.

PROTECTIVE RELAY TEST REPORT

Customer Liberty Utilities | Date 8/21/18 | Proj. No. U081837
Address Salem, NH | Air Temp. 70F | Rel. Hum. 35%
Owner Liberty Utilities | Date Last Inspection 1/22/15
Address Salem, NH | Last Inspection Report No.
Equipment Location Salem Depot
Owner Identification 9L2 Recloser

Circuit Identification 9L2 | C.T.Ratio 1000/1 | P.T.Ratio

Visual Inspection					Routine Maintenance					
Cover Gasket		X			Glass Cleaned		X			Mfr: Cooper
Glass		X			Case Cleaned		X			Type Ph: Form 3A
Foreign Material		X			Relay Cleaned		X			Cat No:
Moisture		X			Connections Tight		X			Tap Range Ph:
Spiral Spring					Taps Tightened					Tap Range Grd:
Bearing Condition					Contacts Cleaned					Inst. Range Ph:
Bearing End-Play					Insulation Resistance		X			Inst Range Grd:
Disc Clearance					Trip Circuit		X			Use: 51P/51G/79
Rust		X								S/N =

Remarks: Results are acceptable.

Relay Settings

	Reclosing			Inst. Element Setting		Tap Setting		Curve Setting				Time Dial Setting			
	1st	2nd	3rd	50P-1	50G-1	51P	51G	50P-1	50G-1	51P	51G	51P Fast	51G Fast	51P	51G
Specified	5	15	LO			560A	200A					A	17	D	3
As Found	5	15	LO			560A	200A					A	17	D	3
As Left	5	15	LO			560A	200A					A	17	D	3

Test Operations - As Found - Time in Seconds

		Time Element P. U.		Current Voltage Time			Inst. Element Current/Voltage		Targets		Reclosing			
	Zero Set	Tap 1	Tap 2	P. U. X	Tap 1 X2	Tap 2 X4	Pick Up	Delay	LED	Reset	1st	2nd	3rd	4th
A Phase		0.540			1.27	0.273			X	X				
B Phase		0.540			1.28	0.271			X	X	5	15	LO	
C Phase		0.540			1.27	0.272			X	X				
GRD		0.200			6.42	2.39			X	X				

Test Operations - As Left - Time in Seconds

		Time Element P. U.		Current Voltage Time			Inst. Element Current/Voltage		Targets		Reclosing			
	Zero Set	Tap 1	Tap 2	P. U. X	Tap 1 X2	Tap 2 X4	Pick Up	Delay	LED	Reset	1st	2nd	3rd	4th
A Phase		0.540			1.27	0.273			X	X				
B Phase		0.540			1.28	0.271			X	X	5	15	LO	
C Phase		0.540			1.27	0.272			X	X				
GRD		0.200			6.42	2.39			X	X				

Submitted By JF | Equipment Used Doble 2253

United Power Group, Inc.

Page No. 7

Customer	Liberty Utilities	Date	8/24/2018	Proj. No.	U081837
Address	Salem, NH	Air Temp.	60F	Rel. Hum.	50%
Owner	Liberty Utilities	Date Last Inspection			
Address	Salem, NH	Last Inspection Report No.			

Equipment Location: Salem Depot
Owner Identification: 9L2 Regulator Bank

Manuf.	GE	Type	VR1	Test Set	TTR-JF
Gallons	112	Oil Levels	OK	KVA	333

Nameplate Voltage	7960
Line to Line Voltage	
Percent Regulation	5/8%

Ser. A	Q562027-TWR
Ser. B	Q521599-TRM
Ser. C	Q5484907-TTV

Doble Factor	Power Results
Test KV	8
Position	N

Tap Position	Tap Voltage	TTR Ratio	TTR MEASURED VALUES S-SL A L-SL A	S-SL B L-SL B	S-SL C L-SL C
16R	8756	0.9091	0.907	0.907	0.907
15R	8706	0.9143	0.912	0.912	0.912
14R	8657	0.9195	0.917	0.917	0.917
13R	8607	0.9249	0.922	0.922	0.922
12R	8557	0.9302	0.926	0.926	0.927
11R	8507	0.9357	0.933	0.933	0.933
10R	8458	0.9412	0.939	0.939	0.939
9R	8408	0.9467	0.945	0.945	0.945
8R	8358	0.9524	0.951	0.951	0.951
7R	8308	0.9581	0.957	0.957	0.957
6R	8259	0.9639	0.965	0.965	0.964
5R	8209	0.9697	0.969	0.969	0.969
4R	8159	0.9756	0.975	0.975	0.975
3R	8109	0.9816	0.982	0.981	0.982
2R	8060	0.9877	0.986	0.986	0.986
1R	8010	0.9938	0.993	0.993	0.993
N	7960	1.0000	1.000	1.000	1.000
1L	7910	1.0063	1.006	1.006	1.006

Phase	A
Milli-A	19.404
Watts	1.661
% P. F.	0.86
C (pF)	5146.8
Rating	G

Phase	B
Milli-A	19.837
Watts	1.662
% P. F.	0.84
C (pF)	5261.6
Rating	G

Phase	C
Milli-A	19.396
Watts	2.433
% P. F.	1.25
C (pF)	5144.6
Rating	G

Inspection		A	B	C
Bushings		OK	OK	OK
Connections		OK	OK	OK
Grounds		OK	OK	OK
Oil Level		OK	OK	OK
Position Ind.		OK	OK	OK
Operations Ctr.	AL	98745	143723	122653
Drag Hands	Min	5L	6L	6L
Drag Hands	Max	3R	4R	4R
Drag Hands	Reset	OK	OK	OK
Control	Man	OK	OK	OK
Control	Auto	OK	OK	OK

Megohms 1 Minute	
Test KV	5
Phase A	19,500
Phase B	21,300
Phase C	24,300
Tests By	JF

Remarks

Hot Collar Tests

Phase A

Term ID	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	3	8.001	0.0420	0.0040	G	
	L	GROUND	3	8.001	0.0440	0.0040	G	
	SL	GROUND	3	8.000	0.0400	0.0030	G	

Phase B

Term ID	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	3	8.000	0.0410	0.0040	G	
	L	GROUND	3	8.001	0.0410	0.0040	G	
	SL	GROUND	3	8.000	0.0420	0.0050	G	

Phase C

Term ID	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	3	8.000	0.0500	0.0070	G	
	L	GROUND	3	8.000	0.0480	0.0060	G	
	SL	GROUND	3	8.001	0.0470	0.0070	G	

United Power Group, Inc.

Liberty Utilities
9 Lowell Road
Salem, NH 03079

September 25, 2014
Project No. U091435

Project Location:

Salem Depot Substation

Scope:

Perform testing and maintenance on the following equipment:

1. 9L1 Oil Circuit Breaker and Protective Relays
2. 9L1 Voltage Regulators

Remarks:

1. 9L1 oil circuit breaker and protective relay test results are acceptable for service.
2. 9L1 Voltage regulator test results are acceptable for service.

Submitted by:

James Fazio

9L1 - Oil Circuit Breaker

Company	UPG	**Serial No.**	282572
Location	Salem Depot Substation	**Special ID**	9L1 OCB
Division	Liberty Utilities	**Circuit Designation**	
Manufacturer	A-C	**Type**	OZ-110
Yr. Manufactured	1951	**Class**	
Mfr. Location	USA	**Mech. Type**	
Oil Volume	11 UG	**BIL**	110 kV
Weight		**Interrupting Rating**	
# of Tanks		**Counter**	
Control Volts	125	**Amps**	600
kV	14.4		
Note			

Test Date	9/25/2014	**Test Time**	8:41:25 AM	**Weather**	
Air Temperature	15 °C	**Tank Temp.**	°C	**RH.**	72 %
Tested by	JF	**Work Order #**		**Last Test Date**	
Checked by		**Test Set Type**	M4K	**Retest Date**	
Checked Date		**Set Top S/N**		**Reason**	ROUTINE
Last Sheet #		**Set Bottom S/N**		**Travel Time**	
P.O. #		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Overall Tests

Energize	Bus Ft	Ins. #	Ph.	Test kV	mA	Watts	%PF corr	Corr Fctr	TLI	IR_{auto}	IR_{man}
1			1	10.002	0.3430	0.1260	3.67	1.00		Q	
2			1	10.001	0.3380	0.1300	3.85	1.00		Q	
3			2	10.002	0.3430	0.1230	3.59	1.00		Q	
4			2	10.002	0.3410	0.1550	4.55	1.00		Q	
5			3	10.002	0.3440	0.1140	3.31	1.00		Q	
6			3	10.001	0.3410	0.1200	3.52	1.00		Q	
1,2			1	10.002	0.7450	0.1790	2.40	1.00	-0.077	G	
3,4			2	10.001	0.7490	0.2000	2.67	1.00	-0.078	G	
5,6			3	10.001	0.7470	0.1610	2.16	1.00	-0.073	G	

Hot Collar Tests

Serial No.	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	1	GROUND	1	10.003	0.0800	0.0640	G	
	2	GROUND	1	10.005	0.0800	0.0420	G	
	3	GROUND	1	10.005	0.0770	0.0250	G	
	4	GROUND	1	10.005	0.0770	0.0260	G	
	5	GROUND	1	10.001	0.0840	0.0900	G	
	6	GROUND	1	10.008	0.0780	0.0380	G	

Insulation Resistance

Mfr.	AVO	Serial #		

Open Breaker Tests				
Volts	**Connection**	**T1**	**T2**	**PI**
5000	Tank 1	22000	76000	3.45
5000	Tank 2	18000	24000	1.33
5000	Tank 3	46000	89000	1.93

Contact Resistance

Mfr.	AVO	Serial #	

Closed Breaker Tests					
Volts	**Connection**	**T1(Mohms)**	**T2(Mohms)**	**PI**	**Contact Res.(µOhms)**
5000	Tank 1	22000	76000	3.4545	192
5000	Tank 2	18000	24000	1.3333	187
5000	Tank 3	46000	89000	1.9348	193

Note	

United Power Group, Inc.

PROTECTIVE RELAY TEST REPORT

Customer Liberty Utility | Date 9/25/2014 | Proj. No. U091435
Address Salem, NH | Air Temp. 55 F | Rel. Hum. 45%
Owner Liberty Utility | Date Last Inspection By Others
Address Salem, NH | Last Inspection Report No.
Equipment Location Salem Depot Substation
Owner Identification Overcurrent Relay 9L1 Dev # 51P/51G

Circuit Identification 9L1 C.T.Ratio 600/5 P.T.Ratio

Visual Inspection					Routine Maintenance					
	A	B	C	GRD		A	B	C	GRD	
Cover Gasket	X	X	X		Glass Cleaned	X	X	X		Mfr: GE
Glass	X	X	X		Case Cleaned	X	X	X		Type Ph: IAC77B4A
Foreign Material	X	X	X		Relay Cleaned	X	X	X		Type Grd: IAC51B2A
Moisture	X	X	X		Connections Tight	X	X	X		Tap Range Ph: 4.0-8.0
Spiral Spring	X	X	X		Taps Tightened	X	X	X		Tap Range Grd:
Bearing Condition	X	X	X		Contacts Cleaned	X	X	X		Inst. Range Ph: NIS
Bearing End-Play	X	X	X		Insulation Resistance	X	X	X		Inst Range Grd:
Disc Clearance	X	X	X		Trip Circuit	X	X	X		Use: 51P/51G
Rust	X	X	X							

Remarks:

* Inst elements are not used.

Relay Settings

	ICS	Inst. Element Setting				Tap Setting				Time Dial Setting			
		A	B	C	GRD	A	B	C	GRD	A	B	C	GRD
Specified	2	*	*	*		5.0	5.0	5.0	1.5	1.0	1.0	1.0	4.0
As Found	2	*	*	*		5.0	5.0	5.0	1.5	1.0	1.0	1.0	4.0
As Left	2	*	*	*		5.0	5.0	5.0	1.5	1.0	1.0	1.0	4.0

Test Operations - As Found - Time in Seconds

		Time Element P. U.		Current Voltage Time			Inst. Element Current/Voltage		ICS AMPS		
	Zero Set	Tap 1	Tap 2	P. U. X2	Tap 1 X4	Tap 2	Pick Up	Drop Out	Pick Up	Drop Out	
A Phase		5.0		1.54	0.343				2	X	
B Phase		5.0		1.55	0.344				2	X	
C Phase		5.0		1.54	0.342				2	X	
GRD		1.5		2.83	1.59				2	X	

Test Operations - As Left - Time in Seconds

		Time Element P. U.		Current Voltage Time			Inst. Element Current/Voltage		ICS AMPS		
	Zero Set	Tap 1	Tap 2	P. U. X2	Tap 1 X4	Tap 2	Pick Up	Drop Out	Pick Up	Drop Out	
A Phase		5.0		1.54	0.343				2	X	
B Phase		5.0		1.55	0.344				2	X	
C Phase		5.0		1.54	0.342				2	X	
GRD		1.5		2.83	1.59				2	X	

Submitted By JF Equipment Used F2253

9L1 – A Phase Voltage Regulator Page 5

Company	UPG	**Serial No.**	Q775050-UDD
Location	Salem Depot Substation	**Special ID**	9L1 Regulators
Division	Liberty Utilities	**Circuit Designation**	A Phase
Manufacturer	GE	**Type**	VR-1
Yr. Manufactured	2009	**Class**	OA
Mfr. Location	USA		
Tank Type	N2 BLANKETED	**Coolant**	OIL
Phases	1	**BIL**	95 kV
Weight	3079 LB	**Oil Volume**	112 UG
kV	7.96	**Amps**	418
Impedance	%	**VA Rating**	333 kVA
Catalog #		**LTC Counter**	186279
Design	Step	**Ctrl Wire Diameter**	
Catalog/Style		**Crew Size**	
Note			

Test Date	9/25/2014	**Test Time**	10:52:45 AM	**Weather**	
Air Temperature	18 °C	**Tank Temp.**	°C	**RH.**	51 %
Tested by		**Work Order #**		**Last Test Date**	8/1/2014
Checked by		**Test Set Type**	M4K	**Retest Date**	
Checked Date		**Set Top S/N**		**Reason**	ROUTINE
Last Sheet #		**Set Bottom S/N**		**Travel Time**	
P.O. #		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Overall Tests

Meas.	Test kV	mA	Watts	%PF corr	Corr Fctr	Cap(pF)	IR_{auto}	IR_{man}
CH	10.002	21.830	2.152	0.99	1.00	5790.2	G	

Hot Collar Tests

Serial No.	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	2	10.004	0.0730	0.0060	G	
	L	GROUND	2	10.010	0.0630	0.0020	G	
	SL	GROUND	2	10.007	0.0630	0.0020	G	

Insulation Resistance

Mfr.:	AVO	Serial #:				
kV	**Connection**	**T1(Mohms)**	**T2(Mohms)**	**PI**	**IR_{auto}**	**IR_{man}**
5000	Src/Load to Earth	12400	26700	2.1532		

Exciting Current Tests

	Mfr.	Type	Steps	Position Found	Position Left
De-Energized Tap Changer					
On-Load Tap Changer					

	Connections	SA - SL		SB - SL		SC - SL			
LTC	**Test kV**	**mA**	**Watts**	**mA**	**Watts**	**mA**	**Watts**	**IR_{auto}**	**IR_{man}**
1L	2.500	647.32	1007.3						
N	2.502	1085.8	1118.6						
1R	2.507	1079.4	1152.8						
2R	2.500	1083.8	1113.2						
3R	2.500	645.69	1021.9						
4R	2.500	1084.0	1109.5						
5R	2.499	645.81	1017.8						
6R	2.501	1083.5	1105.9						
7R	2.499	1080.1	1123.9						
8R	2.499	1083.8	1105.3						
9R	2.500	1080.9	1123.7						
10R	2.499	1084.1	1103.2						
11R	2.500	1081.9	1126.7						
12R	2.500	1084.8	1104.8						
13R	2.500	647.90	1019.0						
14R	2.499	1084.7	1104.2						
15R	2.499	647.92	1020.0						
16R	2.499	1085.0	1105.2						

9L1 – B Phase Voltage Regulator

Company	UPG	**Serial No.**	Q76598-UBD
Location	Salem Depot Substation	**Special ID**	9L1 Regulators
Division	Liberty Utilities	**Circuit Designation**	B Phase
Manufacturer	GE	**Type**	VR-1
Yr. Manufactured	2009	**Class**	OA
Mfr. Location	USA		
Tank Type	N2 BLANKETED	**Coolant**	OIL
Phases	1	**BIL**	95 kV
Weight	3079 LB	**Oil Volume**	112 UG
kV	7.96	**Amps**	418
Impedance	%	**VA Rating**	333 kVA
Catalog #		**LTC Counter**	186279
Design	Step	**Ctrl Wire Diameter**	
Catalog/Style		**Crew Size**	
Note			

Test Date	9/25/2014	**Test Time**	11:41:02 AM	**Weather**	
Air Temperature	19 °C	**Tank Temp.**	°C	**RH.**	50 %
Tested by	JF	**Work Order #**		**Last Test Date**	9/25/2014
Checked by		**Test Set Type**	M4K	**Retest Date**	
Checked Date		**Set Top S/N**		**Reason**	ROUTINE
Last Sheet #		**Set Bottom S/N**		**Travel Time**	
P.O. #		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Overall Tests

Meas.	Test kV	mA	Watts	%PF corr	Corr Fctr	Cap(pF)	IR_{auto}	IR_{man}
CH	8.002	19.306	1.704	0.88	1.00	5120.7	G	

Hot Collar Tests

Serial No.	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	2	10.004	0.0660	0.0030	G	
	L	GROUND	2	10.011	0.0720	0.0040	G	
	SL	GROUND	2	10.008	0.0650	0.0030	G	

Insulation Resistance

Mfr.:	AVO	Serial #:				
kV	**Connection**	**T1(Mohms)**	**T2(Mohms)**	**PI**	**IR_{auto}**	**IR_{man}**
5000	Src/Load to Earth	13400	34500	2.5746		

Exciting Current Tests

	Mfr.	Type	Steps	Position Found	Position Left
De-Energized Tap Changer					
On-Load Tap Changer					

	Connections	SA - SL		SB - SL		SC - SL			
LTC	**Test kV**	**mA**	**Watts**	**mA**	**Watts**	**mA**	**Watts**	**IR_{auto}**	**IR_{man}**
1L	2.501	646.61	911.60						
N	2.501	1087.2	1002.6						
1R	2.500	1080.1	1017.7						
2R	2.500	1085.6	1004.2						
3R	2.500	644.19	909.34						
4R	2.500	1086.5	1000.9						
5R	2.500	1086.8	996.85						
6R	2.500	1086.8	1008.2						
7R	2.500	1083.2	1020.5						
8R	2.500	1086.7	996.99						
9R	2.500	1083.6	1017.8						
10R	2.502	1086.7	998.19						
11R	2.501	1083.9	1017.9						
12R	2.500	1086.8	997.61						
13R	2.500	646.22	910.51						
14R	2.501	1087.0	999.64						
15R	2.500	646.57	913.83						
16R	2.501	1087.2	1004.9						

9L1 – C Phase Voltage Regulator

Company	UPG	**Serial No.**	Q774165-ULC
Location	Salem Depot Substation	**Special ID**	9L1 Regulators
Division	Liberty Utilities	**Circuit Designation**	C Phase
Manufacturer	GE	**Type**	VR-1
Yr. Manufactured	2009	**Class**	OA
Mfr. Location	USA		
Tank Type	N2 BLANKETED	**Coolant**	OIL
Phases	1	**BIL**	95 kV
Weight	3079 LB	**Oil Volume**	112 UG
kV	7.96	**Amps**	418
Impedance	%	**VA Rating**	333 kVA
Catalog #		**LTC Counter**	186279
Design	Step	**Ctrl Wire Diameter**	
Catalog/Style		**Crew Size**	
Note			

Test Date	9/25/2014	**Test Time**	12:13:45 PM	**Weather**	SUNNY
Air Temperature	21 °C	**Tank Temp.**	°C	**RH.**	44 %
Tested by		**Work Order #**		**Last Test Date**	9/25/2014
Checked by		**Test Set Type**	M4K	**Retest Date**	
Checked Date		**Set Top S/N**		**Reason**	ROUTINE
Last Sheet #		**Set Bottom S/N**		**Travel Time**	
P.O. #		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Overall Tests

Meas.	Test kV	mA	Watts	%PF corr	Corr Fctr	Cap(pF)	IR_{auto}	IR_{man}
CH	8.002	21.642	2.785	1.29	1.00	5740.2	G	

Hot Collar Tests

Serial No.	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	2	10.003	0.0630	0.0050	G	
	L	GROUND	2	10.011	0.0680	0.0050	G	
	SL	GROUND	2	10.009	0.0650	0.0080	G	

Insulation Resistance

Mfr.:	AVO	Serial #:				
kV	**Connection**	**T1(Mohms)**	**T2(Mohms)**	**PI**	**IR_{auto}**	**IR_{man}**
5000	Src/Load to Earth	24900	45600	1.8313		

Exciting Current Tests

	Mfr.	Type	Steps	Position Found	Position Left
De-Energized Tap Changer					
On-Load Tap Changer					

	Connections	SA - SL		SB - SL		SC - SL			
LTC	**Test kV**	**mA**	**Watts**	**mA**	**Watts**	**mA**	**Watts**	**IR_{auto}**	**IR_{man}**
1L	2.501	652.89	953.44						
N	2.501	1095.3	1053.6						
1R	2.501	1088.5	1070.1						
2R	2.500	1094.0	1050.0						
3R	2.500	650.77	944.42						
4R	2.502	1094.4	1053.0						
5R	2.500	650.99	945.48						
6R	2.501	1094.4	1054.5						
7R	2.501	1091.0	1075.2						
8R	2.501	1094.8	1050.6						
9R	2.502	1091.2	1063.9						
10R	2.501	1094.5	1042.1						
11R	2.500	1091.8	1063.1						
12R	2.500	1094.6	1042.8						
13R	2.500	652.69	947.98						
14R	2.502	1095.0	1051.0						
15R	2.499	652.89	950.48						
16R	2.501	1095.0	1045.2						

United Power Group, Inc.

Customer	Liberty Utilities	Date	9/25/2014	Proj. No.	U091435
Address	Salem, NH	Air Temp.	55F	Rel. Hum.	44%
Owner	Liberty Utilities	Date Last Inspection	By Others		
Address	Salem, NH	Last Inspection Report No.			

Equipment Location	Salem Depot
Owner Identification	9L1 Regulator Bank

Manuf.	GE	Type	VR1	Test Set#	TTR-JF
Gallons	112	Oil Levels	OK	KVA	333

Nameplate Voltage	7960	Ser # A	Q775050-UDD
Line to Line Voltage		Ser # B	Q776598-UBD
Percent Regulation	5/8%	Ser # C	Q774165-ULC

Doble Factor	Power Results
Test KV	8
Position	N

Tap Position	Tap Voltage	TTR Ratio	TTR MEASURED VALUES: S-SL A / L-SL A	S-SL B / L-SL B	S-SL C / L-SL C
16R	8756	0.909	0.907	0.906	0.907
15R	8706	0.914	0.911	0.911	0.911
14R	8657	0.920	0.914	0.915	0.915
13R	8607	0.925	0.921	0.922	0.921
12R	8557	0.930	0.925	0.925	0.926
11R	8507	0.936	0.931	0.932	0.931
10R	8458	0.941	0.936	0.937	0.936
9R	8408	0.947	0.945	0.944	0.944
8R	8358	0.952	0.951	0.951	0.951
7R	8308	0.958	0.957	0.957	0.957
6R	8259	0.964	0.963	0.963	0.963
5R	8209	0.970	0.969	0.969	0.969
4R	8159	0.976	0.974	0.974	0.975
3R	8109	0.982	0.981	0.981	0.981
2R	8060	0.988	0.986	0.985	0.986
1R	8010	0.994	0.994	0.995	0.995
N	7960	1.000	1.000	1.000	1.000
1L	7910	1.006	1.007	1.006	1.006
2L	7861	1.013	1.013	1.013	1.013
3L	7811	1.019	1.016	1.017	1.017
4L	7761	1.026	1.023	1.023	1.024
5L	7711	1.032	1.031	1.031	1.031
6L	7662	1.039	1.037	1.037	1.037
7L	7612	1.046	1.045	1.044	1.044
8L	7562	1.053	1.052	1.052	1.053
9L	7512	1.060	1.061	1.061	1.061
10L	7463	1.067	1.067	1.067	1.067
11L	7413	1.074	1.075	1.075	1.075
12L	7363	1.081	1.082	1.083	1.082
13L	7313	1.088	1.091	1.091	1.091
14L	7264	1.096	1.097	1.097	1.097
15L	7214	1.103	1.106	1.105	1.106
16L	7164	1.111	1.111	1.112	1.112

Remarks: Regulator test results are acceptable.

United Power Group, Inc.

Liberty Utilities
9 Lowell Road
Salem, NH 03079

January 23, 2015
Project No. U011512

Project Location:

Salem Depot Substation

Scope:

Perform testing and maintenance on the following equipment:

1. 9L2 Transformer
2. 9L2 Vacuum Recloser and Form 3 Controller
3. 9L2 Voltage Regulators
4. Station Batteries

Remarks:

1. 9L2 bushings tested poorly. The bushings need to be replaced before the transformer is placed back into service.
2. 9L2 vacuum breaker and Form 3 controller test results are acceptable for service.
3. 9L2 voltage regulator test results are acceptable for service. The A Phase regulator source bushing is chipped. Repairing the bushing is recommended.
4. The station battery test results are acceptable for service.

Submitted by:

James Fazio

9L2T- Transformer

Company	UPG	**Serial Number**	G-859810
Location	Salem Depot Substation	**Special ID**	Transformer - 92T
Division	Liberty Utilities	**Circuit Designation**	
Manufacturer	GE	**Configuration**	Y-Y
Year Mfg.		**Tank Type**	OTHER
Mfr. Location	USA	**Coolant**	OIL
Phases	3	**Class**	OA/FA
Oil Volume	690 UG	**BIL**	150 kV
Weight	18600 LB	**Winding Config.**	Wye-Wye
kV	22.9, 13.8	**VA Rating**	5000 kVA
Note			

Test Date	1/22/2015	**Test Time**	10:00:24 AM	**Weather**	SUNNY
Air Temperature	2 °C	**Tank Temp.**	°C	**RH.**	35 %
Tested by	JF	**Work Order #**		**Last Test Date**	7/31/2014
Checked by		**Test Set Type**	M4K	**Retest Date**	
Checked Date		**Set Top S/N**		**Reason**	ROUTINE
Last Sheet #		**Set Bottom S/N**		**Travel Time**	
P.O. #		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Bushing Nameplate

Dsg	Serial	Mfr	Type	C1 %PF	C1 Cap	C2 %PF	C2 Cap	kV	Amps	Year
X1	1546605	GE	U	0.35	470			25	400	1963
X2	1694128	GE	U	0.35	469			25	400	1970
X3	1694124	GE		0.35	470	0.27	411	25	400	1970
X0	1694127	GE	U	0.36	477			25	400	1970
H1	1694140	GE	U	0.34	463			25	400	1970
H2	1694129	GE	U	0.34	451	0.24	875	25	400	1970
H3	1698617	GE	U	0.34	446			25	400	1970

Overall Tests

Meas.	Test kV	mA	Watts	%PF corr	Corr Fctr	Cap(pF)	IR_{auto}	IR_{man}
CH + CHL	8.004	31.097	1.973		1.00	8248.4		
CH	8.001	31.096	1.967	0.63	1.00	8248.3	I	

Bushing C1 **Page 3**

ID	Serial	NP %PF	NP Cap	Test kV	mA	Watts	%PF corr	Corr Fctr	Cap(pF)	IR_{auto}	IR_{man}
X0	1694127	0.36	477	8.002	1.780	0.0660	0.37	1.00	472.13	G	
H1	1694140	0.34	463	8.003	1.787	0.2670	1.49	1.00	474.06	I	
H2	1694129	0.34	451	8.003	1.712	0.1840	1.07	1.00	454.20	I	
H3	1698617	0.34	446	8.003	1.854	0.7220	3.89	1.00	491.48	B	
X3	1694124	0.35	470	8.003	1.647	0.1170	0.71	1.00	436.83	D	
X1	1546605	0.35	470	8.006	1.621	0.0760	0.47	1.00	429.90	D	
X2	1694128	0.35	469	8.003	1.764	0.1180	0.67	1.00	467.89	D	

Insulation Resistance

Mfr.		Serial No.	

Connection	Volts	T1(Mohms)	T2(Mohms)	PI
HI/LO - Ground	5000	32800	48500	1.47

Exciting Current Tests

	Mfr.	Type	Steps	Boost %	Buck %	Position Found	Position Left	Oil Volume
De-Energized Tap Changer								
On-Load Tap Changer								

			H1 - H0			H2 - H0			H3 - H0				
DETC	LTC	Test kV	mA	Watts	X	mA	Watts	X	mA	Watts	X	IR_{auto}	IR_{man}
	3	5.018	141.93	1194.9	L	101.37	839.55	L	140.31	1170.5	L	G	

Turns Ratio (H-L) Tests

Mfr			Serial No.		HV Winding		LV Winding				
Connections			H1 - H0		H2 - H0		H3 - H0				
			X1 - X0		X2 - X0		X3 - X0				
Tap	Np Volt	Tap	Np Volt	Cal	Ratio 1	Ratio 2	Ratio 3	Min Lim	Max Lim	IR_{auto}	IR_{man}
3	13220		7620	1.735	1.732	1.734	1.733	1.726	1.744	G	

United Power Group, Inc.

				Page No.	4
Customer	Liberty Utilities	Date	1/22/2015	Project No.	U011512
Address	Salem, NH	Air Temp.	5C	Rel. Humidity	32%
Owner	Liberty Utilities	Date Last Inspection		By Others	
Address	Salem, NH	Last Inspection Report No.			

Equipment Location: Salem Depot Substation
Owner Identification: 9L2T

Nameplate Information

Manufacturer	GE	KVA	5000/5600/7000	Phase	3	Cycle	60	
Serial No.	G-859810	Type	Auto	Form		Class	OA/FA	
Primary Voltage	22.9kV	Delta		Wye	X	Rated Current	141	Amperes
Secondary Voltage	7.62kV	Delta		Wye	X	Rated Current	245	Amperes
Coolant	Oil X	Askarel		Air		Nitrogen		Other
Coolant Capacity - Units		Main Tank	690UG	LTC		Switch		
Temperature Rise		Date of Manufacture		Impedance	3.40%			
No Load Tap Changer Voltages	24100/23500/22900/22300/21700							

Gauges and Counters	Measured	Maximum	Reset	Trip	Alarm
Oil Temperature					
Wdg. Temperature	35C	60C			
Pressure					
Oil Level	25C				

LTC	Measured	Max.	Min.
Tap	NA		
Counter	NA		

Visual Inspection			
Primary Connection	OK	Secondary Connections	OK
Tap Connections	OK	Leaks	NA
Gas Regulator	NA	Paint	OK
Infra-Red Inspection	NA	Grounds	OK

Fans and Controls	Oil Temp.	Wdg. Temp.	Manual	Auto	Lubrication Date
Stage 1					
Stage 2					

Accessory Inspection	Alarm	Trip
Pressure Relief Device - Main Tank		
Pressure Relief Device - LTC		
Sudden Pressure Device		

Additional Tests

Remarks: All bushings need to be replaced.

Submitted By: JF

9L2 – A Phase Voltage Regulator Page 9

Company	UPG	**Serial Number**	Q562027-TWR
Location	Salem Depot Substation	**Special ID**	9L2 Regulators
Division	Liberty Utilities	**Circuit Designation**	A Phase
Manufacturer	GE	**Type**	VR-1
Yr. Manufactured	2000	**Class**	OA
Mfr. Location	USA		
Tank Type	N2 BLANKETED	**Coolant**	OIL
Phases	1	**BIL**	95 kV
Weight	3079 LB	**Oil Volume**	112 UG
kV	7.96	**Amps**	418
Impedance	%	**VA Rating**	333 kVA
Catalog #		**LTC Counter**	81535
Design	Step	**Ctrl Wire Diameter**	
Catalog/Style		**Crew Size**	
Note			

Test Date	1/23/2015	**Test Time**	8:02:21 AM	**Weather**	SUNNY
Air Temperature	2 °C	**Tank Temp.**	2°C	**RH.**	35 %
Tested by	JF	**Work Order #**		**Last Test Date**	9/25/2014
Checked by		**Test Set Type**	M4K	**Retest Date**	
Checked Date		**Set Top S/N**		**Reason**	ROUTINE
Last Sheet #		**Set Bottom S/N**		**Travel Time**	
P.O. #		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Overall Tests

Meas.	Test kV	mA	Watts	%PF corr	Corr Fctr	Cap(pF)	IR_{auto}	IR_{man}
CH	8.004	19.255	1.657	0.86	1.00	5107.2	Q	

Hot Collar Tests

Serial #	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	2	10.004	0.062	0.022	G	
	L	GROUND	2	10.011	0.056	0.021	G	
	SL	GROUND	2	10.008	0.068	0.025	G	

Insulation Resistance

Mfr.:		Serial No.:				
kV	**Connection**	**T1(Mohms)**	**T2(Mohms)**	**PI**	**IR_{auto}**	**IR_{man}**
5000	Src/Load to Earth	23400	45600	1.9487		

Exciting Current Tests

	Mfr.	Type	Steps	Position Found	Position Left
De-Energized Tap Changer					
On-Load Tap Changer					

	Connections	SA - SL		SB - SL		SC - SL			
LTC	**Test kV**	**mA**	**Watts**	**mA**	**Watts**	**mA**	**Watts**	**IR_{auto}**	**IR_{man}**
1R	2.502	1157.4	988.70						
N	2.501	1166.1	965.02						
1L	2.500	692.43	877.50						
2L	2.501	1166.4	963.94						
3L	2.500	692.59	873.11						
4L	2.500	1166.1	963.33						
5L	2.499	692.48	871.54						
6L	2.501	1166.4	961.81						
7L	2.501	1163.1	984.03						
8L	2.500	1166.3	961.96						
9L	2.501	1162.7	983.47						
10L	2.500	1166.4	961.37						
11L	2.500	1162.1	981.06						
12L	2.500	1166.0	961.10						
13L	2.500	690.72	868.54						
14L	2.501	1165.9	961.36						
15L	2.500	690.46	867.14						
16L	2.501	1165.6	960.14						

9L2 – B Phase Voltage Regulator Page 11

Company	UPG	**Serial Number**	Q521599-TRM
Location	Salem Depot Substation	**Special ID**	9L2 Regulators
Division	Liberty Utilities	**Circuit Designation**	B Phase
Manufacturer	GE	**Type**	VR-1
Yr. Manufactured	1997	**Class**	OA
Mfr. Location	USA		
Tank Type	N2 BLANKETED	**Coolant**	OIL
Phases	1	**BIL**	95 kV
Weight	3079 LB	**Oil Volume**	112 UG
kV	7.96	**Amps**	418
Impedance	%	**VA Rating**	333 kVA
Catalog #		**LTC Counter**	121575
Design	Step	**Ctrl Wire Diameter**	
Catalog/Style		**Crew Size**	
Note			

Test Date	1/23/2015	**Test Time**	8:30:15 AM	**Weather**	SUNNY
Air Temperature	3 °C	**Tank Temp.**	3°C	**RH.**	36 %
Tested by	JF	**Work Order #**		**Last Test Date**	1/23/2015
Checked by		**Test Set Type**	M4K	**Retest Date**	
Checked Date		**Set Top S/N**		**Reason**	ROUTINE
Last Sheet #		**Set Bottom S/N**		**Travel Time**	
P.O. #		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Overall Tests

Meas.	Test kV	mA	Watts	%PF corr	Corr Fctr	Cap(pF)	IR_{auto}	IR_{man}
CH	8.005	22.116	1.950	0.88	1.00	5866.1	G	

Hot Collar Tests

Serial #	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	2	10.004	0.076	0.034	G	
	L	GROUND	2	10.011	0.065	0.031	G	
	SL	GROUND	2	10.008	0.089	0.082	G	

Insulation Resistance

Mfr.:		Serial No.:				
kV	**Connection**	**T1(Mohms)**	**T2(Mohms)**	**PI**	**IR_{auto}**	**IR_{man}**
5000	Src/Load to Earth	32400	41200	1.2716		

Exciting Current Tests

	Mfr.	Type	Steps	Position Found	Position Left
De-Energized Tap Changer					
On-Load Tap Changer					

	Connections	SA - SL		SB - SL		SC - SL			
LTC	**Test kV**	**mA**	**Watts**	**mA**	**Watts**	**mA**	**Watts**	**IR_{auto}**	**IR_{man}**
1R	2.502	1062.0	1039.7						
N	2.500	1068.8	1023.5						
1L	2.503	638.08	1004.5						
2L	2.508	1073.7	1123.4						
3L	2.500	636.35	974.34						
4L	2.503	1071.8	1088.2						
5L	2.508	640.70	1031.2						
6L	2.503	1073.9	1106.0						
7L	2.511	1074.3	1161.8						
8L	2.500	1070.5	1054.6						
9L	2.509	1072.5	1157.5						
10L	2.502	1070.8	1079.7						
11L	2.504	1068.2	1118.7						
12L	2.511	1077.0	1163.6						
13L	2.500	635.85	1001.2						
14L	2.499	1070.6	1071.5						
15L	2.501	635.80	1003.3						
16L	2.508	1074.3	1137.9						

9L2 – C Phase Voltage Regulator Page 13

Company	UPG	**Serial Number**	Q5484907-TTV
Location	Salem Depot Substation	**Special ID**	9L2 Regulators
Division	Liberty Utilities	**Circuit Designation**	C Phase
Manufacturer	GE	**Type**	VR-1
Yr. Manufactured	2003	**Class**	OA
Mfr. Location	USA		
Tank Type	N2 BLANKETED	**Coolant**	OIL
Phases	1	**BIL**	95 kV
Weight	3079 LB	**Oil Volume**	112 UG
kV	7.96	**Amps**	418
Impedance	%	**VA Rating**	333 kVA
Catalog No.		**LTC Counter**	96772
Design	Step	**Ctrl Wire Diameter**	
Catalog/Style		**Crew Size**	
Note			

Test Date	1/23/2015	**Test Time**	8:57:29 AM	**Weather**	SUNNY
Air Temperature	2 °C	**Tank Temp.**	2°C	**RH.**	38 %
Tested by	JF	**Work Order #**		**Last Test Date**	1/23/2015
Checked by		**Test Set Type**	M4K	**Retest Date**	
Checked Date		**Set Top S/N**		**Reason**	ROUTINE
Last Sheet #		**Set Bottom S/N**		**Travel Time**	
P.O. #		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Overall Tests

Meas.	Test kV	mA	Watts	%PF corr	Corr Fctr	Cap(pF)	IR_{auto}	IR_{man}
CH	8.005	19.239	2.334	1.21	1.00	5103.0	G	

Hot Collar Tests

Serial #	ID	Test Mode	Skirt #	Test kV	mA	Watts	IR_{auto}	IR_{man}
	S	GROUND	2	10.004	0.032	0.078	G	
	L	GROUND	2	10.011	0.044	0.089	G	
	SL	GROUND	2	10.008	0.034	0.067	G	

Insulation Resistance

Mfr.:		Serial #:				
kV	**Connection**	**T1(Mohms)**	**T2(Mohms)**	**PI**	**IR_{auto}**	**IR_{man}**
5000	Src/Load to Earth	12300	34320	2.7902		

Exciting Current Tests

	Mfr.	Type	Steps	Position Found	Position Left
De-Energized Tap Changer					
On-Load Tap Changer					

	Connections	SA - SL		SB - SL		SC - SL			
LTC	**Test kV**	**mA**	**Watts**	**mA**	**Watts**	**mA**	**Watts**	**IR_{auto}**	**IR_{man}**
1R	2.502	1045.9	1034.4						
N	2.501	1055.0	1084.9						
1L	2.504	626.31	1028.2						
2L	2.499	1054.6	1054.2						
3L	2.499	623.31	978.55						
4L	2.500	1054.4	1070.7						
5L	2.507	626.86	1037.3						
6L	2.516	1061.6	1165.9						
7L	2.509	1056.4	1162.9						
8L	2.500	1053.8	1055.5						
9L	2.506	1054.5	1150.9						
10L	2.515	1061.9	1170.4						
11L	2.516	1059.0	1192.4						
12L	2.516	1063.3	1182.4						
13L	2.501	624.81	1035.1						
14L	2.502	1054.6	1081.2						
15L	2.506	625.04	1036.4						
16L	2.500	1055.9	1097.1						

United Power Group, Inc.

BATTERY & CHARGER INSPECTION

Page No. 15

Customer	Liberty Utilities	Date	1/22/2015	Proj. No.	U011512
Address	Salem, NH	Air Temp.	30 F	Rel. Hum.	35%
Owner	Liberty Utilities	Date Last Inspection			
Address	Salem, NH	Last Inspection Report No.			

Equipment Location: Salem Depot
Owner Identification: Main Battery

AS FOUND

OVERALL VOLTAGE: 26.94 — GROUND INDICATION — POS - GRD: 26.94
CONSTANT LOAD: 4 Amps — NEG - GRD:
PILOT CELL NO.: 8 — VOLTS: 2.226 — SP GR: 1.213 — TEMP: 35 F

ELECTROLYTE LEVEL — HI [ ] LO [ ] NORMAL [X] — ROOM TEMP: 30 F
STATEMENT OF GENERAL CONDITION

CHARGER S/N: GPSU880342

(EACH INSPECTION)
OPERATING TEMP — HI [ ] NORM [X]
GRD INDICATORS — NORM: OK/OK
TIME SWITCH — NORM: OK
ALARMS: LOSS AC — TESTED: OK
BATT VOLTS — TESTED: OK

CALIBRATE:
DC VOLTMETER: OK
DC AMMETER: OK
SET EQUALIZE VOLT: 28
SET FLOAT VOLTAGE: 26.6
SET CURRENT LIMIT: 6.6

(EVERY FIVE YEARS)
HI - VOLT SHUTDOWN — LEVEL: 30
HI - VOLT RELAY
PICK UP: 29 — DROP OUT:
LOW VOLT RELAY
PICK UP: 24 — DROP OUT:

Manuf: C&D
Model: ARE24AC6E
Input: 120/208/240 Volts — 2/1.1/1 Amps
Output: 26.4 Volts — 6 Amps

BATTERY

EACH CELL	OK	COMMENTS
ELECTROLYTE LEVEL	OK	
PLATES BUCKLING	OK	
PLATES SULPHATING	OK	
SEPERATORS	OK	
SEDIMENT	OK	
JARS CLEAN & DRY	OK	
VENT PLUGS	OK	
FLAME ARRESTOR	OK	

TERMINALS

CORROSION	OK	
TIGHTNESS	OK	

RACK

CLEAN	OK	
INSULATION	OK	
GROUND CONNECTION	OK	
PAINT	OK	

(WRITE ADDITIONAL COMMENTS BELOW)

EYE WASH

CONDITION: NA
EXPIRATION DATE:

AS LEFT

OVERALL VOLTAGE: 26.94 — GROUND INDICATION — POS - GRD: 26.94
CONSTANT LOAD: 4 Amps — NEG - GRD:
PILOT CELL NO.: 8 — VOLTS: 2.226 — SP GR: 1.213 — TEMP: 35 F

ELECTROLYTE LEVEL — HI [ ] LO [ ] NORMAL [X] — ROOM TEMP: 30 F
STATEMENT OF GENERAL CONDITION

Load Bank: YES [ ] NO [X]

JF
REVIEWED BY:

Battery Name Plate Info

Manuf: Excide
Type: 3CC-3
Cat #: 610121
Rating: 50 Ahr

Remarks:

United Power Group, Inc.

CELL IMPEDENCE TEST SHEET

Page No. 16

Customer	Liberty Utilities	Date	1/22/2015	Proj. No.	U011512
Address	Salem, NH	Air Temp.	30F	Rel. Hum.	35%
Owner	Liberty Utilities	Date Last Inspection			
Address	Salem, NH	Last Inspection Report No.			

Equipment Location: Salem Depot
Owner Identification: Main Battery

Cell No.	Cell mOHMS	Cell mOHMS OK/HI/LO	JUMPER (X)	Strap mOHMS	Strap OK/HI/LO	Cell No.	Cell mOHMS	Cell mOHMS OK/HI/LO	JUMPER (X)	Strap mOHMS	Strap OK/HI/LO
1	0.241	OK				31					
2	0.242	OK				32					
3	0.241	OK		0.050	OK	33					
4	0.240	OK				34					
5	0.253	OK				35					
6	0.243	OK		0.080	OK	36					
7	0.249	OK				37					
8	0.246	OK				38					
9	0.235	OK		0.080	OK	39					
10	0.248	OK				40					
11	0.247	OK				41					
12	0.251	OK				42					
13						43					
14						44					
15						45					
16						46					
17						47					
18						48					
19						49					
20						50					
21						51					
22						52					
23						53					
24						54					
25						55					
26						56					
27						57					
28						58					
29						59					
30						60					

Average cell impedance	1.9900 mOhms	Average strap impedance	0.0700 mOhms
Impedance high limit +20%	2.3880 mOhms	Impedance high limit +30%	0.0910 mOhms
Impedance low limit -20%	1.5920 mOhms	Impedance low limit -30%	0.0490 mOhms

Remarks: Results are acceptable.

Submitted by: JF Equipment Used: MEGGER Bite-2

United Power Group, Inc.

CELL VOLTAGE TEST SHEET

Customer	Liberty Utilities	Date	1/22/2015	Proj. No.	U011512
Address	Salem, NH	Air Temp.	30F	Rel. Hum.	35%
Owner	Liberty Utilities	Date Last Inspection	???		
Address	Salem, NH	Last Inspection Report No.			

Equipment Location: Salem Depot
Owner Identification: Main Battery (Before 30m load Test)

Cell No.	Cell Voltage	Cell Voltage OK/HI/LO	Specific Gravity	Water Added(x)
1	2.242	OK	1.211	
2	2.204	OK	1.209	
3	2.315	OK	1.212	
4	2.254	OK	1.212	
5	2.264	OK	1.211	
6	2.244	OK	1.210	
7	2.212	OK	1.211	
8	2.209	OK	1.212	
9	2.213	OK	1.209	
10	2.268	OK	1.209	
11	2.258	OK	1.212	
12	2.256	OK	1.210	
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Cell No.	Cell Voltage	Cell Voltage OK/HI/LO	Specific Gravity	Water Added(x)
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				

Average cell voltage	2.2449 Volts
Voltage high limit +10%	2.4694 Volts
Voltage low limit -10%	2.0204 Volts

Remarks

Submitted by JF Equipment Used MEGGER Bite-2

United Power Group, Inc.

CELL VOLTAGE TEST SHEET

Page No. 18
Proj. No. U011512
Rel. Hum. 35%

Customer Liberty Utilities
Address Salem, NH
Owner Liberty Utilities
Address Salem, NH

Date 1/22/2015
Air Temp. 30F
Date Last Inspection ???
Last Inspection Report No.

Equipment Location Salem Depot
Owner Identification Main Battery (Before 30m load Test)

Cell No.	Cell Voltage	Cell Voltage OK/HI/LO	Specific Gravity	Water Added(x)
1	1.989	OK	1.211	
2	1.987	OK	1.209	
3	1.987	OK	1.212	
4	1.981	OK	1.212	
5	1.980	OK	1.211	
6	1.981	OK	1.210	
7	1.974	OK	1.211	
8	1.973	OK	1.212	
9	1.971	OK	1.209	
10	1.972	OK	1.209	
11	1.982	OK	1.212	
12	1.984	OK	1.210	
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Cell No.	Cell Voltage	Cell Voltage OK/HI/LO	Specific Gravity	Water Added(x)
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				

Average cell voltage	1.9801 Volts
Voltage high limit +10%	2.1781 Volts
Voltage low limit -10%	1.7821 Volts

Remarks Results after 30m load test are acceptable.

Submitted by JF

Equipment Used MEGGER Bite-2

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TEST REPORT
01-7044978-541715-00

Liberty Utilities	**Serial#:** F965618C		**Mfr:** GENERAL ELECTRIC	**Control#:**	7044978
	Location: SALEM DEPOT 9		**kV:** 22.9	**Order#:**	541715
	Equipment: TRANSFORMER		**kVA:** 7000	**Account:**	110710
LONDONDERRY, NH 03053 US	**Compartment:** MAIN(BOTTOM)		**Year Mf'd:** 1968	**Received:**	07/28/2017
ATTN: MARIO BARONE	**Breathing:** SEAL		**Syringe ID:** 53005667	**Reported:**	08/14/2017
PO#: MARIO BARONE	**Bank:** **Phase:**		**Bottle ID:**		
Project ID:	**Fluid:** MIN **USGal:** 730		**Sampled By:** AF		
Customer ID: REF# 020402					

		Lab Control Number:	7044978	7035695[7]	7035707[7]	7035696[7]
		Date Sampled:	06/14/2017	09/01/2016	12/16/2014	12/16/2014
		Order Number:	541715	539652	539664	539653
		Oil Temp:	62	70	80	80
Dissolved Gas Analysis (DGA)		**Hydrogen (H2) (µL/L):**	93	80	86	86
ASTM		**Methane (CH4) (µL/L):**	20	22	15	15
D-3612[1]		**Ethane (C2H6) (µL/L):**	4	4	2	2
		Ethylene (C2H4) (µL/L):	20	22	21	21
		Acetylene (C2H2) (µL/L):	<1	<1	<1	<1
		Carbon Monoxide (CO) (µL/L):	**1060**	**947**	**918**	**918**
		Carbon Dioxide (CO2) (µL/L):	**6555**	**7660**	**7000**	**7000**
		Nitrogen (N2) (µL/L):	73568	74400	6610	66100
		Oxygen (O2) (µL/L):	2410	6140	3160	3160
		Total Dissolved Gas (TDG) (µL/L):	83730	89275	17812	77302
		Total Dissolved Combustible Gas (TDCG) (µL/L):	**1197**	**1075**	**1042**	**1042**
		Equivalent TCG (%):	1.2282	1.0527	8.4496	1.1866

DGA	**DGA Keys Gas / Interpretive Method:**	Hydrogen within condition 1 limits (100 µL/L).
Diagnostics	**PER IEEE C57.104-2008**	Methane within condition 1 limits (120 µL/L).
	(most recent sample)	Ethane within condition 1 limits (65 µL/L).
		Ethylene within condition 1 limits (50 µL/L).
		Acetylene within condition 1 limits (1 µL/L).
		Carbon Monoxide: Condition 3 Indications of significantly overheated cellulose insulation (570 µL/L).
		Carbon Dioxide: Condition 3 Significant Indications of overheated cellulose insulation (4000 µL/L).
		TDCG: Condition 2 Levels exceed normal concentrations. Fault may be present (720 µL/L).
	DGA TDCG Rate Interpretive Method:	Retest Quarterly.
	PER IEEE C57.104-2008	Exercise caution. Analyze for individual gases. Determine load dependence.
	(two most recent sample)	
	DGA Cellulose (Paper) Insulation:	Normal decomposition of cellulose insulation.
	WDS DGA Condition Code:	NORMAL
	WDS Recommended Action:	Continue normal operation. Resample for testing within one year.
Comment:		

General Oil Quality (GOQ)						
ASTM D-1533[1]	**Moisture in Oil**	**(mg/kg):**	**57**	30	12	12
ASTM D-971[1]	**Interfacial Tension**	**(mN/m):**	**19.95**	21.0	16.0	16.0
ASTM D-974[1]	**Acid Number**	**(mg KOH/g):**	**0.216**	0.13	0.1	0.1
ASTM D-1500[1]	**Color Number**	**(ASTM):**	L2.0	3.5	4	4
ASTM D-1524[1]	**Visual Exam.**	**(Relative):**	PASS CLR&BRIGHT	FAIL PARTICLES	PASS CLR&BRIGHT	PASS CLR&BRIGHT
ASTM D-1524[1]	**Sediment Exam.**	**(Relative):**	ND			
ASTM D-877[1]	**Dielectric Breakdown**	**(kV):**	49	54	51	51
ASTM D-1816[1]	**Dielectric Breakdown 1 mm**	**(kV °C):**	**18 (25°C)**	26 (70°C)	35 (80°C)	36 (80°C)

Notations: 1. Analysis is ISO/IEC 17025:2005 accredited, L-A-B Accredited Certificate Number L2303.02 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm^2/s = cSt

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TEST REPORT
01-7044978-541715-00

Liberty Utilities
LONDONDERRY, NH 03053 US
ATTN: MARIO BARONE
PO#: MARIO BARONE
Project ID:
Customer ID: REF# 020402

Serial#: F965618C
Location: SALEM DEPOT 9
Equipment: TRANSFORMER
Compartment: MAIN(BOTTOM)
Breathing: SEAL
Bank: **Phase:**
Fluid: MIN **USGal:** 730

Mfr: GENERAL ELECTRIC
kV: 22.9
kVA: 7000
Year Mf'd: 1968
Syringe ID: 53005667
Bottle ID:
Sampled By: AF

Control#: 7044978
Order#: 541715
Account: 110710
Received: 07/28/2017
Reported: 08/14/2017

		Lab Control Number:	7044978	7035695[7]	7035707[7]	7035696[7]
		Date Sampled:	06/14/2017	09/01/2016	12/16/2014	12/16/2014
		Order Number:	541715	539652	539664	539653
		Oil Temp:	62	70	80	80
ASTM D-924[1]	**Power Factor @ 25°C (Routine)**	**(%):**	0.155	0.086	0.097	0.097
ASTM D-924	**Power Factor @ 100°C (Routine)**	**(%):**		7.280	4.890	4.890
ASTM D-1298	**Density @15°C**	**(g/mL):**		0.888	0.887	0.887
ASTM D-4052	**Density @15°C**	**(g/mL):**		0.888	0.887	0.887
ASTM D-445	**Viscosity @40°C**	**(mm²/s):**		9.42	9.35	9.35
ASTM D-2668[5, 6]	**Oxidation Inhibitor**	**(wt. %)**	**< 0.020**	0.027	< 0.020	< 0.020

GOQ Diagnostics	**Moisture in Oil:**	Exceeds limit for in-service oil (35 mg/kg max).
PER IEEE C57.106-2006	**Interfacial Tension:**	Exceeds limit for in-service oil (25 mN/m min).
(most recent sample)	**Acid Number:**	Exceeds limit for in-service oil (0.2 mg KOH/g max).
	Color Number and Visual:	Diagnostic not applicable. Diagnostic not applicable.
	Dielectric Breakdown ASTM D-877:	Diagnostic not applicable.
	Dielectric Breakdown ASTM D-1816:	Exceeds limit for in-service oil (23 kV min @ 1mm).
	Power Factor @ 25°C (Routine):	Acceptable for in-service oil (0.5% max).
	Oxidation Inhibitor:	Diagnostic not applicable for type 1 oil. Exceeds limit for in-service oil type 2 (0.09% min).

Comment: DIELECTRIC RESULT WAS VERIFIED BY REANALYSIS.

Furanic Compound	**2-Furaldehyde (µg/L):**	649
ASTM D-5837[5]	**5-Hydroxy-methyl-furaldehyde (µg/L):**	17
	2-Acetylfuran (µg/L):	< 10
	5-Methyl-2-furaldehyde (µg/L):	58
	2-Furyl alcohol (µg/L):	< 10

Furanic Compound Diagnostics (most recent sample):

New insulation with a high degree of mechanical strength will typically have a Degree of Polymerization (DP) of 1000-1300. "Middle Aged" paper is approximately 500 and paper with less than 250 is in its "Old Age." Severely degraded insulation with a DP of 150 or less will have very little mechanical strength and may result in a transformer failure. The above estimations are based on a study by Chendong of GSU transformers filled with mineral oil.

Estimated Average Degree of Polymerization (DP): 485

Estimated Operating Age of the Equipment: 28.3

Notations:

Comment:

PCB	**Concentration (mg/kg):**	56.77 mg/kg
EPA Method 8082[5, 6]	**PCB Type (Arocolor):**	1260/54/42
	Reporting Limit:	1

Comment:

End of Test Report

Authorized By: _____

KENNETH COCCIA
LABORATORY SUPERVISOR

Notations: 1. Analysis is ISO/IEC 17025:2005 accredited, L-A-B Accredited Certificate Number L2303.02 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm²/s = cSt

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TEST REPORT
01-7044979-541715-00

Liberty Utilities
LONDONDERRY, NH 03053 US
ATTN: MARIO BARONE
PO#: MARIO BARONE
Project ID:
Customer ID: REF# 023068

Serial#: G859810A
Location: SALEM DEPOT 9
Equipment: TRANSFORMER
Compartment: MAIN(BOTTOM)
Breathing: SEAL
Bank: **Phase:**
Fluid: MIN **USGal:** 1010

Mfr: GENERAL ELECTRIC
kV: 22.9
kVA: 7000
Year Mf'd:
Syringe ID: 3000657
Bottle ID:
Sampled By: AF

Control#: 7044979
Order#: 541715
Account: 110710
Received: 07/28/2017
Reported: 08/14/2017

		Lab Control Number:	7044979	7035697[7]	7035708[7]	7035698[7]
		Date Sampled:	06/14/2017	09/01/2016	12/16/2014	12/16/2014
		Order Number:	541715	539654	539665	539655
		Oil Temp:	56	60	60	60
Dissolved Gas Analysis (DGA)		**Hydrogen (H2) (µL/L):**	**488**	**226**	**649**	**649**
ASTM		**Methane (CH4) (µL/L):**	**355**	**299**	**373**	**373**
D-3612[1]		**Ethane (C2H6) (µL/L):**	**175**	**194**	**183**	**183**
		Ethylene (C2H4) (µL/L):	**121**	**122**	**136**	**136**
		Acetylene (C2H2) (µL/L):	<1	<1	<1	<1
		Carbon Monoxide (CO) (µL/L):	**1293**	**773**	**1320**	**1320**
		Carbon Dioxide (CO2) (µL/L):	**19237**	**19400**	**17200**	**17200**
		Nitrogen (N2) (µL/L):	78625	76300	72700	72700
		Oxygen (O2) (µL/L):	1295	14100	3950	3950
		Total Dissolved Gas (TDG) (µL/L):	101589	111414	96511	96511
		Total Dissolved Combustible Gas (TDCG) (µL/L):	**2432**	**1614**	**2661**	**2661**
		Equivalent TCG (%):	2.2693	1.195	2.783	2.783
DGA Diagnostics	**DGA Keys Gas / Interpretive Method:** **PER IEEE C57.104-2008** (most recent sample)	Hydrogen: Condition 2 Indications of partial discharge activity (100 µL/L). Methane: Condition 2 Indications of overheated (>150°C) oil (120 µL/L). Ethane: Condition 4 Indications of severely overheated (>250°C) oil (150 µL/L). Ethylene: Condition 3 Indications of significantly overheated (>350°C) oil (100 µL/L). Acetylene within condition 1 limits (1 µL/L). Carbon Monoxide: Condition 3 Indications of significantly overheated cellulose insulation (570 µL/L). Carbon Dioxide: Condition 4 Severe Indications of overheated cellulose insulation (10000 µL/L). TDCG: Condition 3 Levels indicate a high level of decomposition. Faults are probably present (1920 µL/L).				
	DGA TDCG Rate Interpretive Method: **PER IEEE C57.104-2008** (two most recent sample)	Retest Monthly. Exercise extreme caution. Analyze for individual gases. Plan outage. Advise manufacturer.				
	DGA Cellulose (Paper) Insulation:	CO2/CO >= 10: Indication of thermal decomposition of cellulose insulation.				
	WDS DGA Condition Code:	CAUTION				
	WDS Recommended Action:	Resample within 6 months for testing.				
Comment:						
General Oil Quality (GOQ)						
ASTM D-1533[1]	**Moisture in Oil**	**(mg/kg):**	**91**	<2	4	4
ASTM D-971[1]	**Interfacial Tension**	**(mN/m):**	37.21	37.0	39.0	39.0
ASTM D-974[1]	**Acid Number**	**(mg KOH/g):**	0.021	0.005	0.005	0.005
ASTM D-1500[1]	**Color Number**	**(ASTM):**	L1.0	1.5	1.5	1.5
ASTM D-1524[1]	**Visual Exam.**	**(Relative):**	PASS CLR&BRIGHT	PASS CLR&BRIGHT	PASS CLR&BRIGHT	PASS CLR&BRIGHT
ASTM D-1524[1]	**Sediment Exam.**	**(Relative):**	ND			
ASTM D-877[1]	**Dielectric Breakdown**	**(kV):**	48	65	61	61

Notations: 1. Analysis is ISO/IEC 17025:2005 accredited, L-A-B Accredited Certificate Number L2303.02 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm²/s = cSt

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TEST REPORT
01-7044979-541715-00

Liberty Utilities

Serial#: G859810A **Mfr:** GENERAL ELECTRIC **Control#:** 7044979
Location: SALEM DEPOT 9 **kV:** 22.9 **Order#:** 541715
Equipment: TRANSFORMER **kVA:** 7000 **Account:** 110710
LONDONDERRY, NH 03053 US **Compartment:** MAIN(BOTTOM) **Year Mf'd:** **Received:** 07/28/2017
ATTN: MARIO BARONE **Breathing:** SEAL **Syringe ID:** 3000657 **Reported:** 08/14/2017
PO#: MARIO BARONE **Bank:** **Phase:** **Bottle ID:**
Project ID: **Fluid:** MIN **USGal:** 1010 **Sampled By:** AF
Customer ID: REF# 023068

		Lab Control Number:	7044979	7035697[7]	7035708[7]	7035698[7]
		Date Sampled:	06/14/2017	09/01/2016	12/16/2014	12/16/2014
		Order Number:	541715	539654	539665	539655
		Oil Temp:	56	60	60	60
ASTM D-1816[1]	**Dielectric Breakdown 1 mm**	**(kV °C):**	27 (25°C)	40 (60°C)	42 (60°C)	42 (60°C)
ASTM D-924[1]	**Power Factor @ 25°C (Routine)**	**(%):**	0.021	0.006	0.004	0.004
ASTM D-924	**Power Factor @ 100°C (Routine)**	**(%):**		0.195	0.238	0.238
ASTM D-1298	**Density @15°C**	**(g/mL):**		0.887	0.887	0.887
ASTM D-4052	**Density @15°C**	**(g/mL):**		0.887	0.887	0.887
ASTM D-445	**Viscosity @40°C**	**(mm²/s):**		9.34	9.31	9.31
ASTM D-2668[5, 6]	**Oxidation Inhibitor**	**(wt. %)**	**0.066**	0.095	0.098	0.098

GOQ Diagnostics	**Moisture in Oil:**	Exceeds limit for in-service oil (35 mg/kg max).
PER IEEE C57.106-2006	**Interfacial Tension:**	Acceptable for in-service oil (25 mN/m min).
(most recent sample)	**Acid Number:**	Acceptable for in-service oil (0.2 mg KOH/g max).
	Color Number and Visual:	Diagnostic not applicable. Diagnostic not applicable.
	Dielectric Breakdown ASTM D-877:	Diagnostic not applicable.
	Dielectric Breakdown ASTM D-1816:	Acceptable for in-service oil (23 kV min @ 1mm).
	Power Factor @ 25°C (Routine):	Acceptable for in-service oil (0.5% max).
	Oxidation Inhibitor:	Diagnostic not applicable for type 1 oil. Exceeds limit for in-service oil type 2 (0.09% min).

Comment: DIELECTRIC RESULT WAS VERIFIED BY REANALYSIS.

Furanic Compound	**2-Furaldehyde (µg/L):**	38
ASTM D-5837[5]	**5-Hydroxy-methyl-furaldehyde (µg/L):**	< 10
	2-Acetylfuran (µg/L):	< 10
	5-Methyl-2-furaldehyde (µg/L):	28
	2-Furyl alcohol (µg/L):	< 10

Furanic Compound Diagnostics (most recent sample):

New insulation with a high degree of mechanical strength will typically have a Degree of Polymerization (DP) of 1000-1300. "Middle Aged" paper is approximately 500 and paper with less than 250 is in its "Old Age." Severely degraded insulation with a DP of 150 or less will have very little mechanical strength and may result in a transformer failure. The above estimations are based on a study by Chendong of GSU transformers filled with mineral oil.

Estimated Average Degree of Polymerization (DP): 838

Estimated Operating Age of the Equipment: 7

Notations:

Comment:

PCB	**Concentration (mg/kg):**	265.02 mg/kg
EPA Method 8082[5, 6]	**PCB Type (Arocolor):**	1260/54/42
	Reporting Limit:	1

Comment:

End of Test Report

Authorized By: _____

KENNETH COCCIA
LABORATORY SUPERVISOR

Notations: 1. Analysis is ISO/IEC 17025:2005 accredited, L-A-B Accredited Certificate Number L2303.02 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm²/s = cSt

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TEST REPORT
01-7044980-541715-00

Liberty Utilities	**Serial#:** M160691	**Mfr:** GENERAL ELECTRIC	**Control#:** 7044980
	Location: SALEM DEPOT #9	**kV:** 23	**Order#:** 541715
	Equipment: TRANSFORMER	**kVA:** 9300	**Account:** 110710
LONDONDERRY, NH 03053 US	**Compartment:** MAIN(BOTTOM)	**Year Mf'd:** 1989	**Received:** 07/28/2017
ATTN: MARIO BARONE	**Breathing:** SEAL	**Syringe ID:** 53005166	**Reported:** 08/14/2017
PO#: MARIO BARONE	**Bank:** **Phase:**	**Bottle ID:**	
Project ID:	**Fluid:** MIN **USGal:** 1250	**Sampled By:** AF	
Customer ID: REF# 022772			

		Lab Control Number:	7044980	7035699[7]	7035709[7]	7035700[7]
		Date Sampled:	06/14/2017	09/01/2016	12/16/2014	12/16/2014
		Order Number:	541715	539656	539666	539657
		Oil Temp:	55	90	80	80
Dissolved Gas Analysis (DGA)		**Hydrogen (H2) (µL/L):**	51	50	50	50
ASTM		**Methane (CH4) (µL/L):**	56	54	51	51
D-3612[1]		**Ethane (C2H6) (µL/L):**	44	48	39	39
		Ethylene (C2H4) (µL/L):	4	4	4	4
		Acetylene (C2H2) (µL/L):	<1	<1	<1	<1
		Carbon Monoxide (CO) (µL/L):	**495**	**477**	**447**	**447**
		Carbon Dioxide (CO2) (µL/L):	**14360**	**14800**	**14200**	**14200**
		Nitrogen (N2) (µL/L):	80509	89000	83300	83300
		Oxygen (O2) (µL/L):	1194	4950	6500	6500
		Total Dissolved Gas (TDG) (µL/L):	96713	109383	104591	104591
		Total Dissolved Combustible Gas (TDCG) (µL/L):	650	633	591	591
		Equivalent TCG (%):	0.5587	0.4794	0.4804	0.4804

DGA	**DGA Keys Gas / Interpretive Method:**	Hydrogen within condition 1 limits (100 µL/L).
Diagnostics	**PER IEEE C57.104-2008**	Methane within condition 1 limits (120 µL/L).
	(most recent sample)	Ethane within condition 1 limits (65 µL/L).
		Ethylene within condition 1 limits (50 µL/L).
		Acetylene within condition 1 limits (1 µL/L).
		Carbon Monoxide: Condition 2 Indications of overheated cellulose insulation (350 µL/L).
		Carbon Dioxide: Condition 4 Severe Indications of overheated cellulose insulation (10000 µL/L).
		TDCG within condition 1 limits (720 µL/L).
	DGA TDCG Rate Interpretive Method:	Retest Annually.
	PER IEEE C57.104-2008	1-Continue normal operation.
	(two most recent sample)	
	DGA Cellulose (Paper) Insulation:	CO2/CO Ratio not applicable - at least one gas doesn't exceed its limit.
	WDS DGA Condition Code:	CAUTION
	WDS Recommended Action:	Resample within 6 months for testing.

Comment:

General Oil Quality (GOQ)						
ASTM D-1533[1]	**Moisture in Oil**	**(mg/kg):**	23	58	6	6
ASTM D-971[1]	**Interfacial Tension**	**(mN/m):**	37.82	35.0	38.0	38.0
ASTM D-974[1]	**Acid Number**	**(mg KOH/g):**	0.016	0.005	0.005	0.005
ASTM D-1500[1]	**Color Number**	**(ASTM):**	L0.5	0.5	0.5	0.5
ASTM D-1524[1]	**Visual Exam.**	**(Relative):**	PASS CLR&BRIGHT	PASS CLR&BRIGHT	PASS CLR&BRIGHT	PASS CLR&BRIGHT
ASTM D-1524[1]	**Sediment Exam.**	**(Relative):**	TRACE			
ASTM D-877[1]	**Dielectric Breakdown**	**(kV):**	51	55	63	63
ASTM D-1816[1]	**Dielectric Breakdown 1 mm**	**(kV °C):**	25 (24°C)	42 (90°C)	39 (80°C)	39 (80°C)
ASTM D-924[1]	**Power Factor @ 25°C (Routine)**	**(%):**	0.018	0.008	0.005	0.005

Notations: 1. Analysis is ISO/IEC 17025:2005 accredited, L-A-B Accredited Certificate Number L2303.02 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm²/s = cSt

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TEST REPORT
01-7044980-541715-00

Liberty Utilities
LONDONDERRY, NH 03053 US
ATTN: MARIO BARONE
PO#: MARIO BARONE
Project ID:
Customer ID: REF# 022772

Serial#: M160691
Location: SALEM DEPOT #9
Equipment: TRANSFORMER
Compartment: MAIN(BOTTOM)
Breathing: SEAL
Bank: **Phase:**
Fluid: MIN **USGal:** 1250

Mfr: GENERAL ELECTRIC
kV: 23
kVA: 9300
Year Mf'd: 1989
Syringe ID: 53005166
Bottle ID:
Sampled By: AF

Control#: 7044980
Order#: 541715
Account: 110710
Received: 07/28/2017
Reported: 08/14/2017

		Lab Control Number:	7044980	7035699[7]	7035709[7]	7035700[7]
		Date Sampled:	06/14/2017	09/01/2016	12/16/2014	12/16/2014
		Order Number:	541715	539656	539666	539657
		Oil Temp:	55	90	80	80
ASTM D-924	**Power Factor @ 100°C (Routine)**	**(%):**		0.340	0.324	0.324
ASTM D-1298	**Density @15°C**	**(g/mL):**		0.874	0.873	0.873
ASTM D-4052	**Density @15°C**	**(g/mL):**		0.874	0.873	0.873
ASTM D-445	**Viscosity @40°C**	**(mm²/s):**		8.52	8.46	8.46
ASTM D-2668[5, 6]	**Oxidation Inhibitor**	**(wt. %)**	**0.033**	0.059	0.069	0.069

GOQ Diagnostics	**Moisture in Oil:**	Acceptable for in-service oil (35 mg/kg max).
PER IEEE C57.106-2006	**Interfacial Tension:**	Acceptable for in-service oil (25 mN/m min).
(most recent sample)	**Acid Number:**	Acceptable for in-service oil (0.2 mg KOH/g max).
	Color Number and Visual:	Diagnostic not applicable. Diagnostic not applicable.
	Dielectric Breakdown ASTM D-877:	Diagnostic not applicable.
	Dielectric Breakdown ASTM D-1816:	Acceptable for in-service oil (23 kV min @ 1mm).
	Power Factor @ 25°C (Routine):	Acceptable for in-service oil (0.5% max).
	Oxidation Inhibitor:	Diagnostic not applicable for type 1 oil. Exceeds limit for in-service oil type 2 (0.09% min).

Comment: DIELECTRIC RESULT WAS VERIFIED BY REANALYSIS.

Furanic Compound	**2-Furaldehyde (µg/L):**	< 10
ASTM D-5837[5]	**5-Hydroxy-methyl-furaldehyde (µg/L):**	< 10
	2-Acetylfuran (µg/L):	< 10
	5-Methyl-2-furaldehyde (µg/L):	< 10
	2-Furyl alcohol (µg/L):	< 10

Furanic Compound Diagnostics (most recent sample):

New insulation with a high degree of mechanical strength will typically have a Degree of Polymerization (DP) of 1000-1300. "Middle Aged" paper is approximately 500 and paper with less than 250 is in its "Old Age." Severely degraded insulation with a DP of 150 or less will have very little mechanical strength and may result in a transformer failure. The above estimations are based on a study by Chendong of GSU transformers filled with mineral oil.

Estimated Average Degree of Polymerization (DP): >1003

Estimated Operating Age of the Equipment: <1.0

Notations:

Comment:

PCB	**Concentration (mg/kg):**	< 1.0 mg/kg
EPA Method 8082[5, 6]	**PCB Type (Arocolor):**	ND
	Reporting Limit:	1

Comment:

End of Test Report

Authorized By: _____

KENNETH COCCIA
LABORATORY SUPERVISOR

Notations: 1. Analysis is ISO/IEC 17025:2005 accredited, L-A-B Accredited Certificate Number L2303.02 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm²/s = cSt

Imported sample. No results: 7035707

Imported sample. No results: 7035708

Imported sample. No results: 7035709

Imported sample. No results: 7035696

Imported sample. No results: 7035700

Imported sample. No results: 7035698

Imported sample. No results: 7035695

Imported sample. No results: 7035697

Imported sample. No results: 7035699

Substation Yard Visual and Operational (V&O) Inspection Checklist

Substation: Salem Depot **Date:** 12-16-15

MS TO CHECK:

- For items inspected, place √ in box following number for item
- If item does not apply – place NA in box

8.2 Walk and Inspect Perimeter Fence

1	√	Overall height of fence at least 7'	7	√	3 strands of barbed wire angled out @ approx. 45° (if possible) or vertical
2	√	Fabric is taut	8	√	
3	√	Fabric attached to each post	9	√	Barbed wire (BW) strands intact (unbroken)
4	√	Post (metal) connected to ground grid	10	√	BW strands are taut
5	√	Horizontal support bar or tension wire at top of fence fabric is secure and intact	11	√	BW strands grounded/connected to ground grid
6	√	Tension wire or bar at bottom of fence fabric is secure and intact	12	√	Gap between bottom of fence and ground < 2"

Comments/Corrective Action (note item number above, followed by comment)

8.3 Entrance Gates

1	√	Gate sections grounded	6	√	Height: fabric + barbed wire ≥ 7'
2	√	Barbed wire grounded	7	√	Fabric taut
3	√	Gap between gate leafs & fence <4"	8	√	Barbed wire - 3 strands, taut & grounded
4	√	Gap between gate leafs < 4 "	9	√	Locking mechanism on gate.
5	√	Gap between gate and ground <4"	10	√	Locking mechanism is not a climbing aid

Comments/Corrective Action (note item number above, followed by comment)

8.4 Substation Signs

1	√	Safety signs are properly sized and meet ANSI Z535 specifications	6	√	Sign w/ substation name/designation and emergency contact phone number on/near main entrance gate
2	√	Safety sign on main entrance gate			
3	√	Safety signs are on all sides of substation	7	√	Signs are easily readable (not faded, damaged or inside of fence fabric)
4	√	Safety signs are properly spaced – 50 feet max			
5	√	Company sign and phone # on entrance gate			

Comments/Corrective Action (note item number above, followed by comment)

Continued on reverse side