

CONTROLLER OSCILLATORY SWC TEST REPORT

Client:	Schweitzer Engineering Laboratories, Inc., Pullman, WA, 99163-5603, USA	
Test Date:	7 February 2012	Project: 21414-27
Nameplate Data:		
Recloser Controller:		
Manufacturer:	Schweitzer Engineering Laboratories, Inc., Pullman, WA, 99163-5603, USA	
Model:	SEL-651R-2	
Serial No.:	1113060653	
Three-phase Recloser:		
Manufacturer:	Tavrida	
Type:	OSM25_AI_1(150)	
Impulse level (BIL):	150 kV _{peak}	
Rated voltage:	27 kV _{rms}	
Rated current:	630 A _{rms} continuous	
Serial No.:	160609	
Test Witness:	Alex Bradley - Schweitzer Engineering Laboratories, Inc	
Test Standard:	IEEE C37.60-2003, Clause 6.13.1: "Oscillatory and fast transients surge tests"	
Atmospheric Conditions:	Temperature	22 °C
	Relative humidity	30 %
	Barometric pressure	759.8 mmHg
Test Voltage:	2.5 kV _{peak}	
Test Procedure:	Test surge was applied to the control cable in common mode using a capacitive clamp and transverse mode through 1.5 mH coils. Test surge were applied to ac power input in common mode and transverse mode using an external coupling filter. The AC power supplied to the controller was 120 Volts, 60 Hz.	
Test Results:	The controller and recloser operated normally following the Oscillatory SWC Test performed in accordance with the test procedures as per the above document. The controller complied with requirements of "IEEE C37.60-2003, Clause 6.13.1".	
Remarks:	None	

Tested by:



Alex Babakov, P. Eng.
 Project Engineer

Reviewed by:


 M. Wang, P. Eng. *Murrell, 2, 2012*
 High Voltage Specialist Engineer

This report shall not be reproduced except in full, without the written approval of Powertech Labs Inc.

APPENDIX 1

Oscillatory SWC Waveform Validity Tests
(in accordance with IEEE Std C37.90.1-2002, Clause A.2)

Performed before the Oscillatory SWC Test

1. Measuring system feed through test

Generator Output voltage 2.5 kVFeed through voltage 1.0 V (pass $\leq 1\%$)

2. Open circuit voltage waveform test

Recorded waveforms – Figures 1 and 2.

3. Test Generator performance verification

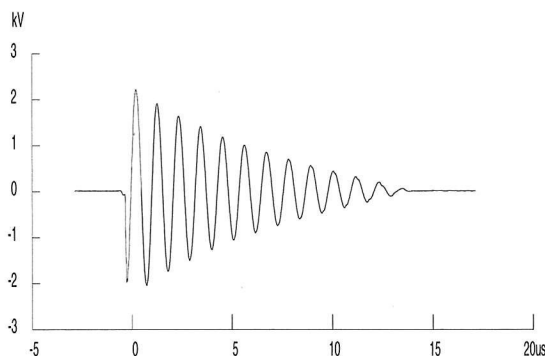
Test duration 2.1 s (2 to 2.2 s)Repetition rate 8 bursts per period (6-10 bursts per 16.7 ms)Oscillation frequency 0.94 MHz (0.9 to 1.1 MHz)Waveform envelope decay 4.3 μ s (4 to 6 μ s to 50%)Rise time of the first peak 73 ns (60 to 90 ns – 10% to 90%)Peak voltage level (no load) 2.4 kV (2.25 to 2.5 kV when set to 2.5 kV)Output impedance 227 Ω (160 to 240 Ω)4. Test Pass X Test Fail _____

Figure 1

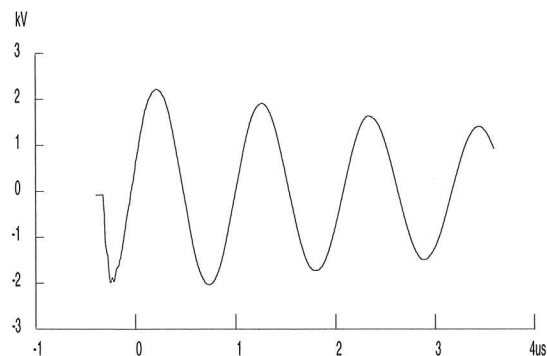


Figure 2

This report shall not be reproduced except in full, without the written approval of Powertech Labs Inc.

APPENDIX 2

Oscillatory SWC Waveform Validity Tests
 (in accordance with IEEE Std C37.90.1-2002, Clause A.2)

Performed after the Oscillatory SWC Test

5. Measuring system feed through test

Generator Output voltage 2.5 kV

Feed through voltage 8.5 V (pass $\leq 1\%$)

6. Open circuit voltage waveform test

Recorded waveforms – Figures 1 and 2.

7. Test Generator performance verification

Test duration 2.09 s (2 to 2.2 s)

Repetition rate 8 bursts per period (6-10 bursts per 16.7 ms)

Oscillation frequency 0.91 MHz (0.9 to 1.1 MHz)

Waveform envelope decay 4.8 μ s (4 to 6 μ s to 50%)

Rise time of the first peak 81 ns (60 to 90 ns – 10% to 90%)

Peak voltage level (no load) 2.4 kV (2.25 to 2.5 kV when set to 2.5 kV)

Output impedance 185 Ω (160 to 240 Ω)

8. Test Pass X Test Fail _____

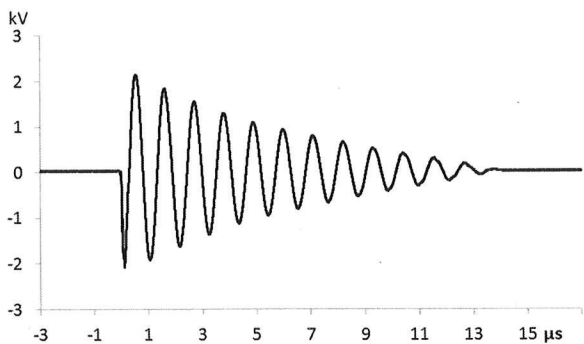


Figure 1

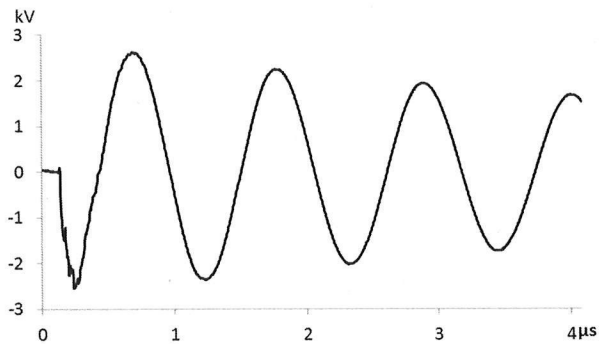


Figure 2

This report shall not be reproduced except in full, without the written approval of Powertech Labs Inc.

CONTROLLER FAST TRANSIENT SWC TEST REPORT

Client:	Schweitzer Engineering Laboratories, Inc., Pullman, WA, 99163-5603, USA	
Test Date:	7 February 2012	Project: 21414-27
Nameplate Data:		
Recloser Controller:		
Manufacturer:	Schweitzer Engineering Laboratories, Inc., Pullman, WA, 99163-5603, USA	
Model:	SEL-651R-2	
Serial No.:	1113060653	
Three-phase Recloser:		
Manufacturer:	Tavrida	
Type:	OSM25_AI_1(150)	
Impulse level (BIL):	150 kV _{peak}	
Rated voltage:	27 kV _{rms}	
Rated current:	630 A _{rms} continuous	
Serial No.:	160609	
Test Witness:	Alex Bradley - Schweitzer Engineering Laboratories, Inc.	
Test Standard:	IEEE Std C37.60-2003, Clause 6.13.1: "Oscillatory and fast transients surge tests"	
Atmospheric Conditions:	Temperature	22 °C
	Relative humidity	30 %
	Barometric pressure	759.8 mmHg
Test Voltage:	4.0 kV _{peak}	
Test Procedure:	Test surge was applied to the control cable in common mode using a capacitive clamp and transverse mode through 1.5 mH coils. Test surges were applied to ac power input in common mode and transverse mode using an external coupling filter. The AC power supplied to the controller was 120 Volts, 60 Hz.	
Test Results:	The controller and recloser operated normally following the Fast Transient SWC Test performed in accordance with the test procedures as per the above document. The controller complied with requirements of "C37.60-2003, Clause 6.13.1".	
Remarks:	None	

Tested by:

Reviewed by:



Alex Babakov, P. Eng.
 Project Engineer



M. Wang, P. Eng. *March 12, 2012*
 High Voltage Specialist Engineer

This report shall not be reproduced except in full, without the written approval of Powertech Labs Inc.

APPENDIX 1

Fast Transient SWC Waveform Validity Tests
(in accordance with IEEE Std C37.90.1-2002, Clause A.2)

Performed before the Fast Transient SWC Test

1. Measuring system feed through test

Generator Output voltage 4 kV

Feed through voltage 2.4 V (pass if $\leq 1\%$)

2. Open circuit voltage waveform test

Recorded waveforms – Figures 1 and 2.

3. Test Generator performance verification

Rise time 5.3 ns (3.5 to 6.5 ns – 10% to 90%)

Peak voltage level (no load) 4.3 kV (3.6 to 4.4 kV when set to 4 kV)

Output impedance 50 Ω (40 to 60 Ω)

Impulse duration 54 ns (35 to 65 ns to 50% value)

Repetition rate 2.5 kHz (2 to 3 kHz)

Burst duration 14.8 ms (12 to 18 ms)

Burst period 300 ms (240 to 360 ms)

Test duration 60 s (≥ 60 s)

4. Test Pass X Test Fail

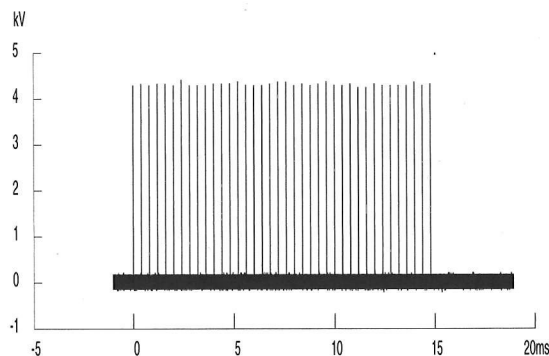


Figure 1

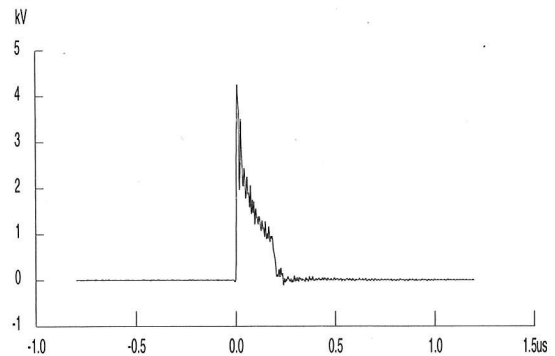


Figure 2

This report shall not be reproduced except in full, without the written approval of Powertech Labs Inc.

APPENDIX 2

Fast Transient SWC Waveform Validity Tests
(in accordance with IEEE Std C37.90.1-2002, Clause A.2)

Performed after the Fast Transient SWC Test

5. Measuring system feed through test

Generator Output voltage 4 kV

Feed through voltage 1.8 V (pass if $\leq 1\%$)

6. Open circuit voltage waveform test

Recorded waveforms – Figures 1 and 2.

7. Test Generator performance verification

Rise time 4.55 ns (3.5 to 6.5 ns – 10% to 90%)

Peak voltage level (no load) 4.2 kV (3.6 to 4.4 kV when set to 4 kV)

Output impedance 51 Ω (40 to 60 Ω)

Impulse duration 59.4 ns (35 to 65 ns to 50% value)

Repetition rate 2.5 kHz (2 to 3 kHz)

Burst duration 14.8 ms (12 to 18 ms)

Burst period 300 ms (240 to 360 ms)

Test duration 60.1 s (≥ 60 s)

8. Test Pass X Test Fail

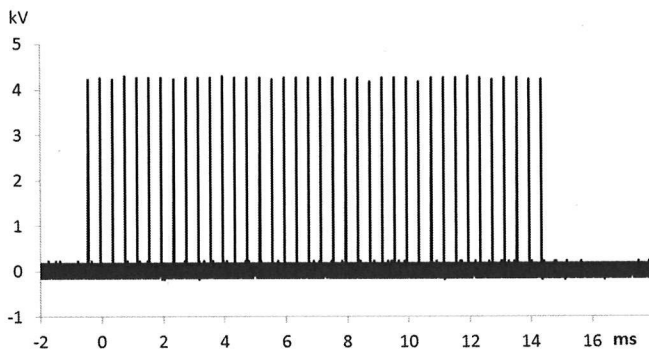


Figure 1

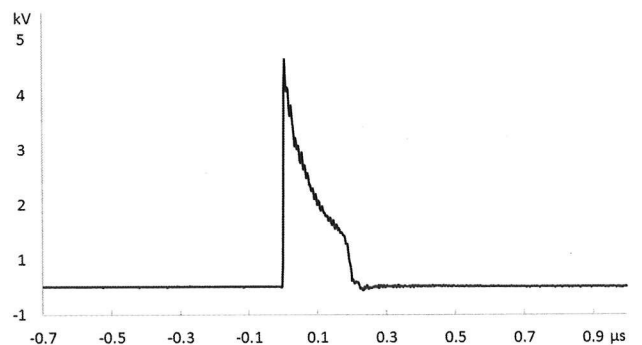


Figure 2

This report shall not be reproduced except in full, without the written approval of Powertech Labs Inc.


RECLOSER-CONTROLLER SIMULATED SURGE ARRESTER OPERATION TEST REPORT

Client:	Schweitzer Engineering Laboratories, Inc., Pullman, WA, 99163-5603, USA	
Test Date:	16 to 18 May 2012	Project: 21645-27
Nameplate Data:		
Recloser Controller:		
Manufacturer:	Schweitzer Engineering Laboratories, Inc.	
Model:	SEL-651R-2	
Serial No.:	1113060652	
Model No.:	0651R223XGA8AE2112XXXX	
Three-phase Recloser:		
Manufacturer:	Tavrida Electric	
Model No.:	QSM25_AL_Z (630_150)	
Impulse level (BIL):	150 kV _{peak}	
Serial No.:	160 955	
Test Standard:	IEEE Std C37.60-2003, Clause 6.13.2: "Simulated Surge Arrester Operation Test"	
Test Witness:	Eric Stratte - Schweitzer Engineering Laboratories, Inc.	
Nominal Test Voltage and Current:	120 kV _{peak} (150 kV _{peak} * 0.8), 7 kA _{peak}	
Test Configurations Tested (in accordance with the above standard):		
<p>A – 15 surges of positive polarity and 15 surges of negative polarity were applied to the source bushing with the recloser open.</p> <p>B – 15 surges of positive polarity and 15 surges of negative polarity were applied to the source bushing with the recloser closed.</p> <p>C – 15 surges of positive polarity and 15 surges of negative polarity were applied to the load bushing with the recloser closed.</p> <p>D - 15 surges of positive polarity and 15 surges of negative polarity were applied to a properly rated transformer with the recloser open.</p> <p>E - 15 surges of positive polarity and 15 surges of negative polarity were applied to a properly rated transformer with the recloser closed.</p>		
Test Results:	The controller and recloser complied with the requirements of IEEE Std C37.60-2003, Clause 6.13.2, Configurations A to E.	
Remarks:	None	

Tested by:

Reviewed by:


 M. Wang, P. Eng. *Aug 29, 2012*
 High Voltage Specialist Engineer


 A.J. Vandermaar, P. Eng.
 Manager, High Voltage Laboratory

This report shall not be reproduced except in full, without the written approval of Powertech Labs Inc.