Powertech
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CONTROLLER SIMULATED SURGE ARRESTER OPERATION TEST REPORT

Client:	Schweitzer Engineering Laboratories, 2350 NE Hopkins Court, Pullman, WA 99163-5603, USA		
Test Date:	7 & 8 November 2005	**Project:**	16063-27

Nameplate Data:

Controller:

Manufacturer:	Schweitzer Engineering Laboratories, Pullman, Washington, USA
Model No.:	0351R2128Q11HXCXX
Serial No.:	2005122186

Recloser:

Manufacturer:	Cooper Power Systems
Type:	Nova 27
Impulse level (BIL):	125 kV_{peak}
Rated voltage:	27 kV_{rms}
Rated current:	630 A_{rms} continuous; 12.5 kA interrupting
Serial No.:	4925-BH

Test Witness:	Kenneth G. Workman, Schweitzer Engineering Laboratories Francois Soulard, Hydro Québec Jacques Côté and Jean-Francois Briard, Grimard	
Test Standard:	IEEE Std C37.60-2003, Clause 6.13.2: "Simulated Surge Arrester Operation Test"	
Atmospheric Conditions:	Temperature	19.7 °C
	Relative humidity	36%
	Barometric pressure	755.8 mmHg
Test Current:	7 kA_{peak}	

Test Configurations (in accordance with the above standard):

A – surges applied to the source bushing with the recloser open
B – surges applied to the source bushing with the recloser closed
C – surges applied to the load bushing with the recloser closed
D – surges applied to a properly rated transformer with the recloser open
E – surges applied to a properly rated transformer with the recloser closed

Test Results: The controller and recloser operated normally following the Simulated Surge Arrester Operation Test performed in accordance with the test procedures as per the above standard. The controller complied with the requirements of IEEE Std C37.60-2003, Clause 6.13.2.

Remarks: None

Prepared by:

Milan Vasko, P.Eng. 22 Feb 2006
Senior Electrical Engineer

Approved by:

A.J. Vandermaar, P.Eng. 06/02/22
Manager, High Voltage Laboratory

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CONTROLLER OSCILLATORY SWC TEST REPORT

Client:	Schweitzer Engineering Laboratories, 2350 NE Hopkins Court, Pullman, WA 99163-5603, USA	
Test Date:	9 November 2005	**Project:** 16063-27
Nameplate Data:		
Controller:		
Manufacturer:	Schweitzer Engineering Laboratories, Pullman, Washington, USA	
Model No.:	0351R2128Q11HXCXX	
Serial No.:	2005122186	
Recloser:		
Manufacturer:	Cooper Power Systems	
Type:	Nova 27	
Impulse level (BIL):	125 kV_{peak}	
Rated voltage:	27 kV_{rms}	
Rated current:	630 A_{rms} continuous; 12.5 kA interrupting	
Serial No.:	4925-BH	
Test Witness:	Kenneth G. Workman, Schweitzer Engineering Laboratories Francois Soulard, Hydro Québec Jacques Côté and Jean-Francois Briand, Grimard	
Test Standard:	IEEE Std C37.60-2003, Clause 6.13.1: "Oscillatory and Fast Transients Surge Tests"	
Test Voltage:	2.5 kV_{peak}	
Test Procedure:	Test surge applied in common mode and transverse mode to wire pairs.	
Test Results:	The controller and recloser operated normally following the Oscillatory SWC Test performed in accordance with the test procedures. The controller complied with requirements of IEEE C37.60-2003, Clause 6.13.1.	
Remarks:	The controller passed the test.	

Tested by:

22/04/06

Robert G. Pollock
Senior Project Specialist

Approved by:

A.J. Vandermaar, P.Eng. 06/05/22
Manager, High Voltage Laboratory

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 feedthrough test

   Generator Output voltage 2.5 kV

   Feedthrough voltage 2.1 V (pass ≤ 1%)

2. Open circuit voltage waveform test

   Recorded waveforms – Figures 1 and 2.

3. Test Generator performance verification

Rise time of the first peak	84	ns	(60 to 90 ns – 10% to 90%)
Peak voltage level (no load)	2.5	kV	(2.25 to 2.5 kV when set to 2.5 kV)
Output impedance	199	Ω	(160 to 240 Ω)
Waveform envelope decay	4.94	µs	(4 to 6 µs to 50%)
Oscillation frequency	0.917	MHz	(0.9 to 1.1 MHz)
Repetition rate	8	bursts per period (6-10 bursts per 16.7 mS)	
Test duration	2.2	s	(2 to 2.2 s)

4. Test Pass X Test Fail _____

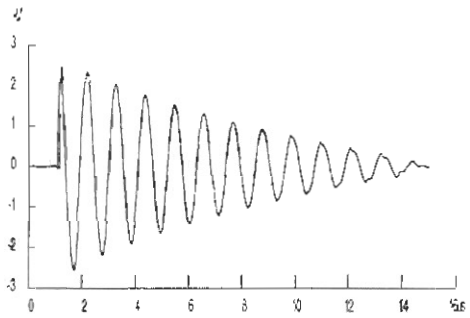

Figure 1

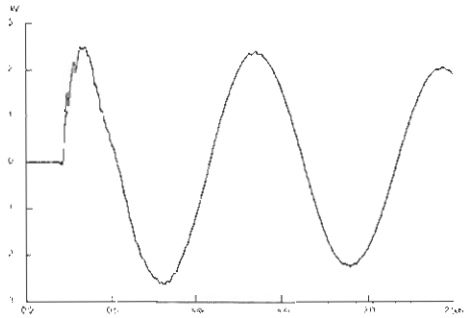

Figure 2

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

4. Measuring system feedthrough test

   Generator Output voltage 2.5 kV

   Feedthrough voltage 0 V (pass ≤ 1%)

5. Open circuit voltage waveform test

   Recorded waveforms – Figures 1 and 2.

6. Test Generator performance verification

Rise time of the first peak	68	ns	(60 to 90 ns – 10% to 90%)
Peak voltage level (no load)	2.5	kV	(2.25 to 2.5 kV when set to 2.5 kV)
Output impedance	194.7	Ω	(160 to 240 Ω)
Waveform envelope decay	6.0	µs	(4 to 6 µs to 50%)
Oscillation frequency	0.91	MHz	(0.9 to 1.1 MHz)
Repetition rate	8	bursts per period	(6-10 bursts per 16.7 mS)
Test duration	2.2	s	(2 to 2.2 s)

5. Test Pass X Test Fail _____

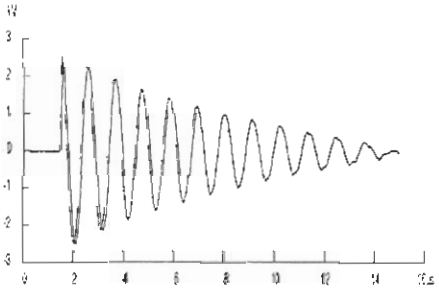

Figure 1

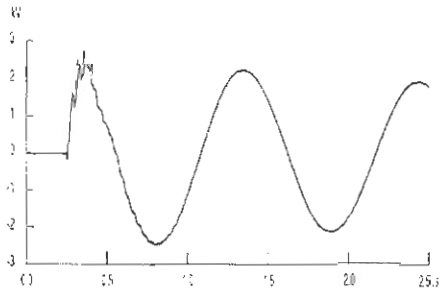

Figure 2

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CONTROLLER FAST TRANSIENT SWC TEST REPORT

Client:	Schweitzer Engineering Laboratories, 2350 NE Hopkins Court, Pullman, WA 99163-5603, USA	
Test Date:	9 November 2005	**Project:** 16063-27

Nameplate Data:

Controller:

Manufacturer:	Schweitzer Engineering Laboratories, Pullman, Washington, USA
Model No.:	0351R2128Q11HXCXX
Serial No.:	2005122186

Recloser:

Manufacturer:	Cooper Power Systems
Type:	Nova 27
Impulse level (BIL):	125 kV_{peak}
Rated voltage:	27 kV_{rms}
Rated current:	630 A_{rms} continuous; 12.5 kA interrupting
Serial No.:	4925-BH

Test Witness:	Kenneth G. Workman, Schweitzer Engineering Laboratories Francois Soulard, Hydro Québec Jacques Côté and Jean-Francois Briand, Grimard
Test Standard:	IEEE Std C37.60-2003, Clause 6.13.1: "Oscillatory and Fast Transients Surge Tests"
Test Voltage:	4.0 kV_{peak}
Test Procedure:	Test surge applied in common mode and transverse mode to wire pairs.
Test Results:	The controller and recloser operated normally following the Fast Transient SWC Test performed in accordance with the test procedures. The controller complied with the requirements of IEEE C37.60-2003, Clause 6.13.1.
Remarks:	The controller passed the test.

Tested by:

22/02/06

Robert G. Pollock
Senior Project Specialist

Approved by:

A.J. Vandermaar, P.Eng. 22/02/22
Manager, High Voltage Laboratory

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 feedthrough test

   Generator Output voltage 4 kV

   Feedthrough voltage 0.22 V (pass if ≤ 1%)

2. Open circuit voltage waveform test

   Recorded waveforms – Figures 1 and 2.

3. Test Generator performance verification

Rise time	3.6	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	44.3	Ω	(40 to 60 Ω)
Impulse duration	65	ns	(35 to 65 ns to 50% value)
Repetition rate	2.5	kHz	(2 to 3 kHz)
Burst duration	14.9	ms	(12 to 18 ms)
Burst period	300	ms	(240 to360 ms)
Test duration	60.0	s	(≥ 60 s)

4. Test Pass X Test Fail _____

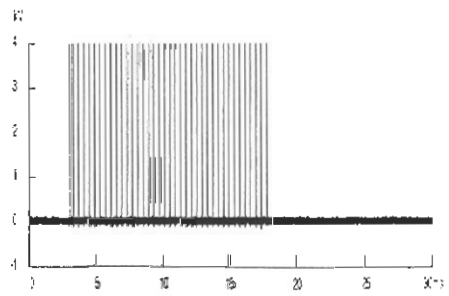

Figure 1

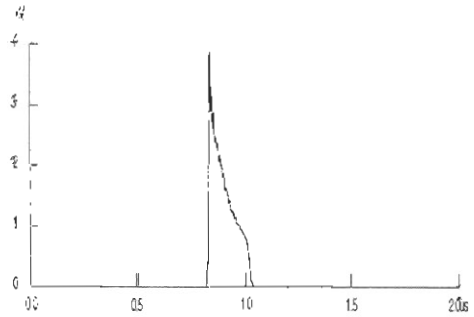

Figure 2

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 feedthrough test

   Generator Output voltage ____4____ kV

   Feedthrough voltage ____0.1____ V (pass if ≤ 1%)

6. Open circuit voltage waveform test

   Recorded waveforms – Figures 1 and 2.

7. Test Generator performance verification

Rise time	4	ns	(3.5 to 6.5 ns – 10% to 90%)
Peak voltage level (no load)	4.4	kV	(3.6 to 4.4 kV when set to 4 kV)
Output impedance	45.5	Ω	(40 to 60 Ω)
Impulse duration	52	ns	(35 to 65 ns to 50% value)
Repetition rate	2.5	kHz	(2 to 3 kHz)
Burst duration	15.0	ms	(12 to 18 ms)
Burst period	301	ms	(240 to360 ms)
Test duration	60.0	s	(≥ 60 s)

8. Test Pass ___X___ Test Fail _____

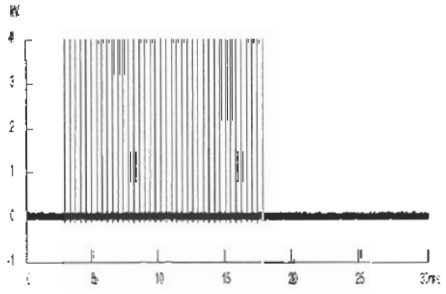

Figure 1

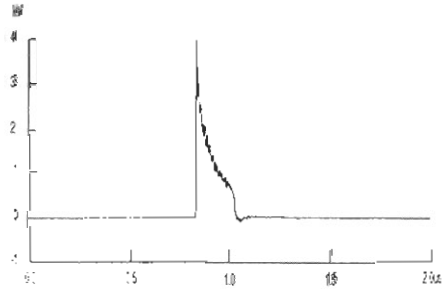

Figure 2