Application Note AN2013-04

Using a Soldering Gun to Perform Current Injection Testing for SEL Recloser Controls

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INTRODUCTION

There are different methods for performing current injection testing for recloser controls. A protective relay test set can be used. However, many small municipal and cooperative utilities find the cost and necessary training to use these devices prohibitive. A recloser control tester presents a more economical solution, but the available models are typically designed only for 14-pin controls.

Tests that might be performed with either device include the following:

1. Control operation test – sequencing through a reclose cycle with fast and delay curve operations.
2. Minimum-trip tests – for phase and ground.
3. Fast and delay curve checks – for phase and ground.
4. Reclosing tests – for reclose interval and reset times.

Experience shows that Tests 2 and 3 should always pass with a microprocessor-based recloser control, provided that the control meters properly, because the test engineer merely tests a software algorithm that does not drift or require calibration. The same is true for the timing test in Test 4. For these reasons, Tests 2 through 4 are informative but not necessarily important for a microprocessor-based recloser control. Test 1 remains important because it tests the control operation to prove that it was programmed and operates correctly with the recloser as a system.

Many small utilities take a simple yet novel approach by using a standard soldering gun to inject current and verify proper control operation. The soldering gun provides all the necessary components to do this: a step-down transformer and a switch built in to a convenient enclosure.

PROBLEM

The soldering gun method to test recloser control is reasonably well-known but has not been previously tested and documented by SEL.

SEL SOLUTION

The soldering gun method was first tested using an SEL-651R Advanced Recloser Control, and a test procedure was then developed to commission an SEL recloser control using a soldering gun.

Testing the Soldering Gun Method

In order to prove the merits of a soldering gun for current injection testing, a standard Weller® 140/100W (model 8200PK) soldering gun was applied. The tip was removed from the posts of

the soldering gun by loosening the hexagonal screws. A short clip lead was connected to each post, as shown in Figure 1.

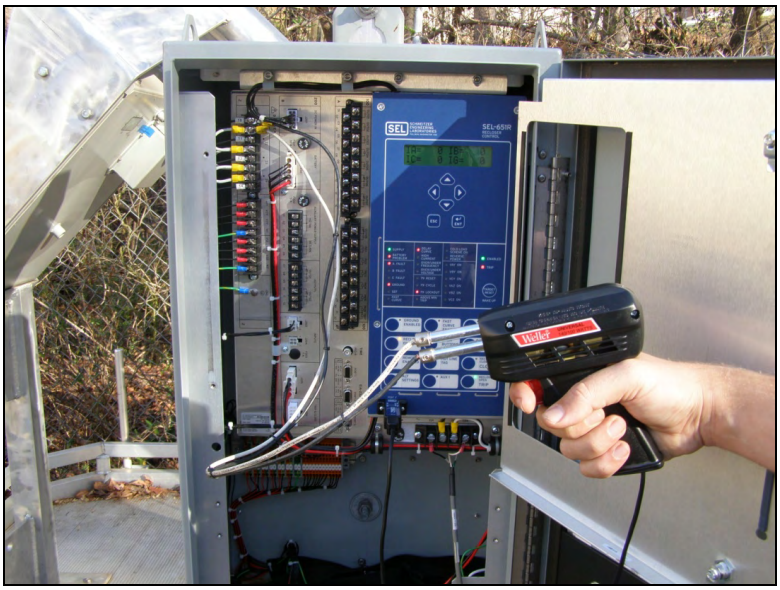

Figure 1 Soldering Gun Connections

The leads of the soldering gun were connected to I1 (Terminals Z01 and Z02) of an SEL-651R. The leads were connected in parallel with the recloser current transformer (CT). This is acceptable due to the high impedance of the recloser CTs.

The SEL-651R was connected to a Tavrida OSM-150 recloser on a demonstration trailer. The settings of this SEL-651R were the default settings from the SEL QuickSet® Design Template Guide, "Settings for the Tavrida OSM-150 32-Pin Recloser," available at http://www.selinc.com/.

The control was tested by manually closing the recloser from the recloser control and then waiting for the recloser control **RESET** target to illuminate. Then, current was injected into the A-phase of the recloser control using the soldering gun. Whenever the control indicated that the recloser was closed, the soldering gun was manually switched on by pulling the trigger. Whenever the control indicated that the recloser was open, the soldering gun was manually switched off by releasing the trigger.

The current injected by this soldering gun was 4.67 A, as shown in the event report in Figure 2. (Note that the CT ratio is 1000:1. The output of other brands and wattages of soldering guns varies somewhat.) Results with other SEL recloser controls are similar because the SEL-351R Falcon™ Recloser Control and the SEL-351RS Kestrel® Single-Phase Recloser Control have a similar input impedance to that of the SEL-651R.

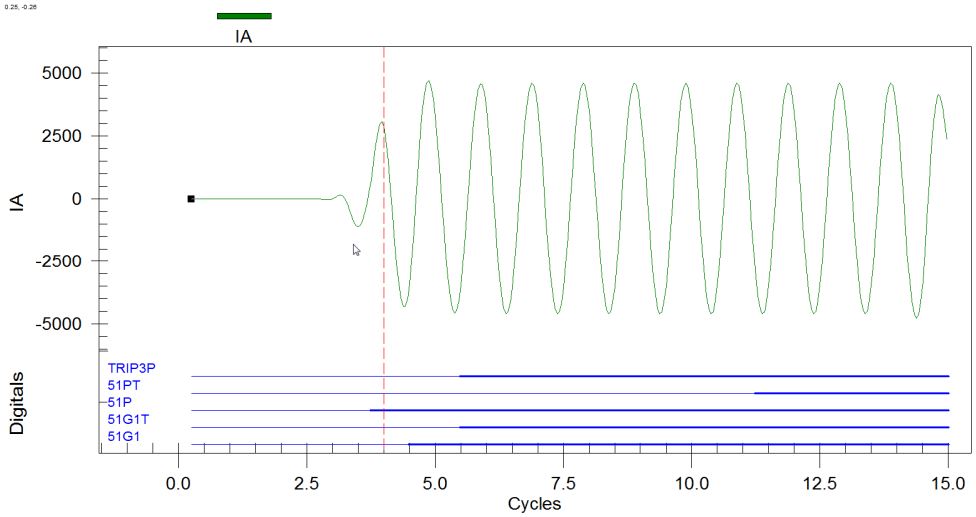

Figure 2 SEL-651R Event Report

It is important to note that the current is beyond the 3 A continuous rating of the current input. It is recommended that the current should not be applied for more than 15 seconds to avoid damaging the current input.

The recloser performed its control operation successfully. The Sequential Events Recorder (SER) report for the recloser operation was downloaded from the recloser control. The following screen capture shows the SER report for the last shot. It shows the pickup time (15:48:43.441) and trip time (15:48:43.458) of the ground element, 51G1, as well as the reclose interval (15:48:33.129 to 15:48:43.133). Therefore, when combined with the event and SER reports in the SEL recloser controls, the soldering gun method can be used for fast and delay curve checks and reclose interval tests, as well as to test control operation. Only the pickup test cannot be performed. However, the value of the fast and delay curve checks is rather limited because the injected current is very high compared to the minimum pickup.

#	Date	Time	Element	State
23	12/19/2012	15:48:33.133	TRIP3P	Deasserted
22	12/19/2012	15:48:43.129	SH33P	Asserted
21	12/19/2012	15:48:43.129	SH23P	Deasserted
20	12/19/2012	15:48:43.129	CLOSE3P	Asserted
19	12/19/2012	15:48:43.191	52A3P	Asserted
18	12/19/2012	15:48:43.191	CLOSE3P	Deasserted
17	12/19/2012	15:48:43.204	TCCAP	Deasserted
16	12/19/2012	15:48:43.391	TCCAP	Asserted
15	12/19/2012	15:48:43.429	51P	Asserted
14	12/19/2012	15:48:43.441	51G1	Asserted
13	12/19/2012	15:48:43.458	51G1T	Asserted
12	12/19/2012	15:48:43.458	TRIP3P	Asserted
11	12/19/2012	15:48:43.462	79LO3P	Asserted
10	12/19/2012	15:48:43.462	79CY3P	Deasserted
9	12/19/2012	15:48:43.466	SH43P	Asserted
8	12/19/2012	15:48:43.466	SH33P	Deasserted
7	12/19/2012	15:48:43.512	52A3P	Deasserted

Similar testing was performed for the phase elements by disabling the ground elements. This testing worked equally well.

Example Commissioning Test Using a Soldering Gun

An example of a commissioning test using a soldering gun for current injection on an SEL recloser control is shown in Table 1. Fast and delay curve checks for phase and ground, as well as reclosing tests for reclose interval and reset times, can also be performed.

Table 1 Commissioning Test Using a Soldering Gun

Step	Name	Description
1	Meter Test	While under load, use the recloser control METER command or the metering screens of the human-machine interface (HMI) in the ACSELERATOR QuickSet® SEL-5030 Software to verify the ac current, voltage magnitude, and phase rotation by comparing it to another source of metering information.
2	Output Test	Use the PULSE command or the control screen of the HMI in ACSELERATOR QuickSet to verify recloser control output contact operation.
3	Input Test	Use the TARGET command or the target screen of the HMI in ACSELERATOR QuickSet to verify optoisolated input operation.
4	Control Operation Test – Ground	Close the recloser. Turn the GROUND ENABLED and RECLOSE ENABLED lights on by pressing the associated pushbuttons. Apply current to the A-phase of the recloser control using the soldering gun. When the control indicates that the recloser is open, release the trigger on the soldering gun. When the control indicates that the recloser is closed, pull the trigger on the soldering gun to inject current. Verify that the recloser and control operate as expected. Repeat for other phases as desired.
5	Control Operation Test – Phase	Close the recloser. Turn the GROUND ENABLED light off by pressing the associated pushbutton. Apply current to the A-phase of the recloser control using the soldering gun. When the control indicates that the recloser is open, release the trigger on the soldering gun. When the control indicates that the recloser is closed, pull the trigger on the soldering gun to inject current. Verify that the recloser and control operate as expected. Repeat for other phases as desired.
6	Control Operation Test – Other Functions	Test other applied functions such as Reclose Disabled or Hot-Line Tag by injecting current similarly to Steps 4 and 5 to verify that these functions are operating properly.

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