Closed-Loop Operation

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March 11, 2024

Qualified Persons

⚠ WARNING

Only qualified persons knowledgeable in the installation, operation, and maintenance of overhead and underground electric distribution equipment, along with all associated hazards, may install, operate, and maintain the equipment covered by this publication. A qualified person is someone trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed
- The proper use of special precautionary techniques, personal protective equipment, insulated and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read this Instruction Sheet

NOTICE

Thoroughly and carefully read this instruction sheet and all materials included in the product's instruction handbook before installing or operating an IntelliTeam SG Automatic Restoration System. Become familiar with the Safety Information on page 5. The latest version of this publication is available online in PDF format at **sandc.com/en/contact-us/product-literature/**.

Retain this Instruction Sheet

This instruction sheet is a permanent part of the IntelliTeam SG Automatic Restoration System. Designate a location where users can easily retrieve and refer to this publication.

Warranty

The warranty and/or obligations described in S&C's Price Sheet 150, "Standard Conditions of Sale–Immediate Purchasers in the United States," (or Price Sheet 153, "Standard Conditions of Sale–Immediate Purchasers Outside the United States"), plus any special warranty provisions, as set forth in the applicable product-line specification bulletin, are exclusive. The remedies provided in the former for breach of these warranties shall constitute the immediate purchaser's or end user's exclusive remedy and a fulfillment of the seller's entire liability. In no event shall the seller's liability to the immediate purchaser or end user exceed the price of the specific product that gives rise to the immediate purchaser's or end user's claim. All other warranties, whether express or implied or arising by operation of law, course of dealing, usage of trade or otherwise, are excluded. The only warranties are those stated in Price Sheet 150 (or Price Sheet 153), and THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY EXPRESS WARRANTY OR OTHER OBLIGATION PROVIDED IN PRICE SHEET 150 (OR PRICE SHEET 153) IS GRANTED ONLY TO THE IMMEDIATE PURCHASER AND END USER, AS DEFINED THEREIN. OTHER THAN AN END USER, NO REMOTE PURCHASER MAY RELY ON ANY AFFIRMATION OF FACT OR PROMISE THAT RELATES TO THE GOODS DESCRIBED HEREIN, ANY DESCRIPTION THAT RELATES TO THE GOODS, OR ANY REMEDIAL PROMISE INCLUDED IN PRICE SHEET 150 (OR PRICE SHEET 153).

End User License Agreement

The end user is granted a nontransferable, non-sublicensable, nonexclusive license to use the IntelliTeam Designer software, IntelliLink Setup Software, IntelliTeam SG Automatic Restoration software, and/or other software furnished with the IntelliTeam SG Automatic Restoration System only upon acceptance of all the terms and conditions of the seller's end-user license agreement set forth in Price Sheet 155.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet. Become familiar with these types of messages and the importance of these various signal words:

⚠ DANGER

"DANGER" identifies the most serious and immediate hazards that will likely result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ WARNING

"WARNING" identifies hazards or unsafe practices that can result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ CAUTION

"CAUTION" identifies hazards or unsafe practices that can result in minor personal injury if instructions, including recommended precautions, are not followed.

NOTICE

"NOTICE" identifies important procedures or requirements that can result in product or property damage if instructions are not followed.

Following Safety Instructions

If any portion of this instruction sheet is unclear and assistance is needed, contact the nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C's website **sandc.com**, or call the S&C Global Support and Monitoring Center at 1-888-762-1100.

NOTICE

Read this instruction sheet thoroughly and carefully before using the IntelliTeam Designer software.

Replacement Instructions and Labels

If additional copies of this instruction sheet are required, contact the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

Overview

The IntelliTeam® SG Automatic Restoration System allows 6801 Automatic Switch Controls to operate in a closed-loop configuration. The functionality only applies to 6801 Automatic Switch Controls and IntelliRupter® PulseCloser® Fault Interrupters (with software version 7.6 and later).

In a closed-loop system, a Scada-Mate® Switching System with six voltage sensors is treated the same as one with three voltage sensors.

Unlike earlier versions of IntelliTeam SG system software, the IntelliTeam SG system software running firmware 7.3 and later now requires a switch to serve as a closed-loop break switch in the closed-loop configuration. Because of this, S&C recommends running a load-flow analysis and selecting the switch closest to the load center. This ensures the sources on either side can carry the load when the center point opens to split the closed-loop into two sections.

Note: When the center switch trips open on a single count of overcurrent or voltage loss, a situation could arise where the fault is temporary and both breakers close because of a good voltage condition. At this point, the center switch now has a method of reclosing on its own to restore the original closed-loop circuit. For a switch to reclose itself following a temporary fault, the following must be true:

- The memory time has expired.
- No team reconfiguration event has taken place.
- All other switches on the closed loop are still closed.
- All available voltage sensors indicate good voltage.
- Team indications on both sides show they are energized.

This function is always enabled for **Closed-Loop** logic, and there is presently no way to disable it.

With a closed-loop system, only one of the two sources is listed in the FeederNet when it is configured. See Figure 1. If a normally closed switch is inserted in a series of normally closed switches, only one FeederNet and its associated field devices will need to be updated.

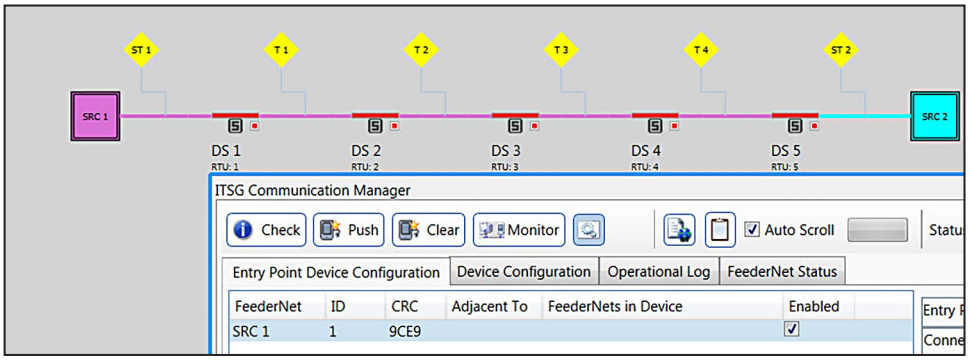

Figure 1. A single FeederNet in a closed-loop system.

Circuit Configurations

The **Closed-Loop** function can be used in simple closed-loop circuits, as shown in Figure 2. This configuration requires the participating devices to have gold licenses.

The **Closed-Loop** function can also be used with branched circuits, as shown in Figure 3. When configured as a closed-loop circuit, all team members on the main line will be defined as "Source-LoadTie" for their normal switch function. The IntelliTeam SG system will update these during normal operation.

With control software version 7.3 and later and IntelliTeam Designer version 7.3.0.99, IntelliRupter® fault interrupters and IntelliNode™ Interface Modules can be placed on radial branch circuits that are part of closed-loop circuits as well as distributed generation sources. See Figure 4.

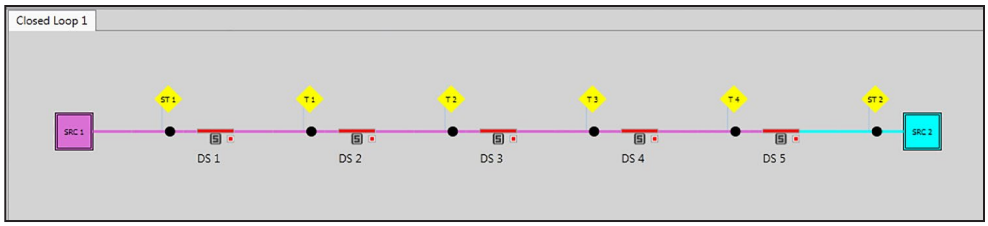

Figure 2. A two-source closed-loop system.

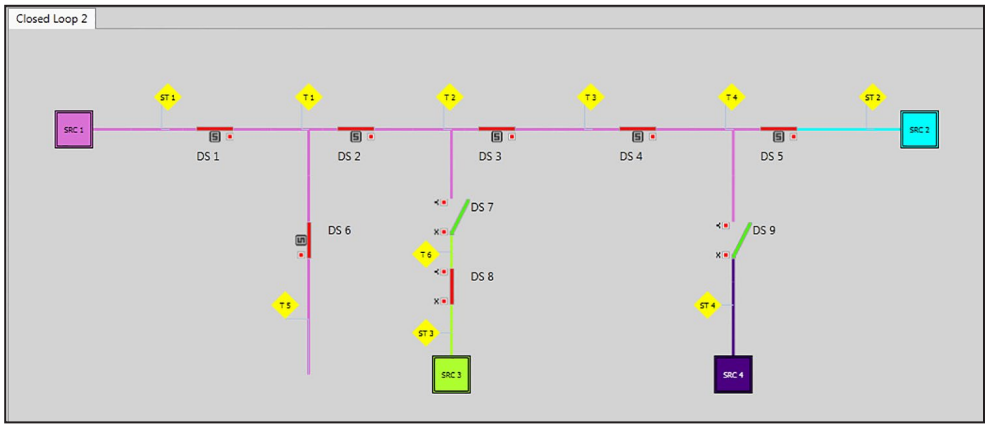

Figure 3. A multi-source branched closed-loop system.

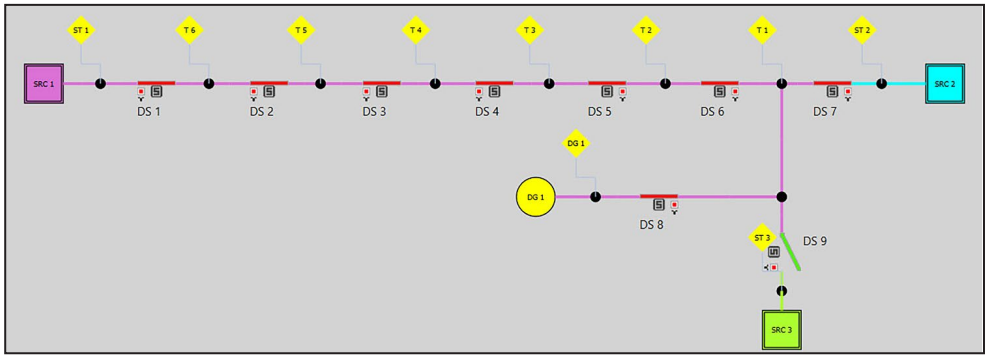

Figure 4. A closed-loop system with distributed generation.

6800 Series Automatic Switch Control Configuration

The **Automatic Operation** mode of 6801 Automatic Switch Controls must be configured correctly for closed-loop operations with the IntelliTeam SG system. The first settings are located in IntelliLink® Setup Software on the *Setup>General>Automatic Op.* screen. See Figure 5.

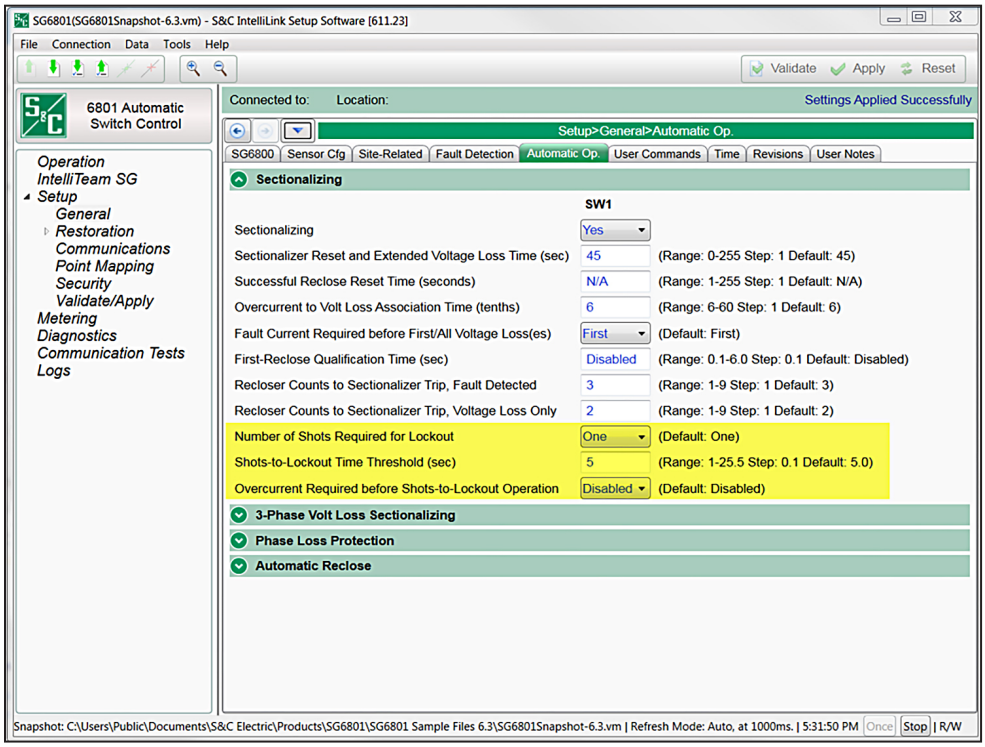

Figure 5. The 6801 control *Setup>General>Automatic Op.* screen.

Follow these steps to configure the control for closed-loop operation:

STEP 1. Configure these settings:

(a) The **Number of Shots Required for Lockout** setting must be set to the value 1.

The **Overcurrent Required before Shots-to-Lockout Operation** mode must be set to the **Disabled** state.

STEP 2. Review these settings in the *Setup>General>Automatic Op* screen and adjust them if necessary:

(a) The **Sectionalizing** mode must be set to the "Yes."

The **Recloser Counts to Sectionalizer Trip, Fault Detected** setting must be set to a value greater than 1, and this value should be coordinated with the **Total Number Of Recloser Shots To Lockout** setting for the source breakers.

The **Recloser Counts to Sectionalizer Trip, Voltage Loss Only** setting must be set to a value greater than 1 and should be set to a value one lower than the **Recloser Counts to Sectionalizer Trip, Fault Detected** setting.

The **Shots-to-Lockout Time Threshold** setting should be set to the **Default** value of 5 seconds.

Note: When using distributed generation on a closed-loop system, load directionality must be configured correctly for accurate load calculations. See S&C Instruction Sheet 1044-578: "IntelliTeam® SG Automatic Restoration System, *Distributed Generation Setup and Configuration*," for details.

The next setting that must be configured for closed-loop operation is on the *Setup>Restoration>IntelliTeam SG>Team Summary* screen, shown in Figure 6.

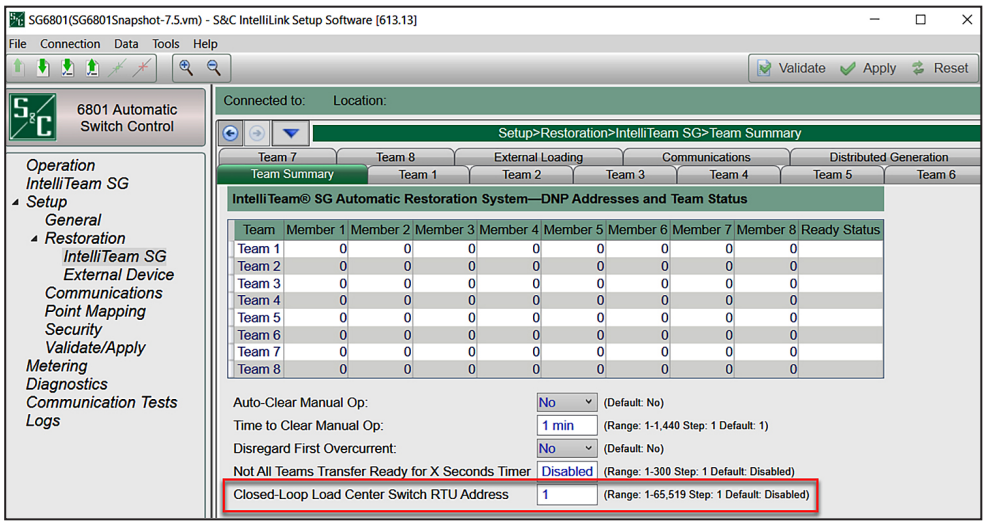

Figure 6. The *IntelliTeam>Team Summary* screen.

STEP 3. Click on the **Closed-Loop Load Center Switch RTU Address** field. The Change Value dialog box opens. See Figure 7. Enter the RTU address in the **Numeric Value** field and click on the **OK** button.

This setting must be set at each switch in the closed-loop circuit, and the same RTU address must be entered. Otherwise, a single center point switch will not be configured and the closed loop may misoperate. Also, if no load center switch is configured for the closed-loop circuit, the loading will be estimated as "0 A" and will impact restoration.

STEP 4. Repeat Step 3 for every switch on the closed-loop circuit.

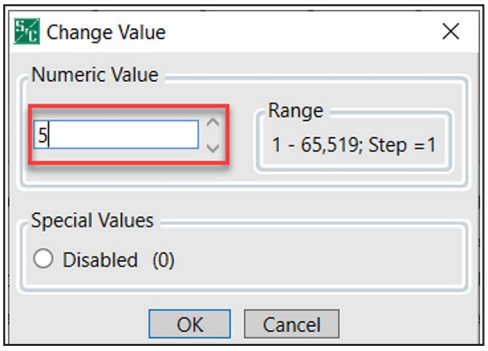

Figure 7. The Closed-Loop Center Switch RTU Address setting.

IntelliRupter Fault Interrupter Control Configuration

With firmware version 7.6 and later, IntelliRupter fault interrupters can be used on the main line of IntelliTeam SG system closed-loop circuits. For an IntelliRupter fault interrupter to be used in an IntelliTeam closed-loop system, it must be configured as a sectionalizer, similar to how the 6801 controls are configured. The first settings are located in IntelliLink Setup Software on the *Setup>Protection>General Profile 1-4* screens. See Figure 8.

Follow these steps to configure the IntelliRupter fault interrupter for closed-loop operation:

STEP 1. Make sure all **Initial Trip** settings are in the **Disabled** state (unchecked) for *General Profile 1-4* screens.

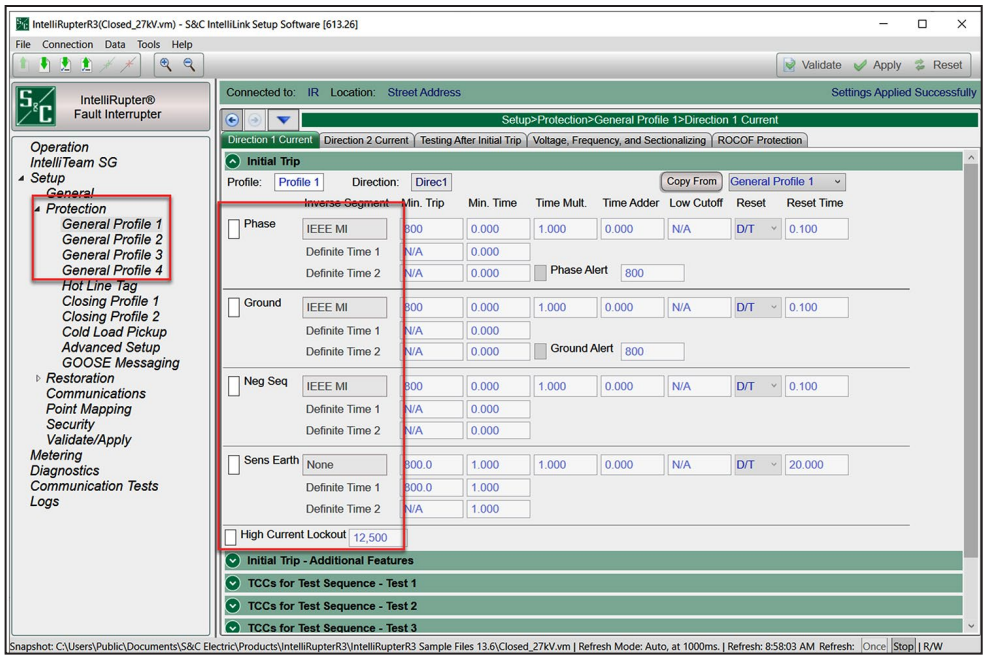

Figure 8. The *General Profiles* screen.

STEP 2. Check the settings in the *Protection>General Profile 1-4>Voltage, Frequency, and Sectionalizing>Voltage Trip* screen and adjust them if necessary (See Figure 9):

(a) In the Voltage Trip panel, make sure the **Open-Source Sectionalizing (Positive Sequence)** setting is set to "No" (disabled) for any of the **General** profiles that will be used.

Make sure the **Trip on Three-Phase Voltage** setting is set to "Yes" (enabled).

Note: This can also be set to the **IntelliTeam SG** setting, but the device will only trip if the IntelliTeam system is in the **Ready** state.

S&C recommends leaving all other settings in the Trip on Three-Phase Voltage panel at the default value.

All other settings in the Voltage Trip panel should be left at the default value.

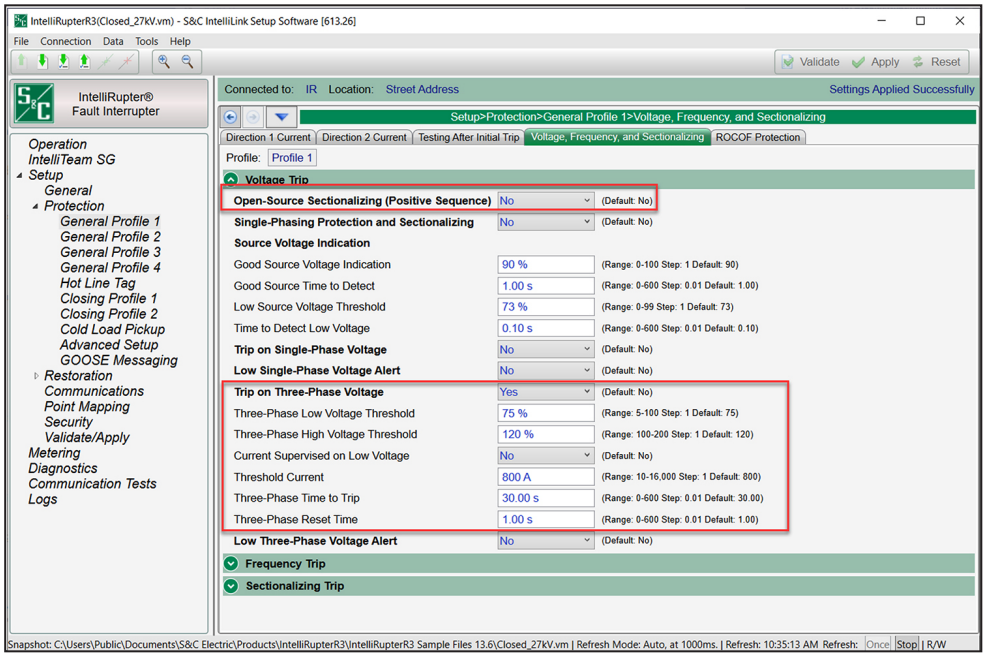

Figure 9. The Voltage, Frequency, and Sectionalizing—Voltage Trip settings.

STEP 3. Check the settings in the *Protection>General Profile 1-4>Voltage, Frequency, and Sectionalizing>Sectionalizing Trip* screen and adjust them if necessary (See Figure 10):

(a) In the Sectionalizing Trip panel, set the **Fault Current Detected – Counts to Trip** setting to "Yes."

Note: This can also be set to the **IntelliTeam SG** setting, but the device will only trip if the IntelliTeam system is in the **Ready** state.

i. The **Counts to Trip** setting must be set to a value greater than 1, and this value should be coordinated with the **Total Number Of Recloser Shots To Lockout** setting for the source breaker.

Note: When using a mix of IntelliRupter fault interrupters with 6801 controls in a closed-loop system, this value should be the same value as the 6801 control **Recloser Counts to Sectionalizer Trip, Fault Detected** setting.

ii The **Voltage Loss Association Time** setting should be the same on the IntelliRupter fault interrupter as the 6801 control for the **Overcurrent to Voltage Loss Association Time (tenths)** setting.

Note: The default for the IntelliRupter fault interrupter is 0.10 seconds, but the default for the 6801 control is 0.6 seconds for these settings. So, one or both of these settings must be changed to align them.

iii All other setpoints in the Fault Current Detected–Counts to Trip panel should remain at the default values or be changed to match the voltage class of the feeder they are deployed on.

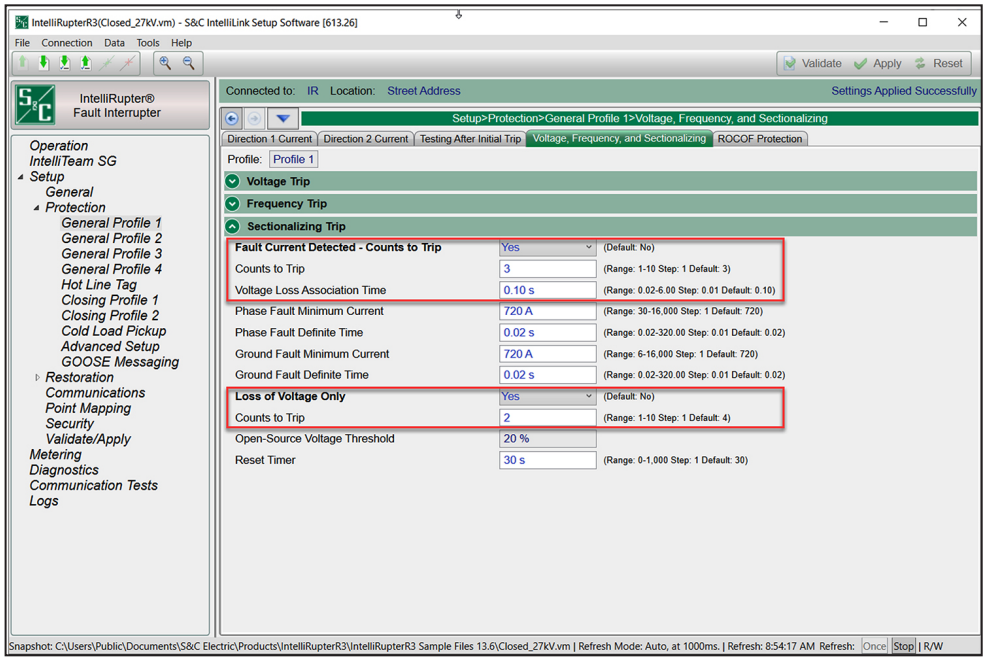

Figure 10. The Sectionalizing Trip settings.

In the Sectionalizing Trip panel, set the **Loss of Voltage Only** setting to "Yes."

Note: This can also be set to the **IntelliTeam SG** setting, but the device will only trip if the IntelliTeam system is in the **Ready** state.

i The **Counts to Trip** setting must be set to a value greater than 1, and this value should be set to one lower than the **Fault Current Detected—Counts To Trip** setting (shown in Step 3(a)i above).

Note: When using a mix of IntelliRupter fault interrupters with 6801 controls in a closed-loop system, this value should be the same value as the 6801 control **Recloser Counts to Sectionalizer Trip, Voltage Loss Only** setting. See Step 2(c) on page 7.

ii All other setpoints in the Loss of Voltage panel should remain at the default values.

Check the Frequency Trip panel and make sure all settings are set to "No" (disabled). See Figure 11.

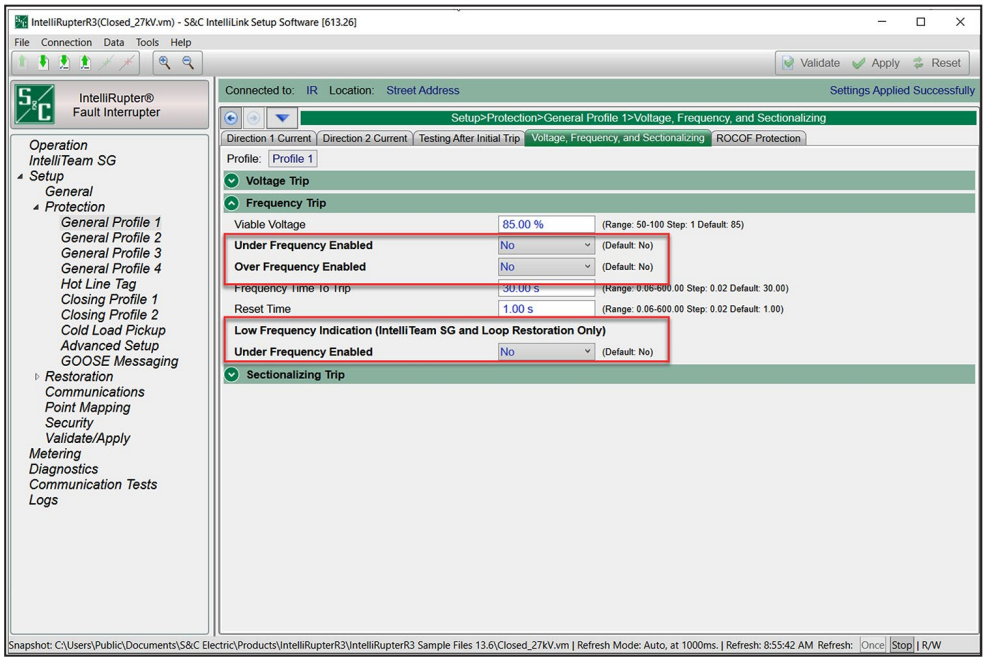

Figure 11. The Frequency Trip setpoints.

STEP 4. Check the settings on the *Protection>Closing Profile 1* screen and adjust them if necessary. See Figure 12.

(a) In the Closing Profile Main panel, set the **PulseClosing Enabled** setpoint to "No" and make sure the **Sync Check Enabled** setpoint is set to "No."

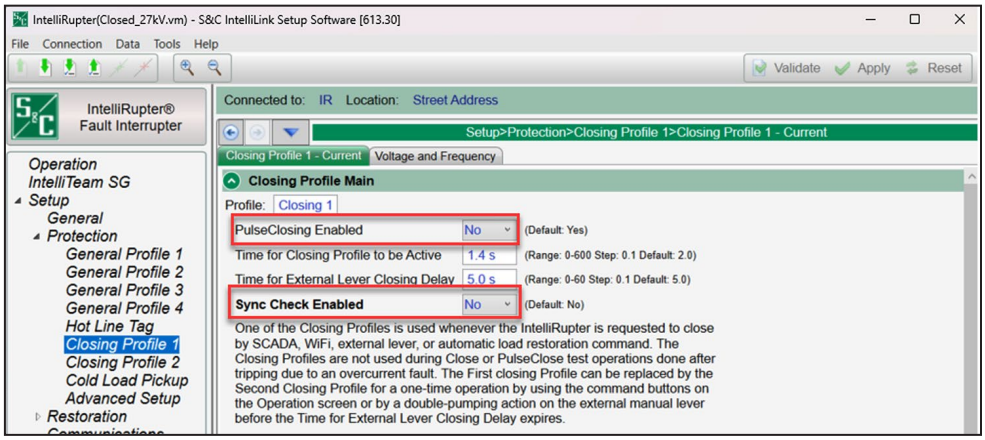

Figure 12. The Closing Profile Main setpoints.

In the TCC panel, make sure all options are unchecked (disabled) for both **Direction 1** and **Direction 2** settings. See Figure 13.

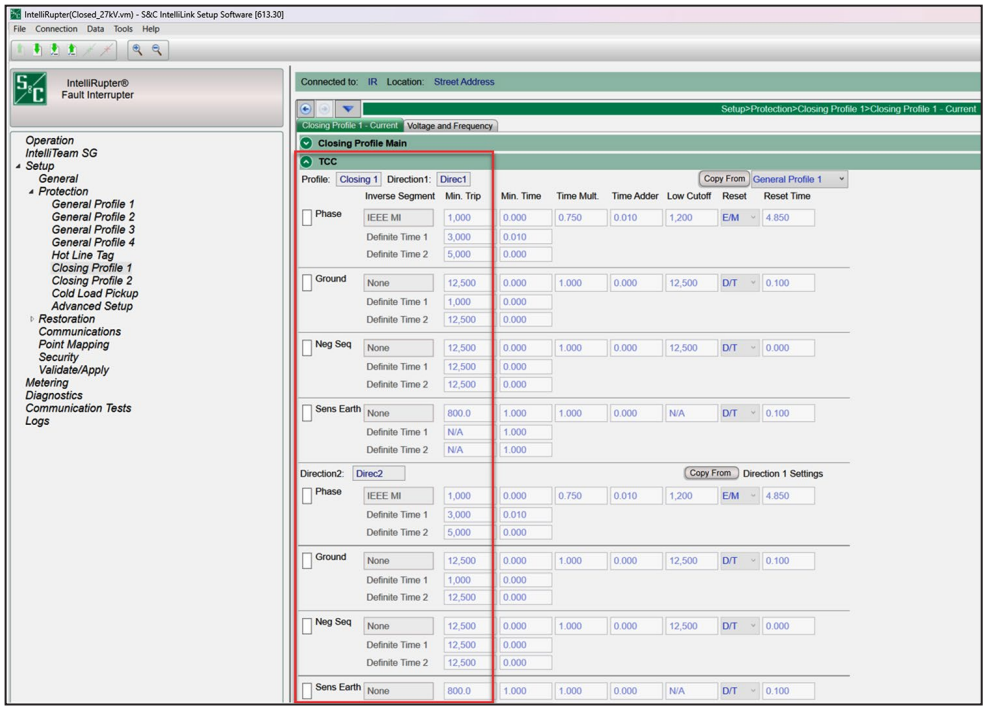

Figure 13. The Closing Profile 1 TCC setpoints.

Note: When using distributed generation on a closed-loop system, load directionality must be configured correctly for accurate load calculations. See S&C Instruction Sheet 1044-578: "IntelliTeam® SG Automatic Restoration System, *Distributed Generation Setup and Configuration*," for details.

The next setting that must be configured for closed-loop operation is on the *Setup>Restoration>IntelliTeam SG>Team Summary* screen, shown in Figure 14.

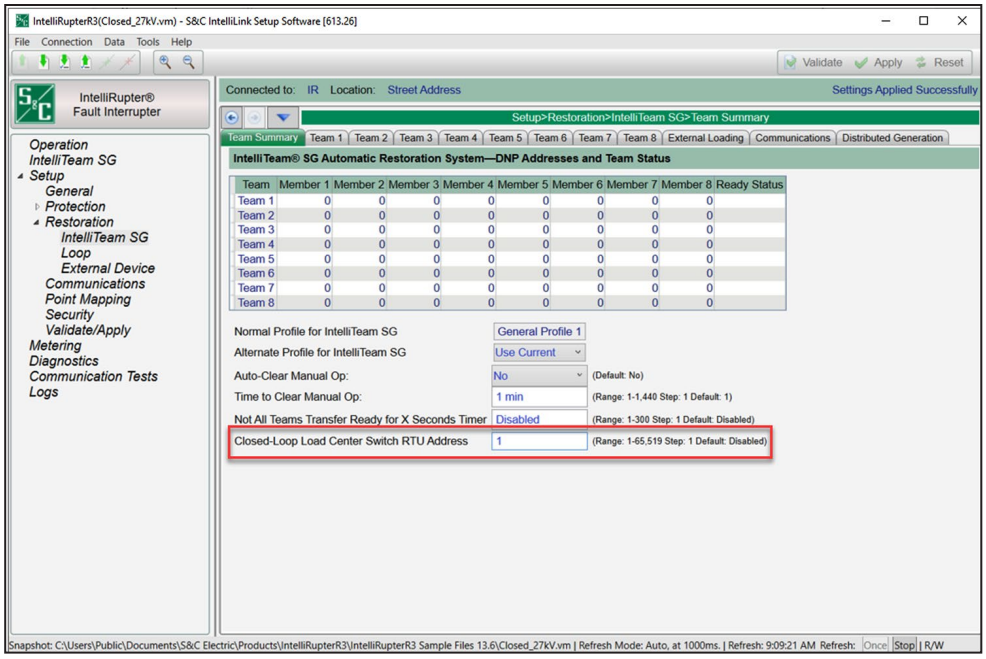

Figure 14. The *IntelliTeam>Team Summary* screen.

STEP 5. Click on the **Closed-Loop Load Center Switch RTU Address** field. The Change Value dialog box opens. See Figure 15. Enter the RTU address in the **Numeric Value** field and click on the **OK** button.

This setting must be set at each switch in the closed-loop circuit, and the same RTU address must be entered. Otherwise, a single center-point switch will not be configured and the closed loop may misoperate. Also, if no load-center switch is configured for the closed-loop circuit, the loading will be estimated as "0 A" and will impact restoration.

STEP 6. Repeat Step 5 for every switch on the closed-loop circuit.

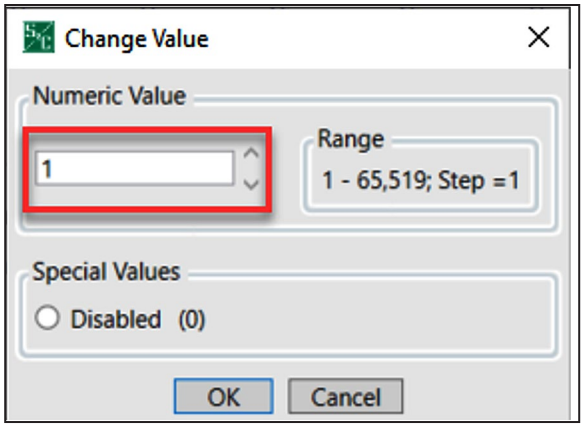

Figure 15. The Closed-Loop Load Center Switch RTU Address setting.

Verification

To verify the closed-loop circuit is configured correctly, follow these steps:

STEP 1. Go to the *Setup>Restoration>IntelliTeam SG>Team Summary* screen of every switch on the closed-loop circuit and make sure they all have the same RTU address configured in the **Closed-Loop Load Center Switch RTU Address** setpoint. See Figure 16.

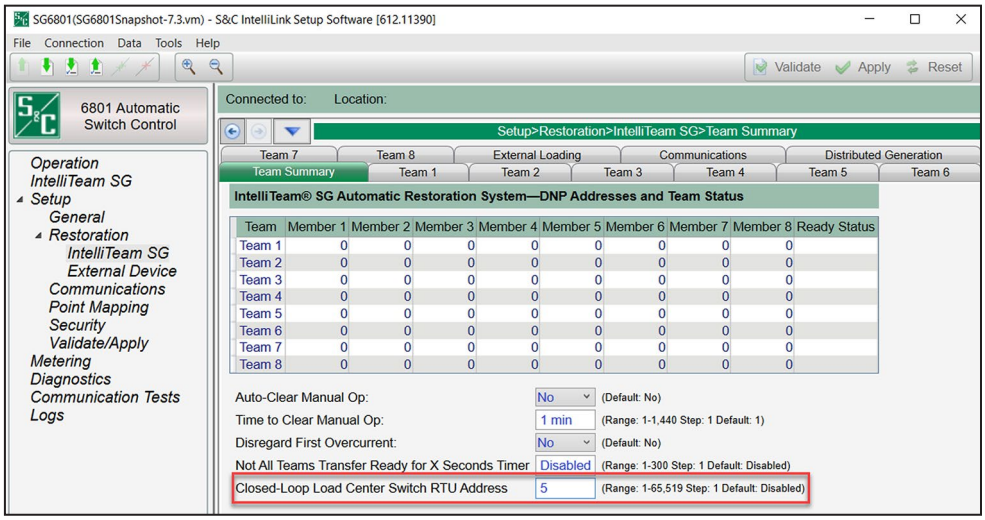

Figure 16. Verification of the Closed-Loop Load Center Switch RTU Address at each switch.

STEP 2. Log in to the center-point switch with IntelliLink Setup Software.

STEP 3. If the closed-loop break switch has a 6801 switch control, go to the *Operation* screen and verify the CLOSED-LOOP BREAK SWITCH LED is on. See Figure 17.

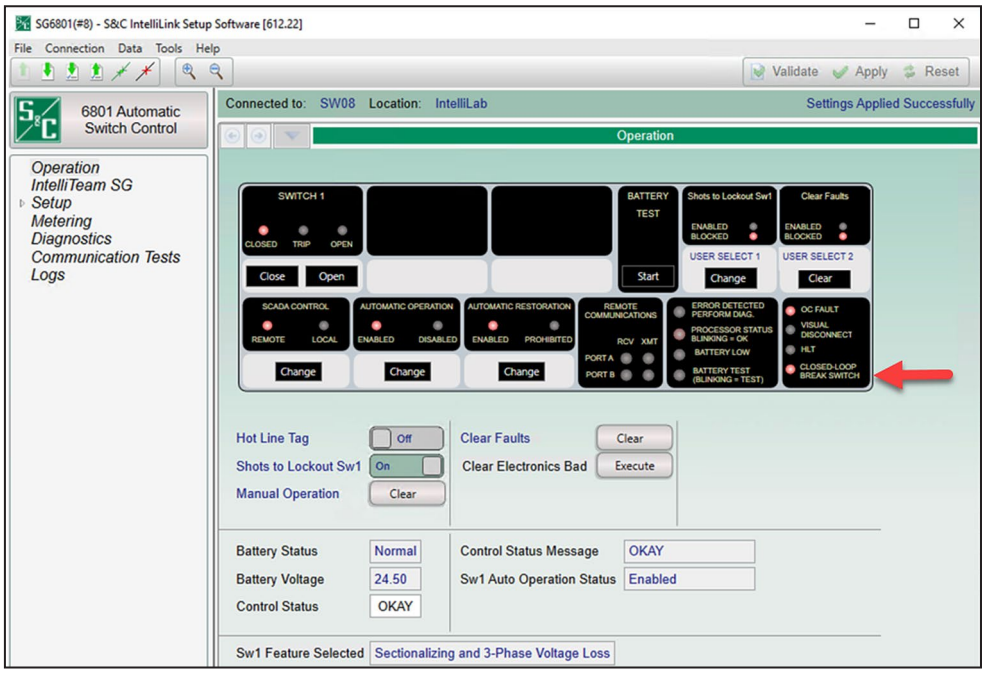

Figure 17. The 6801 switch control CLOSED-LOOP BREAK SWITCH LED.

STEP 4. If the closed-loop break switch is an IntelliRupter fault interrupter, go to the *Operation* screen and verify the Closed Loop Break Switch status box indicates "On." See Figure 18.

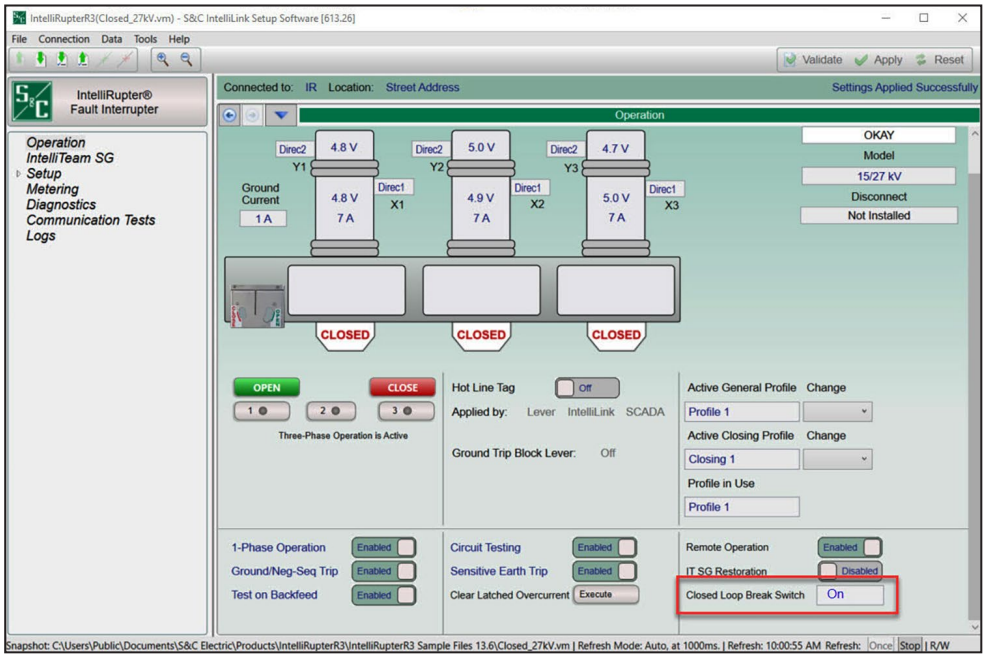

Figure 18. The IntelliRupter fault interrupter Closed-Loop Break Switch status box.

Functional Limitations

When deploying a closed-loop circuit with the **Return-to-Normal** mode enabled, do not use the **Open Transition** mode.

Rapid Self Healing mode and **Phase-Loss Isolation** mode will not work on a two-source closed-loop circuit, and they may not work in all cases when deployed with a branched closed-loop system. If either of these features is needed for a branched closed-loop system, an IntelliTeam system acceptance test will be required to prove compatibility of these features with the actual system circuit.

When configuring a closed-loop system where distributed generation is present, the distributed generation load contribution must be taken into consideration when making the load-flow analysis. Then, a center-point switch can be selected where either source can carry the load it becomes responsible for when the loop is broken and the distributed generation is tripped offline. If the distributed generation load contribution is not accounted for, one of the sources may become overloaded when the center-point switch opens to break the loop.