Phase-Loss Isolation

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March 3, 2025

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 operating an IntelliTeam SG Automatic Restoration System. Become familiar with the Safety Information on page 3 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.

Proper Application

⚠ WARNING

The equipment in this publication is only intended for a specific application. Refer to Specification Bulletin 1044-31.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet for the IntelliTeam SG Automatic Restoration System. Become familiar with these types of messages and the importance of these 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 operating the IntelliTeam SG Automatic Restoration System.

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 **Phase-Loss Isolation** (PLI) feature of the IntelliTeam® SG Automatic Restoration System uses both IntelliTeam SG system peer-to-peer communication between team members and voltage sensing at the controls to provide detection of loss of voltage on one or two phases and isolate the problem section when overcurrent elements do not trip. A common application for this feature is to detect and isolate a broken conductor.

The **Phase-Loss Isolation** function is different from the **Phase-Loss Sectionalizing** function. When enabled, the conventional automatic phase-loss sectionalizing opens the switch to protect downstream three-phase load from being single-phased because of an upstream open conductor or blown fuse. Phase-Loss Sectionalizing is part of the switch control logic, whereas the **Phase-Loss Isolation** function is part of the IntelliTeam SG system application logic.

The IntelliTeam SG system operates based on the connectivity of each feeder in the IntelliTeam SG system. By combining connectivity information with the voltage sensing at each control, IntelliTeam SG system software provides phase-loss isolation. For this feature to function properly, all controls must be configured with IntelliTeam Designer to use **Phase-Loss Isolation** mode and have their individual **Phase-Loss Sectionalizing** function enabled. See Figure 1 and Figure 2 on page 5 for configuration examples.

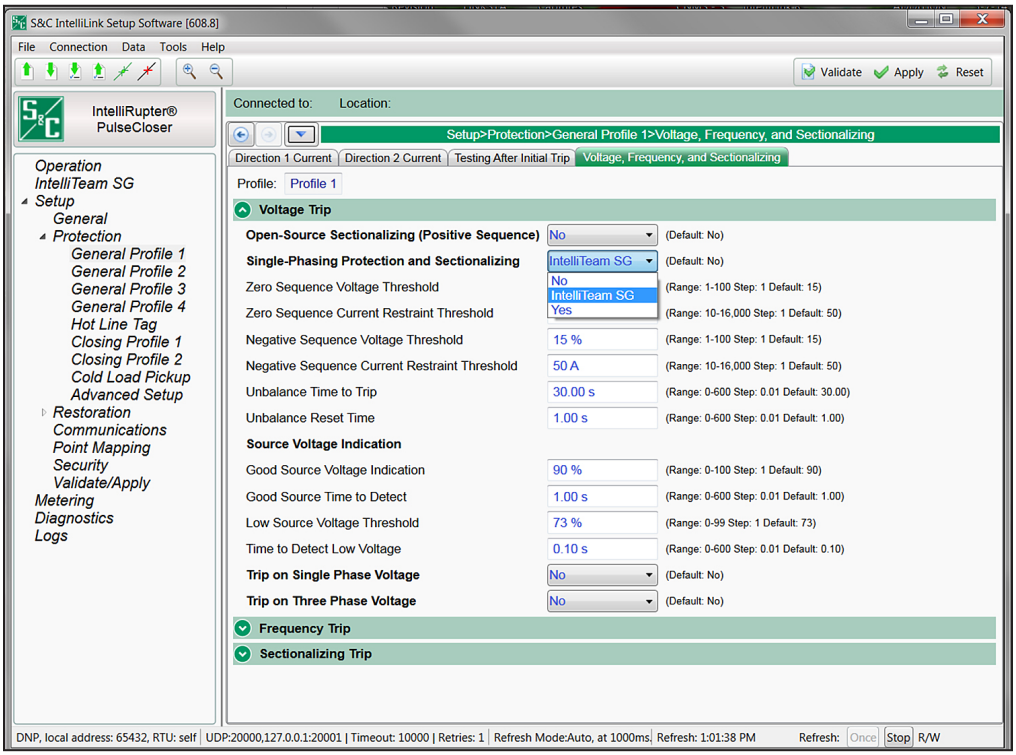

Figure 1. The IntelliRupter® fault interrupter Phase-Loss Sectionalizing settings.

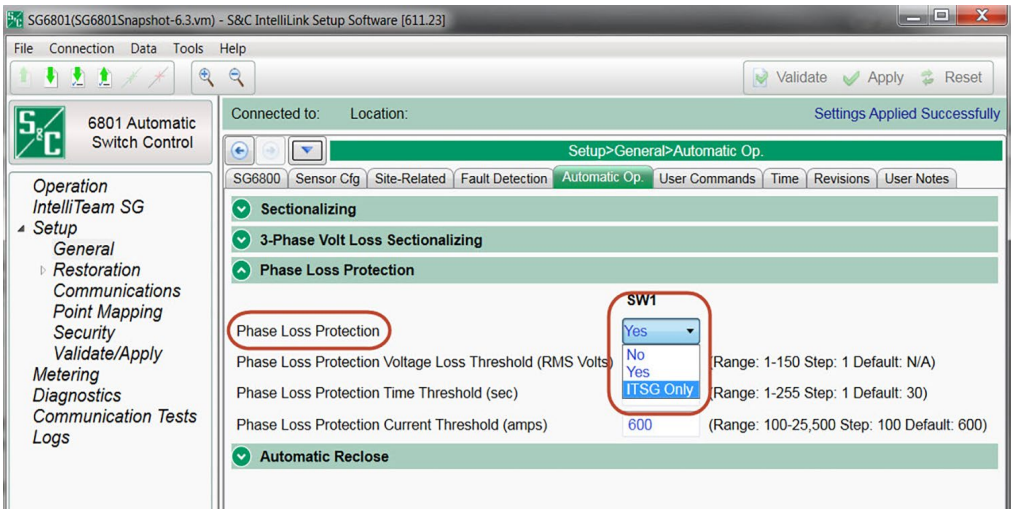

Figure 2. The 6800 series control Phase-Loss Protection settings.

Phase-Loss Sectionalizing

The **Phase-Loss Isolation** feature is used primarily for overhead circuits, but it is also supported in Vista® Underground Distribution Switchgear with S&C 6802 Automatic Switch Controls and PME/PMH Pad-Mounted Switchgear with S&C 6802/3 controls, which are commonly used in mixed systems that include both overhead and underground line segments.

The **Phase-Loss Isolation** feature requires the sectionalizing/interrupting devices to have their **Phase-Loss Sectionalizing** feature enabled. Sectionalizing must be configured properly for phase-loss isolation to take action because the core **Phase-Loss Sectionalizing** logic must detect the voltage loss and complete timing to fully qualify the **Phase-Loss** condition.

When the sectionalizing/interrupting device is a third-party device installed with an IntelliNode™ Interface Module, the **Phase-Loss Sectionalizing** function must be enabled in the IntelliNode module. To properly configure an IntelliNode module for phase-loss isolation with the IntelliTeam SG system, users must set the **Extended VLoss and Single Phase VLoss** setting as "Enabled" and the **Extended VLoss and Single Ph. VLoss Protection Type** setpoint to "Extended 1Ph and 3Ph VLoss," as shown in Figure 3.

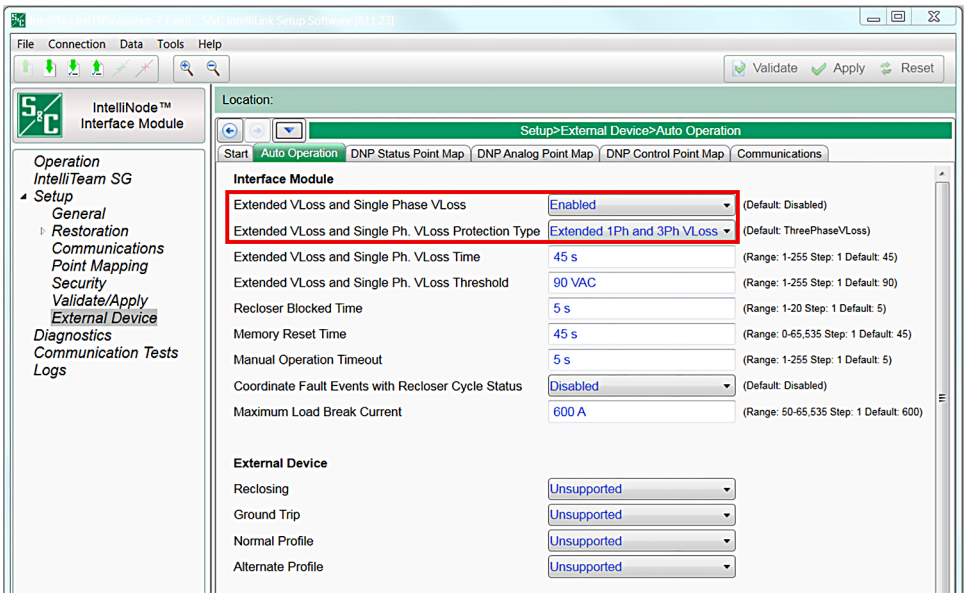

Figure 3. The IntelliNode Interface Module Phase-Loss Protection settings.

Phase-loss sectionalizing instructions for the IntelliNode module are in S&C Instruction Sheet 1043-530, "IntelliNode™ Interface Module: *Setup*." IntelliRupter fault interrupter phase-loss sectionalizing instructions are in S&C Instruction Sheet 766-530, "IntelliRupter® PulseCloser® Fault Interrupter: *Setup*," and 6800 Series Automatic Switch Control phase-loss sectionalizing instructions are in S&C Instruction Sheet 1045-530, "S&C 6800 Series Automatic Switch Controls: *Setup*."

It is important to configure all devices in the circuit with similar phase-loss sectionalizing timing. The IntelliTeam SG restoration system's distributed intelligence architecture can tolerate some miscoordination of voltage-element timing, but significant miscoordination can cause unexpected results.

When the **Phase-Loss Sectionalizing** mode is not enabled, the device cannot take part in a **Phase-Loss Isolation** operation. For example, a downstream switch that experiences a **Phase-Loss Trip** operation cannot complete the Phase-Loss Isolation event, when the source switch's **Phase-Loss Sectionalizing** mode is "Disabled." This is because it is impossible for the IntelliTeam SG system to know the switch was experiencing a **Phase-Loss** condition.

There are additional considerations when configuring phase-loss sectionalizing for an IntelliRupter fault interrupter and phase-loss protection for 6800 Series Automatic Switch Controls. Their phase-loss schemes can be configured so they will only operate when the IntelliTeam SG system is in the **Ready** state.

To use the **Phase-Loss Isolation** feature with IntelliRupter fault interrupters, the IntelliRupter fault interrupter **Single-Phase Protection and Sectionalizing** element can be set to either **Yes** or **IntelliTeam SG** mode. The **Trip on Single Phase Voltage** element should be set to "No." See Figure 1 on page 7. For either setting, when **IntelliTeam System** operation is enabled and in the **Ready** state, the **Inform** mode will be in effect. See the "Inform Mode" section on page 8.

However, when the IntelliTeam system is not in the **Ready** state and the **Sectionalizing** element is set to **Yes** mode, the **Sectionalizing** element will trip based only on its native settings. But, when the IntelliRupter fault interrupter **Sectionalizing** element is set to **IntelliTeam SG** mode, the element can only trip when the IntelliTeam system is in the **Ready** state. When the IntelliTeam system is not in the **Ready** state and the **Sectionalizing** element is set to **IntelliTeam SG** mode, the element will not respond.

The 6800 Series control's **Phase-Loss Protection** feature works in the same manner as the **Phase-Loss Sectionalizing** element works on the IntelliRupter fault interrupter. The same rules apply for whether the 6800 Series control's **Phase-Loss Protection** feature is set to the **Yes** or **IntelliTeam SG** mode and whether the IntelliTeam system is in the **Ready** state, as described for the IntelliRupter fault interrupter. See Figure 2 on page 5.

Application of the **Phase-Loss Isolation** feature on systems with mixed control types requires additional consideration of how the voltage elements will respond to system events. The 6800 Series controls and the IntelliNode modules use the voltage magnitude of individual phases to detect single-phase loss-of-voltage problems. This is a simple element and is easy to set up, but it may miss detecting an event when voltage on the problem phase is supported by phase-to-phase loads or transformers.

On the other hand, IntelliRupter fault interrupters use all six voltage sensors, **Negative-Sequence** and **Zero-Sequence** elements to detect single-phase loss-of-voltage problems.

The elements can be more difficult to set up, but this is a more dependable method of detecting a single-phase voltage problem. Therefore, when using the **Phase-Loss Isolation** feature on a system with different controls and with phase-to-phase connected loads or transformers, configure the **Time-to-Trip** setpoint to be the same in all devices. The IntelliTeam SG system will select the best switches to open or close.

Inform Mode

When using the IntelliTeam SG system **Phase-Loss Isolation** function with the **Rapid Self-Healing** (RSH) function, the **Phase-Loss Sectionalizing** element operates in **Inform** mode instead of tripping and locking out the device on its own. The **Phase-Loss Sectionalizing** feature will tell the IntelliTeam SG system when it detects an event and then waits for the IntelliTeam SG system to supervise the operation.

Inform mode is active when the IntelliTeam SG system **Phase-Loss Isolation** feature and the device's **Phase-Loss Sectionalizing** mode are both "Enabled" and the **Rapid Self-Healing** feature is also "Enabled." When **Inform** mode is active, instead of opening on **Single-Phase Sectionalizing** logic, all controls will inform the IntelliTeam SG system about the condition, and the IntelliTeam SG system will locate and isolate the problem section. All other downstream controls not involved with the Phase-Isolation event will remain closed and will wait for the IntelliTeam SG system with the **Rapid Self-Healing** feature "Enabled" to restore all unaffected line segments.

Inform mode is not used when the **Phase-Loss Isolation** feature is "Enabled" and the **Rapid Self-Healing** feature is "Disabled." Configured this way, all switches will open for the Phase-Loss event (with their **Phase-Loss Sectionalizing** settings). When all switches are open, the IntelliTeam SG system will restore teams up to where the Phase-Loss event occurred.

Note: Inform mode is always used at an open switch regardless of the state of the **Rapid Self-Healing** feature or the configured options for the **Phase-Loss Isolation** feature. The reason for this is the IntelliTeam SG system needs to initiate phase-loss isolation when an open conductor is in the line segment directly adjacent to the open switch.

In this situation, the only switch that may see the phase-loss condition is the open switch (if there are voltage sensors on that side). Normal **Phase-Loss Isolation** logic can't do anything because the switch is already open. With **Inform** mode enabled at the normally open switch, the IntelliTeam SG system will request the switch logic to report the phase-loss condition, so the **Phase-Loss Isolation** feature will open the source switch to isolate the phase-loss section.

Note: While **Inform** mode, when active and enabled, prevents the **Phase-Loss Sectionalizing** logic from opening a switch, regardless of the time it takes to complete phase-loss isolation, it has no effect on other forms of **Protection** or **Sectionalizing** logic. The switch may still be opened by switch logic for those other reasons. If this occurs, the IntelliTeam SG system will assess the state of the system to determine what is needed to isolate the problem area and restore teams around it.

Enabling Phase-Loss Isolation

Devices with gold IntelliTeam SG system licenses can be configured for phase-loss isolation. A validation error will occur when a bronze license is used.

Follow these steps to configure a device to participate in phase-loss isolation:

STEP 1. Enable the **Phase-Loss Isolation** feature with IntelliTeam Designer software by clicking on the **Team Attributes** tab, highlighted in Figure 4.

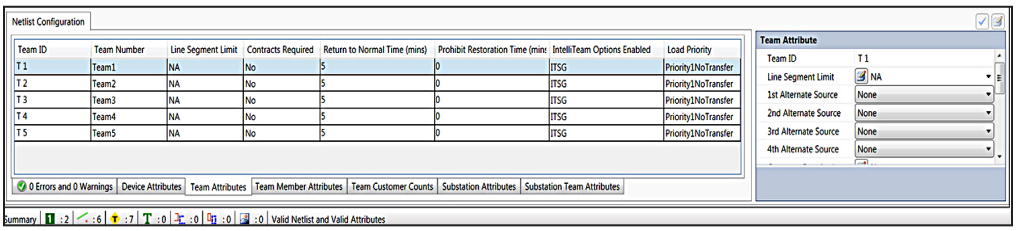

Figure 4. Using the Team Attributes tab to enable the Phase-Loss Isolation feature.

STEP 2. Select the device by clicking on the appropriate Team ID entry in the left column.

STEP 3. In the Team Attribute editor on the right, select either the **ITSGwPLIsolation** or the **ITSGwRapidSelf-HealingAndPLIsolation** option from the list provided for the **IntelliTeam Options Enabled** setting, or select it in the IntelliTeam options enabled column in the **Team Attributes** tab.

Table 1 on page 10 shows all configurations of the applicable **Phase-Loss Isolation** settings in the IntelliTeam SG system application, the **Phase-Loss Sectionalizing** settings of the IntelliRupter fault interrupter and 6800 series controls, and resulting behavior.

Legends for Table 1 on page 10:

PL Sect: **No/Yes/IT-SG Only** mode of the **Phase-Loss Sectionalizing** feature (control settings)

IT-SG: **Off/On** state of the IntelliTeam SG system (IntelliTeam system settings)

PLI: **Off/On** state of the **Phase-Loss Isolation** feature (IntelliTeam system settings)

w/RSH: **Off/On** state of the **Phase-Loss Isolation with Rapid Self-Healing** feature (IntelliTeam system settings)

Ready: **Yes/No** state of the team **Ready** mode (IntelliTeam system state)

Table 1. Phase-Loss Isolation and Phase-Loss Sectionalizing 6800 Series Control Settings

PL Sect	IT-SG	PLI	w/RSH	Ready	Result
No	—	—	—	—	Switch will not open based on phase-loss sectionalizing or PLI
Yes	No	—	—	—	Switch will always open based on qualified loss of voltage for phase-loss sectionalizing
Yes	Yes	No	—	—	Switch will always open based on qualified loss of voltage for phase-loss sectionalizing
Yes	Yes	Yes	No	Yes	Switch always opens on qualified loss of voltage for phase-loss sectionalizing; performs PLI as necessary to isolate the broken conductor
Yes	Yes	Yes	No	No	Switch always opens on qualified loss of voltage for phase-loss sectionalizing; no PLI performed
Yes	Yes	Yes	Yes	Yes	Switch qualifies voltage loss for phase-loss sectionalizing but does not open (**Inform** mode active); performs PLI to open source and load switches of the broken-conductor team only
Yes	Yes	Yes	Yes	No	Switch always opens on qualified loss of voltage for phase-loss sectionalizing (**Inform** mode not active); no PLI performed
IT-SG	No	—	—	—	Switch does not use phase-loss sectionalizing logic
IT-SG	Yes	No	—	Yes	Switch opens on qualified loss of voltage for phase-loss sectionalizing; no PLI performed
IT-SG	Yes	No	—	No	Switch does not use phase-loss sectionalizing logic
IT-SG	Yes	Yes	No	Yes	Switch opens on qualified loss of voltage for phase-loss sectionalizing, performs PLI as necessary to isolate the broken conductor
IT-SG	Yes	Yes	No	No	Switch does not use **Phase-Loss Sectionalizing** logic; no PLI performed
IT-SG	Yes	Yes	Yes	Yes	Switch qualifies loss of voltage for phase-loss sectionalizing but does not open (**Inform** mode active); performs PLI to open source and load switches of the broken-conductor team only
IT-SG	Yew	Yes	Yes	No	Switch does not use **Phase-Loss Sectionalizing** logic; no PLI performed

Table 2 on page 12 shows all configurations of the applicable **Phase-Loss Isolation** settings in the IntelliTeam SG system application, the **Phase-Loss Sectionalizing** settings of the IntelliNode Interface Module, and resulting behavior.

Legends for Table 2 on page 12:

EVL/SVL: **Enable/Disable** state of the **Extended Voltage Loss and Single Phase Voltage Loss** sectionalizing setting (IntelliNode module setting)

EVL/SVL Type: **ThreePhaseVLoss** or **Extended 1Ph and 3Ph VLoss** mode of the **Extended Voltage Loss and Single Phase Voltage Loss Protection Type** setting (IntelliNode module setting)

IT-SG: **Off/On** state of the IntelliTeam SG system (IntelliTeam system settings)

PLI: **Off/On** state of the **Phase-Loss Isolation** feature (IntelliTeam system settings)

w/RSH: **Off/On** state of the **Phase-Loss Isolation with Rapid Self-Healing** feature (IntelliTeam system settings)

Ready: **Yes/No** state of the team **Ready** mode (IntelliTeam system state)

Table 2. Phase-Loss Isolation and Phase-Loss Sectionalizing IntelliNode Interface Module Settings

EVS/SVL	EVL/SVL Type	IT-SG	PLI	w/RSH	Ready	Result
Disabled	—	—	—	—	—	Switch will not open as all options are disabled
Enabled	3-P VL	No	—	—	—	Switch does not use **Phase-Loss Sectionalizing** logic
Enabled	3-P VL	Yes	—	—	No	Switch does not use **Phase-Loss Sectionalizing** logic
Enabled	3-P VL	Yes	—	—	Yes	Switch opens on qualified 3-phase voltage loss, no PLI performed
Enabled	3-P VL	Yes	Yes	No	No	Switch does not use **Phase-Loss Sectionalizing** logic at all, no PLI performed (The setting of 3-P VL only is incompatible with PLI. This setting combination is not recommended.)
Enabled	3-P VL	Yes	Yes	No	Yes	Switch opens on qualified 3-phase voltage loss, no PLI performed (The setting of 3-P VL only is incompatible with PLI. This setting combination is not recommended.)
Enabled	3-P VL	Yes	Yes	Yes	No	Switch does not use **Phase-Loss Sectionalizing** logic at all, no PLI performed (The setting of 3-P VL only is incompatible with PLI. This setting combination is not recommended.)
Enabled	3-P VL	Yes	Yes	Yes	Yes	Switch opens on qualified 3-phase voltage loss, no PLI performed (The setting of 3-P VL only is incompatible with PLI. This setting combination is not recommended.)
Enabled	3+1-P VL	—	—	—	—	Switch does not use **Phase-Loss Sectionalizing** logic
Enabled	3+1-P VL	No	—	—	—	Switch does not use **Phase-Loss Sectionalizing** logic
Enabled	3+1-P VL	Yes	—	—	No	Switch does not use **Phase-Loss Sectionalizing** logic at all, no PLI performed
Enabled	3+1-P VL	Yes	—	—	Yes	Switch opens on qualified 3-phase or 1-phase voltage loss, no PLI performed
Enabled	3+1-P VL	Yes	Yes	No	No	Switch does not use **Phase-Loss Sectionalizing** logic at all, no PLI performed
Enabled	3+1-P VL	Yes	Yes	No	Yes	Switch opens on qualified 3-phase voltage loss, or if it is a 1-phase voltage loss event, then switch opens on qualified 1-phase loss and then performs PLI as necessary to isolate the broken conductor
Enabled	3+1-P VL	Yes	Yes	Yes	No	Switch does not use **Phase-Loss Sectionalizing** logic at all; no PLI performed
Enabled	3+1-P VL	Yes	Yes	Yes	Yes	Switch opens on qualified 3-phase voltage loss, or if it is a 1-phase voltage loss event, switch qualifies voltage loss for phase-loss sectionalizing but does not open (**Inform** mode active); performs PLI to open source and load switches of the broken-conductor team only

Limitations

IntelliTeam system devices are normally installed with three voltage sensors. If any team member has been installed with only one voltage sensor, that team should not have the **Phase-Loss Isolation** feature set to "Enabled." To use the **Phase-Loss Isolation** feature on teams that incorporate multi-switch devices and a common bus between the team members, three-phase voltage sensing is required at all team switch positions in the multi-switch device.

Phase Loss Isolation Example

Figure 5 shows a broken conductor between the Team 1 source IR A and pole 3 of SM-CX. When the **Phase Loss Isolation** feature is enabled and a conductor breaks, the voltage elements in SM-CX and Vista:Sw1 begin timing. When the voltage elements reach the **Trip** state, instead of tripping they inform the IntelliTeam system about the **Phase Loss** condition.

The IntelliTeam system checks whether the team source switch, in this case IR A, has good voltage, has not picked up, and does not see the **Phase Loss** condition. If true, the IntelliTeam system first opens IR A to de-energize the broken conductor. Then, the IntelliTeam system opens SM-CX and IR B to isolate the phase loss.

Opening IR B initiates a check of the data collected by the runners to determine whether IR C has sufficient capacity to restore the unaffected segment of Team 2. Opening SM-CX initiates a check of the data collected by the runners to determine whether Vista:Sw2 has sufficient capacity to restore the unaffected segments of Team 6 and the Vista switchgear's bus.

If capacity exists, IR C will close to restore service to Team 2. If capacity does not exist, it will remain open. Similarly, if capacity exists, Vista:Sw2 will close. In this case, if capacity does not exist, the Vista switchgear's bus coach will open Vista:Sw1 and check with Team 5 to see whether it has capacity to restore the Vista switchgear's bus. If capacity is available, Vista:Sw2 will close. Otherwise, it remains open.

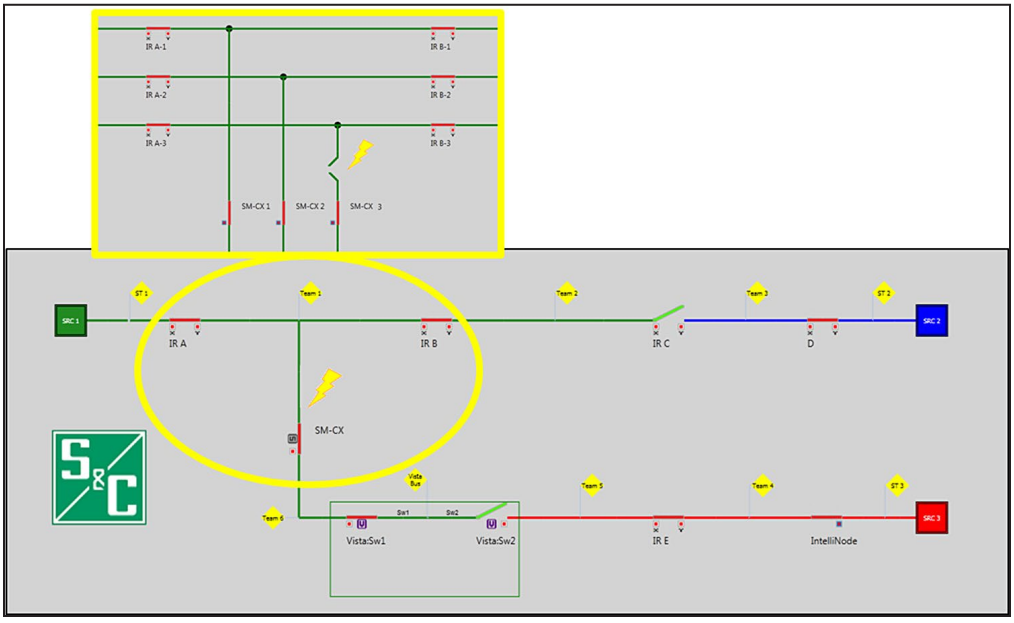

Figure 5. Phase-loss isolation example: loss of phase at SM-CX.