Introduction

This guide provides a reference for basic operation of the S&C IntelliTeam SG Automatic Restoration System. Since there are many factors, such as equipment type, settings, communications, and event timing that affect the actual outcome of a restoration event, the actual performance of your system may vary from the examples given here. IntelliTeam SG operations will be explained to help you understand what to expect during an event.

If a Factory Acceptance Test (FAT) was performed as part of your IntelliTeam SG system installation, the Instant Replay of fault, loss-of-phase, and loss-of-source events performed on a simulation of your system will be made available to participants of the FAT. The replays demonstrate how IntelliTeam SG will perform on your system.

IntelliTeam SG is native to S&C IntelliRupter® Pulse-Closers, and S&C 6800 Series Automatic Switch Controls, but IntelliTeam SG can incorporate many Intelligent Electronic Devices (IED) when the device is equipped with an S&C IntelliNode™ Interface Module. Since IntelliTeam SG takes over after the automatic functions of an IED have completed, the system performance will vary depending on the device type and mix. Examples in this guide use all-IntelliRupter systems, and systems with IntelliRupters and 6800 Series Automatic Switch Controls. See Figure 1 on page 2.

Safety is an important feature of IntelliTeam SG. Almost two decades of experience has gone into the design and implementation of the system features. Numerous methods are provided to manually disable the system, and a number of checks and features will automatically disable the system, to avoid unexpected operation.

IntelliTeam SG Mission

1. Identify the location and types of problems. When protection and sectionalizing have completed, isolate distribution circuit problems.

2. Restore power to as much of the circuit as possible. After the problems are isolated, the system will restore as much load as possible, given the location of the fault, and in accordance with configured loading limits. Switches will not close if there is more load than allowed.

3. Return the system to its normal state. If configured to do so, the system will attempt to return to its normal state after the circuit problem has been corrected. Otherwise, manual intervention will be required to return the system to the normal state.

Basic Definitions

IntelliNode: The IntelliNode™ Interface Module is a device added to a relay or recloser control to make that control part of an IntelliTeam SG system. The protective functions of the relay or control are not affected by the IntelliNode. It will still trip and reclose as before. IntelliTeam operates after the host device has locked out.

Team Member: A team member can be a motor-operated switch (overhead or underground) with a 6800 Series Automatic Switch Control, an S&C IntelliRupter PulseCloser, or a recloser or relay installed with an IntelliNode Interface Module.

Team: A team is any line segment bounded by IntelliTeam devices. Any number of teams can be combined to create an automated distribution system. The circuit shown in Figure 1 below has seven teams. Team 1 has three team members, IR A, IR B, and SM-CX.

Coach: A coach travels between the IntelliTeam devices in its team, to gather information and share it among the team members. The coach is a virtual software agent that meets with the coaches of adjacent teams to ensure certain criteria are met prior to operating IntelliTeam devices during the restoration process.

FeederNet: A FeederNet is the collection of all teams between a source and the open points. The circuit shown in Figure 1 below has three FeederNets. The FeederNet labeled SRC 1 has six team members (IR A, IR B, IR C, SM-CX, Vista:Sw1, and Vista:Sw2), four teams (Team 1, Team 2, Team 6, and Vista Bus), and two open points (IR C and Vista:Sw2).

Runner: A runner travels the full length of the circuit between sources, to collect information about FeederNet loading and update each device as it travels. Runners originate from the first device at each source resulting in multiple runners existing at any given point in time. This continuous distribution of data means that Rapid Self-Healing can use the data that exists at each device immediately during restoration.

READY: The system must be in READY to accomplish restoration and a return-to-normal.

- You can take a team out of READY on purpose—typically in preparation for line work.
- Loss of communication between team members can take a team out of READY.
- A problem at an IntelliTeam device shared between two teams can take both teams out of READY.
- A number of factors will take the system out of READY. They are discussed in the Prohibit Restoration section below.

When a setting option of *IT-SG Only* has been selected for a device function, IntelliTeam must be READY for that function to be enabled. Some examples are:

- Open-Source Sectionalizing
- Single-Phasing Protection and Sectionalizing
- Trip on Single-Phase Voltage
- Trip on Three-Phase Voltage
- Fault Count Detected—Counts to Trip
- Loss of Voltage Only.

Rapid Self-Healing: Rapid Self-Healing is a restoration event that occurs to minimize the number of switch operations and reduce the time required to perform a restoration. Rapid Self-Healing is an optional IntelliTeam SG feature, and must be enabled in the IntelliTeam SG configuration.

Sequential Restoration: Also called IntelliTeam® II Mode, sequential restoration involves multiple switch operations where all IntelliTeam devices that experience a loss-of-voltage are first opened, and then sequentially closed—starting at each of the available sources, and continuing until as much as the load has been picked up as possible, without overloading the available sources.
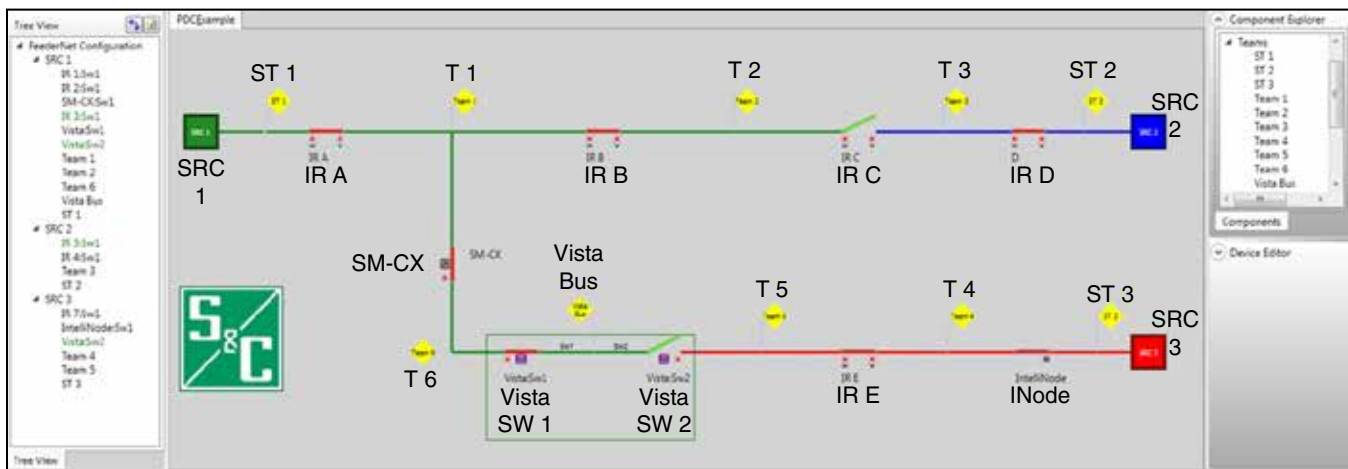

Figure 1. Example of an IntelliTeam SG circuit.

IntelliTeam II mode will occur whenever Rapid Self-Healing is not available, due to insufficient capacity, or if it was disabled in the system configuration. When there are multiple faults or voltages losses, IntelliTeam II mode will also operate for subsequent disturbances after the initial disturbance.

Interruption, Isolation, and Restoration

When a fault occurs, there are three sequential system responses: fault interruption, fault isolation, and power restoration.

1. Fault Interruption—is not a function of IntelliTeam SG, rather it is performed by a fault interrupting device, such as an IntelliRupter PulseCloser, or the substation breaker. Except for special features, such as Communication Enhanced Coordination and Phase Loss Isolation, IntelliTeam does not intervene until all protection devices have locked out.

2. Fault Isolation—when a system incorporates both sectionalizing and protective devices, the sectionalizer may provide part of the fault isolation during the interruption process. When the protective devices have locked out, IntelliTeam SG determines the location of the fault, and initiates or completes isolation of the fault.

3. Power Restoration—when the fault has been isolated, IntelliTeam SG begins the process of restoring power to as many customers as possible, without overloading the available sources.

Fault in Team 6

An example of interruption, isolation, and restoration is shown with the fault in **Team 6**, on the circuit in Figure 2.

IR A, an IntelliRupter in the substation, is the first fault-interrupting device between the fault and the source, and opens to interrupt the fault. The open operation is the result of IntelliRupter's automatic protection functions. In this case it was an IntelliRupter inside a substation. It could also have been either a recloser or substation breaker, with an IntelliNode Interface Module, acting as a team member.

After **IR A** opens, **SM-CX**, the Scada-Mate CX™ switch, will be opened by the automatic sectionalizing logic of its 6801 Automatic Switch Control, resulting in partial isolation of the fault. The sectionalizing logic is configured to open on first voltage loss after a fault, see Sectionalizing Rules on page 5.

The fault is now isolated from the source, so **IR A** can pulse test, close, and stay closed. Until now all switching operations have been directed by the local intelligence of protection and sectionalizing devices on the system. Communication between devices has not been a factor so far. Now that those processes are complete, IntelliTeam SG takes over to complete the fault isolation, if necessary, and restore service as much as possible. The **Team 6** coach travels between its team members to collect information about the fault. The **Team 6** coach determines that IntelliTeam must open **Vista:Sw1** to complete fault isolation.

Now that the fault is isolated, restoration can begin. If Rapid Self-Healing is configured, the data collected by the runners is used immediately. Each runner carries the loading information needed to determine if there is sufficient capacity available from each open point to restore the affected segment. If one or more of the open points has the necessary capacity available to pick up the affected segment, without overloading, IntelliTeam will close the open point that has the most capacity. In this case, IntelliTeam closes **Vista:Sw2** to restore power to the loads connected to the Vista Bus.

Had there been more IntelliTeam devices in the affected feeder segment, or an insufficient capacity from all of the open points, or if Rapid Self-Healing was not enabled—then Sequential Restoration, *IntelliTeam II mode*, would operate to open all of the IntelliTeam switches between the faulted section and the tie points, and begin closing one device at a time at each available source, until as much load as possible has been picked up.
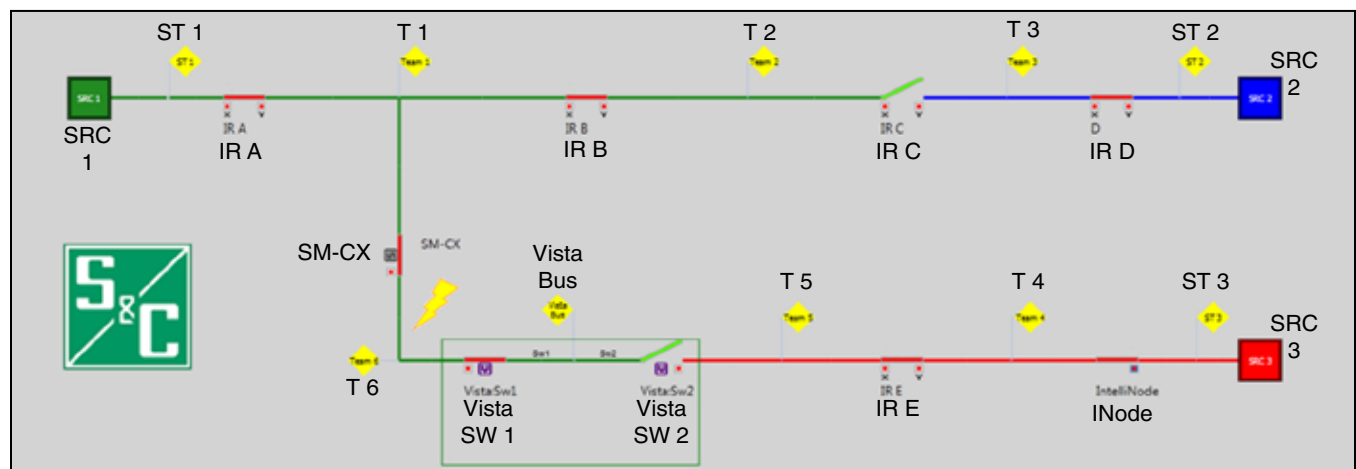

Figure 2. Fault in Team 6.

Rapid Self-Healing

An example of Rapid Self-Healing can be demonstrated by a fault in **Team 1**, as shown in Figure 3.

Again, IntelliRupter **IR A** is the first fault interrupting device between the fault and the source, so **IR A** opens to interrupt the fault. In this example the fault is permanent, so **IR A** proceeds through its test sequence and locks out. When lockout has occurred, IntelliTeam first completes isolation of the fault, and then begins the restoration process.

The coach travels through communications to each member of **Team 1** and analyzes fault information from each device. Since **IR B** and **SM-CX** did not see fault current pass through them, IntelliTeam opens those devices to complete the fault isolation because it has determined that fault is within **Team 1**.

R*apid Self-Healing* is enabled in this example, so runners travel through communications to each of the open points. They find sufficient capacity is available from **Source 2**, so **IR C** is closed to return service to **Team 2**. Sufficient restoration capacity is also found at **Source 3**, so **Vista:Sw2** is closed to return service to the **Vista Bus** and **Team 6**.

If sufficient capacity had not been available to pick up the segment consisting of **Team 6** and the **Vista Bus**, IntelliTeam would have reverted to *IntelliTeam II Mode* and opened **Vista:Sw1**. After **Vista:Sw1** had been opened, the **Vista Bus** coach would be responsible for determining if **Vista:Sw2** could be closed to restore the **Vista Bus**. When **Vista:Sw2** closes, the coach for **Team 6** attempts to determine if **Vista:Sw1** can be closed. The coach will continue to check for capacity to restore service, for the duration of the *Prohibit Restoration Time* configured for **Team 6**. If capacity becomes available before that timer expires, IntelliTeam will close **Vista:Sw1**. Otherwise, it will remain open until the system is returned to normal. See *Prohibit Restoration Time* on page 9 for more information about this feature.
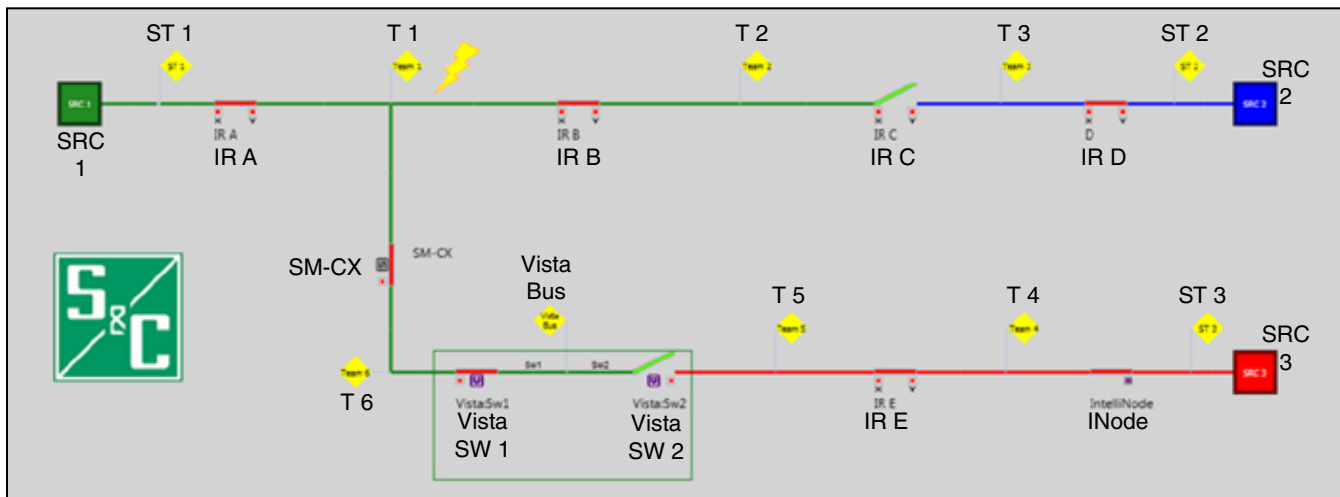

Figure 3. A fault in Team 1 is handled by Rapid Self-Healing.

Rules of Operation

IntelliTeam II Mode

IntelliTeam II operation consists of three basic parts: Sectionalizing, Restoration, and Return to Normal.

- **Sectionalizing** uses the sensors on each switch to identify loss of voltage, and whether fault current has passed through the switch—then determines when to open the switches. IntelliRupters, or reclosers and relays with an IntelliNode, will trip and reclose as determined by their protection settings. Both sectionalizing and protection are completed prior to restoration. Communication is not needed to sectionalize or interrupt a fault, unless configured for *IT-SG Only* has been selected for sectionalizing.

- **Restoration** uses information gathered by the IntelliTeam devices just prior to a system event, along with communication among IntelliTeam devices, to determine how best to restore the circuit. The faulted section is isolated, and not restored. Communication between IntelliTeam devices is essential for restoration.

- **Automatic Return to Normal** uses configured switch definitions to determine the normal system configuration, and returns to that configuration when the problem has been fixed. Again, communication is essential to complete the return to normal process. Automatic return to normal is optional, and can be disabled. **Manual Return to Normal** is required when the return to normal mode is configured for *None*. Manual intervention is required to put the system back into the normal state. This can be accomplished locally, or through SCADA.

Sectionalizing Rules

Switches with 6800 Automatic Switch Controls, when configured to, will sectionalize when any of the following occur:

- A switch sees a number of loss-of-voltage and fault-current events that exceed the configured counter setting.

- A switch sees a number of loss-of-voltage events that exceed the configured counter setting.

- A switch sees loss of voltage for a period longer than the loss-of-voltage timer setting.

- Switches use local control logic to open—they don't need to communicate, unless configured for *IT-SG Only*.

Reclosers and relays with an IntelliNode will still trip and reclose as determined by their protection settings.

- IntelliTeam will open the device if it sees a loss of voltage for a period longer than the loss-of-voltage timer setting.

- IntelliTeam will open the device if it determines the operation is needed to isolate a fault or if the coach needs to open the device to begin Sequential Restoration.

All IntelliTeam devices on a circuit beyond the faulted section open.

- They react to the events outlined above without communicating with each other. By opening all IntelliTeam devices, the restoration process can proceed in an orderly manner—allowing the restoration process to systematically check for any possible overload conditions.

Completion of the sectionalizing process triggers the restoration process.

- Sectionalizing should start quickly, but since IntelliTeam II works in conjunction with the reclosing settings of the substation breakers and mid-line reclosers, sectionalizing completion will be determined by the number of reclosing operations in use—and the time between reclosing operations.

- When all switches have been opened between the faulted section and the tie point, then the system starts looking for ways to accomplish its second mission—restoring service. Note that sectionalizing and restoration can occur simultaneously in different sections of the affected circuit. It depends on how different devices were configured for coordination with the breaker. All switches do not have to be open before beginning restoration. However, in this mode the tie can't close into a team with a closed switch.

Automatic Return to Normal

Following a reconfiguration event that involves a fault, and subsequent repair and restoration of the faulted line section, team members can automatically return to their normal state.

- When restoration occurred as a result of a loss-of-voltage at the preferred source substation, the team connected to that substation will sense when it has been reenergized for a configured period of time, and automatically return to its original switch configuration—if the *Return to Normal* feature is enabled.

- When restoration occurred as the result of a fault, *Return to Normal* is initiated by manually closing the first upstream switch of the faulted line section—either by a local command, or via SCADA. Teams downstream of the previously faulted team sense that the line segment has been re-energized for a configured period of time, and automatically return to the original switch configuration—if the *Return to Normal* feature is enabled.

- If at any time the affected teams are taken out of the READY state (by placing the Switch Control Enable/Disable switch in *Disable* for example), *Automatic Return to Normal* is cancelled and must be accomplished manually.

- When enabled, *Return to Normal* can be set for either Open or Close transition.

Manual Return to Normal

If Return to Normal has been set to *None*, switch controls must be manually reset to return the teams to their normal operation state. Switch controls must be checked to see that they have no errors, faults, or communication problems so they can enter the READY state. The following steps are necessary to manually return a system to its normal state:

1. Crews complete repair of the faulted line segment in accordance with utility safety and operation practices.

2. Every switch in the team bounding the faulted line segment must be set to its normal position. Switching may be performed locally, or by SCADA command if available.

3. Automatic Operation may have been disabled before or after the manual operation, but every switch that was manually operated to return its team to normal must have Automatic Operation *Enabled* after being switched.

4. If IntelliRupter PulseClosers, or reclosers or relays with IntelliNodes, are operated during this process, they will have a *Manual Override* alarm that requires clearing. This can be accomplished by SCADA or locally.

5. Work outward from the repaired line section to return each reconfigured team to its normal state.

Prohibit Automatic Restoration Locally

In case of an emergency, or for circuit situations where automatic restoration would be undesirable, Automatic Restoration can be *Disabled* with local control settings, or by a remote SCADA command. When automatic restoration is *Disabled* at any control, all teams that include that control will be taken out of READY. All other teams will continue to operate.

IntelliRupters

- The READY status of the team does not affect a pulse-close or other protective functions. The device will still trip and pulse test the line as before, regardless of whether the team is in READY mode or not.

- The team can be taken out of READY through WiFi by clicking on the *IntelliTeam SG Restoration* slide button found on the *Operation* screen and on the *IntelliTeam SG>Team Summary* screen. When *Disabled* has been selected and the Prohibit Restoration state entered, IntelliTeam cannot automatically operate the IntelliRupter.

- Hot Line Tag will also activate the Prohibit Restoration mode in that IntelliRupter.

- The status of the IntelliRupter Prohibit Restoration mode does not prevent Control Center operation of that IntelliRupter through the SCADA system.

6800 Series Controls

Any switch can be disabled by setting the Enable/Disable Automatic Operation indication on the front panel of its 6800 Control to the *Disabled* state, or placing the Enable/Prohibit Automatic Restoration indication on the front panel to the *Prohibited* state. In either case, the state is changed by pushing the change button for the state indication. See Figure 4.

Placing the control in the Automatic Operation *Disabled* state prevents any automatic control operation. When a control is *Disabled*, the line switch will not automatically Open or Close.

Placing the control in the Automatic Restoration *Prohibited* stated prevents IntelliTeam from automatically operating the control, but leaves Automatic Sectionalizing active, if configured.

- If a team is out of READY, but the line switch Automatic Operation is in the *Enabled* state, it will act like an overcurrent sectionalizer. The device can open in response to a downstream fault, but will never automatically close.

- Any switch can have remote operation blocked by setting the SCADA Control on the front panel of its control to the *Local* position. This does not prevent sectionalizing or restoration, but does prevent Control Center operation of the switch through the SCADA system.
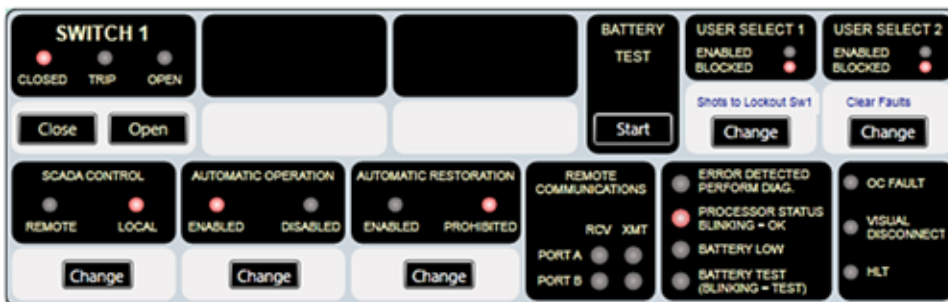

Figure 4. 6801 IntelliLink Operation screen controls.

IntelliNode Interface Modules

- The READY status of the team does not affect the recloser or relay protective functions. The device will still trip and reclose as before, regardless of whether the team is in READY mode or not. READY status is shown on the Team Summary screen, see Figure 5.

- The team can be taken out of READY at the IntelliNode faceplate by pressing the *Change* button next to the Prohibit Restoration status indicators. When the IntelliNode is in the Prohibit Restoration *Enabled* state, IntelliTeam cannot automatically operate the device. The team can also be taken out of READY by clicking on the IntelliTeam SG Restoration slide button to *Disabled*, found on the *IntelliTeam SG>Team Summary* screen.

- If the Hot Line Tag feature is configured (please confirm with your engineering department), placing a recloser in Hot Line Tag will also activate the Prohibit Restoration *Disabled* mode in the IntelliNode.

- The status of the IntelliNode Prohibit Restoration mode does not prevent Control Center operation of the recloser or relay through the SCADA system.

Prohibit Automatic Restoration Remotely

IntelliRupters

Automatic Restoration can be disabled remotely by your Control Center with the SCADA command *Prohibit Restoration*—which prevents the IntelliRupter, and any IntelliTeam devices in any team in which it participates, from automatically closing to restore load under any circumstances. The IntelliRupter can still trip and pulse test the line as determined by the *Testing After Initial Trip* settings in the active protection profile. The Prohibit Restoration command only prevents the IntelliTeam logic from being able to open or close the device.

To indicate that an IntelliRupter has been set to the Automatic Restoration *Prohibited* state:

- The IntelliTeam *Operation* screen will indicate *ALARM* in the *Status* field.

- The *READY Status* field on the *IntelliTeam SG>Team Summary* and *IntelliTeam SG>Team* screens will indicate *ALARM*. See Figure 6.

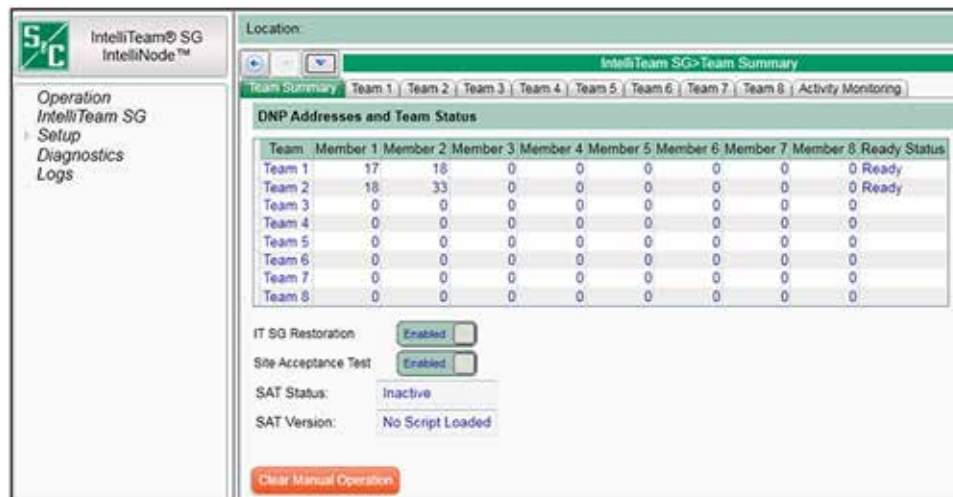- And, a DNP Status Point will be set.

Figure 5. 6801 IntelliNode IntelliTeam SG>Team Summary screen.

Figure 6. IntelliTeam SG>Team screen.

6800 Series Controls

Automatic Restoration can be disabled remotely by your Control Center with the SCADA command *Prohibit Automatic Restoration*—which prevents the local switch, and any IntelliTeam devices in any team in which its switch control participates, from automatically closing to restore load under any circumstances.

Automatic Operation including Restoration can be disabled remotely by your Control Center with the SCADA command *Disable Automatic Operation*—which prevents the local switch, and any IntelliTeam devices in any team in which its switch control participates, from automatically closing to restore load under any circumstances, and prevents the local sectionalizing function from opening the switch.

To indicate that a team has been set to the Automatic Restoration Prohibited state:

- The Team Operation screen will indicate *ALARM* in the *READY Status* field.

- The front panel LCD will indicate *ALARM* rather than *READY* for that team.

- And, a DNP Status Point will be set.

IntelliNode Interface Modules

Automatic Restoration can be disabled remotely by your Control Center with the SCADA command *Prohibit Restoration*—which prevents the IntelliNode, and any IntelliTeam devices in any team in which it participates, from automatically closing to restore load under any circumstances. The recloser or relay can still trip and reclose. The Prohibit Restoration command only prevents the IntelliTeam logic from being able to close the device.

To indicate that an IntelliNode has been set to the Automatic Restoration Prohibited state:

- The *Team Operation* screen will indicate *ALARM* in the *READY Status* field.

- The front panel LCD will indicate *ALARM* rather than *READY* for that team.

- And, a DNP Status Point will be set.

Prohibit Automatic Restoration —Automatic Functions

Team Not Ready

A team will automatically go *Out of READY*—and display the *ALARM* state—if any of the following occur:

- IntelliTeam communication is not available.

- The system detects a problem at one of the team devices, such as a bad battery or a visual disconnect open.

- A device has been manually operated, or disabled.

- A relay or recloser with an IntelliNode has been placed in Supervisory Off (or Local) or Hot Line Tag.

- The switch state does not match the normal switch position after a new FeederNet has been pushed to the device.

IntelliTeam SG depends on reliable communication. When the system was installed at your utility, S&C and/or your company performed a site survey to ensure proper communication between switches, and back to the master station, or gateway radio.

But communication might break down for a number of reasons. Over time, trees grow and impede radio signals. New buildings can block signals. Severe weather may shut down an already-weak signal to a device. Sometimes a radio can malfunction, or its battery goes dead.

If a radio is being used as a repeater link and it malfunctions, or its signal is blocked, communication to a number of devices may break down. The symptom may be a large number of out-of-scan, or similar alarms on SCADA.

If communication between switches breaks down for some reason, the affected team(s) will take themselves out of READY, preventing automatic switch closing. It's better to be safe when not sure of the status of all system components. Automatic restoration will be prevented, but the switches can still be operated locally, and they can still open automatically, by using local control logic, unless the *IT-SG Only* setting was configured. Switches taken out of READY because of a non-communicating Team member can still be operated remotely if their communications are not affected.

If the link from the IntelliTeam SG system to your master station breaks down, it's possible that automatic system operation will not be affected. Your SCADA screen might indicate an out-of-scan condition, but as long as the team members can communicate to one another, and there are no other conditions to create an alarm, IntelliTeam will remain operational.

Prohibit Restoration Time

Each Team has a *Prohibit Restoration Timer* setpoint. The Team can continue to look for restoration capacity for this time interval, after the initial attempt was rejected due to insufficient capacity. This is typically a time period shorter than the time it takes a crew to get to the site. Setting the *Prohibit Restoration Timer* setpoint to *Disabled* allows an unlimited number of subsequent attempts to restore the team.

Manual Operation

When an IntelliTeam device is operated manually, a *Manual Operation* alarm is set, and the teams this device belongs to are taken out of READY. A manual operation can be executed through the faceplate, IntelliLink, or SCADA. Once set, the *Manual Operation* alarm must be cleared after the device has been returned to its normal position, by either a local or SCADA *Clear Manual Operation* command. If *Auto-Clear Manual Op* has been configured for yes, the device is in its normal switch position, and no other error conditions exist, the manual operation will automatically clear after the *Time to Clear Manual Op* timer has expired.

Troubleshooting

This section provides guidance about what to look for when IntelliTeam SG does not seem to be working as expected. Understand that unique situations do occur on power systems, and another utility's practices could be different. Your utility practices and procedures supersede any suggested action in this section.

We ask that you report any new "situations" to your local S&C Sales Office, or call S&C Electric Company Automation & Communication Service Support at (855) 381-8800, or send an e-mail to **AutomationServices@sandc.com**.

Team Not in READY with Bad Communication

When a team member has lost communication its team will go out of READY. Only teams having members with lost communications are affected. Communication may become intermittent due to environmental conditions, such as an increase in vegetation combined with bad weather. Intermittent loss of communication can result in a team temporarily going out of READY. If communication returns, IntelliTeam will automatically return to the READY state.

If communication loss is permanent, IntelliTeam will remain disabled, and out of READY, until the problem is corrected. Other teams with good communication will remain operational.

Team Not in READY with Good Communication

All switches are in the proper position, and devices are communicating properly.

1. Check to be sure all switch controls have Automatic Operation *Enabled*.

2. Make sure all IntelliNodes have Automatic Restoration *Enabled* (Prohibit Restoration is *Disabled*).

3. Check that there are no device alarms. The team won't go into READY if a switch control has detected an operational problem such as a bad battery, a switch-position indication error, or a product-specific indication such as an open visible disconnect on a Scada-Mate® Switch, or low gas pressure on a unit of Vista® Underground Distribution Switchgear.

4. Make sure none of the devices have been operated manually, if so there will be a *Manual Operation* alarm indication. To clear this alarm remotely on an IntelliRupter, 6800 Control, or IntelliNode, send the *Clear Manual Operation* command. The alarm can also be cleared locally on an IntelliRupter, 6800 Control, or IntelliNode with the *Clear Manual Operation* button on the *IntelliTeam SG>Team Summary* screen. See Figure 5 on page 7. Additionally, 6800 Controls can also be cleared from the front panel with an LCD command (see S&C Instruction Sheet 1045-540 *Operation*), or you can clear a Manual Operation with a configured *User Select* button (see S&C Instruction Sheet 1045-530 *Setup*). If the *Auto-Clear Manual Op* set point has been set to *Yes* then the Manual Operation will automatically clear after the *Time to Clear Manual Op* timer has expired.

No Automatic Close

Devices are communicating properly, but a device did not automatically close to restore when it should have.

• If an IntelliTeam device is not in READY, it will not close automatically.

• If the team is in READY, the restoration process may have exceeded the configured load limits. The logs will contain an entry that indicates insufficient capacity was the cause of the denied transfer. You may need to confirm that loading limits set for the devices are appropriate.

Phase Loss Isolation

Another optional feature of IntelliTeam SG is Phase Loss Isolation (PLI). When Phase Loss Isolation is *Enabled*, IntelliTeam uses voltage information collected from each team member to locate and isolate an open phase.

Phase Loss Isolation Example

Figure 7 shows a broken conductor between the **Team 1** source **IR A** and pole 3 of **SM-CX**. When Phase Loss Isolation 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 IntelliTeam about the phase loss condition.

IntelliTeam then checks that 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, then IntelliTeam first opens IR A to de-energize the broken conductor. Then IntelliTeam 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 if **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 if **Vista:Sw2** has sufficient capacity to restore the unaffected segments of **Team 6** and **Vista Bus**.

If capacity exists, **IR C** will close to restore service to **Team 2**, if not it will remain open. Similarly if capacity exists **Vista:Sw2** will close, but in this case if capacity does not exist the **Vista Bus** coach will open **Vista:Sw1** and check with **Team 5** to see if it has capacity to restore **Vista Bus**. If capacity is available **Vista:Sw2** will close, otherwise it remains open.
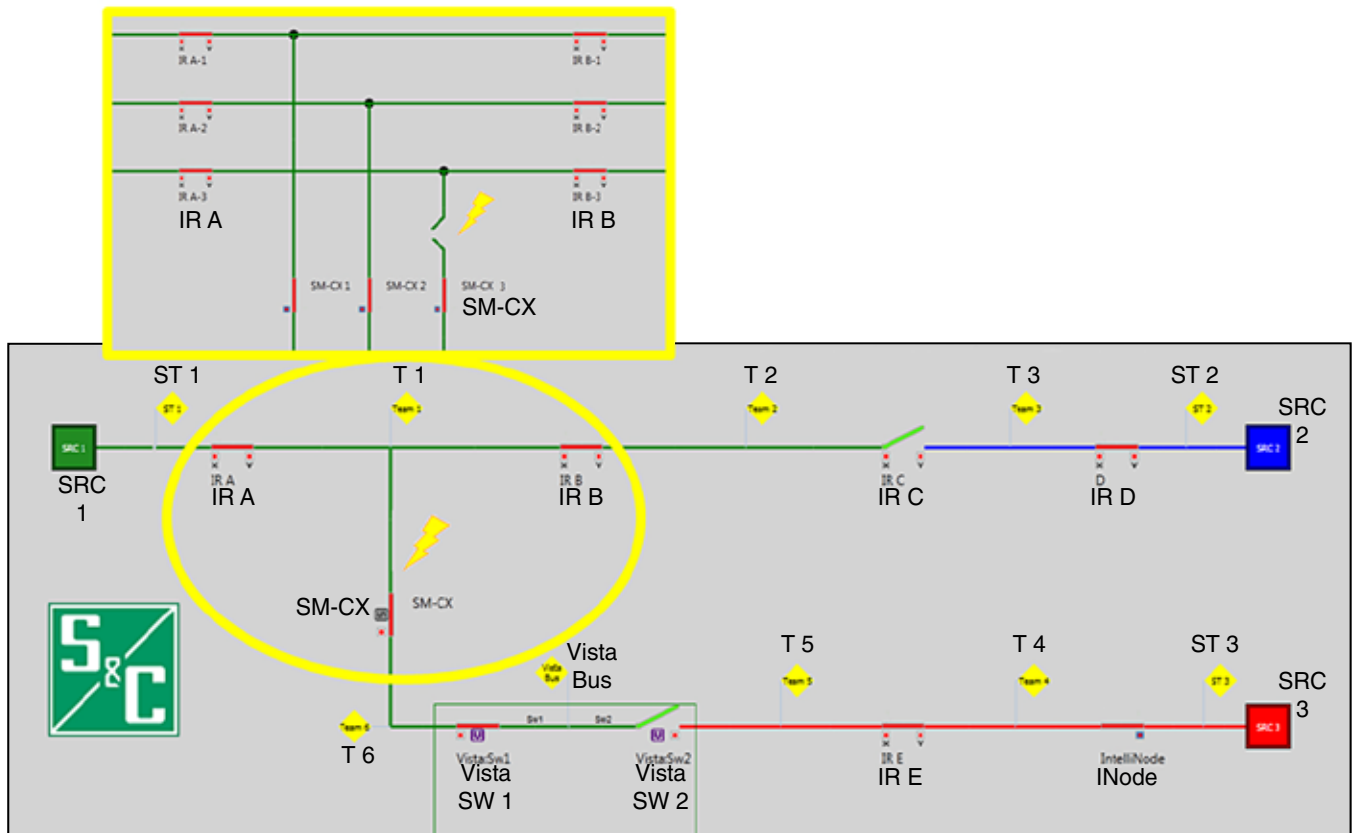

Figure 7. Phase Loss Isolation example: loss of phase at SM-CX.