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IMAGINE you have a time machine and you brought Alexander Graham Bell and Thomas Edison into the year 2019. If you showed Mr. Bell your smart phone, he wouldn’t understand what he was looking at. But if you took Mr. Edison outside and showed him an electrical distribution system, he would have a pretty good idea what he was seeing. That, however, is quickly changing.

In the past decade, we have seen a tremendous shift in the way the electric grid works, how it operates, and how consumers use electricity.

Reliability of power has seen an increased focus as our day-to-day lives rely on electricity being available at all times. The costs of outages have been estimated at more than $150 billion a year in the United States alone.

Major weather events are increasing in frequency and severity, requiring new ways to harden our electric grid and new methods to restore service as quickly and safely as possible.

More than 1.8 GW of operational battery energy storage is tied to the grid today. Use of stored energy is playing an important role as utilities and others build microgrids backed by distributed generation to improve power reliability.

Indeed, distributed generation and microgrids are creating unique challenges for protecting and controlling the power grid as loads and generation sources fall outside of traditional operations.

It’s difficult to keep ahead of the curve and address these changes.

S&C IS HERE TO HELP. We are applying our century-long heritage of innovation to address the challenges facing today’s power grid. Our distribution automation systems are pushing the boundaries of reliability and reducing the duration of outages from hours to seconds—or to no outage at all.

Our solutions are designed to withstand the impacts of time and nature to help keep the lights on for your customers. We understand the important role energy storage plays on the grid, having in excess of 49 projects totaling more than 189 MWh installed around the world. Our award-winning microgrids are providing breakthroughs in how distributed generation resources, including energy storage, are managed by customers and the utility.

To help you solve the challenges of today and tomorrow’s grid, our solutions are backed by our S&C experts. These are the men and women with the skills and know-how to help you plan and execute the solutions you need—from concept through completion.

We have designed this catalog to help you, too. It is designed to help you quickly reference the wide range of solutions S&C offers in our specialty of electric power switching, protection, and control. Keep this catalog as a reference when you are researching the solutions you need.

Should you need more detail than is provided here, please visit sandc.com, or contact your local S&C sales representative.
The IntelliRupter® fault interrupter is a breakthrough in overhead and underground distribution system protection. It features revolutionary PulseClosing® Technology—a unique means for verifying the line is clear of faults before initiating a closing operation. PulseClosing Technology is superior to conventional reclosing. It greatly reduces stress on system components as well as voltage sags experienced by customers upstream of the fault.

PulseClosing Technology drastically reduces overcurrent stress on your system, as shown here for a phase-wire to grounded-neutral fault.

**HANDLE ALL YOUR APPLICATION NEEDS**

The IntelliRupter fault interrupter offers outstanding protection for systems through 38 kV. It features a generous continuous-current capability of up to 800 amperes and a fault-interrupting rating of up to 16,000 amperes symmetrical. Models are available with or without an integrated, interlocked disconnect for visible air-gap isolation. All switching is performed internally for reliable all-weather operation.

In standalone fault-interrupting applications, PulseClosing Technology enhances power quality by minimizing momentary interruptions. For example, on a radial circuit, the IntelliRupter fault interrupter can be configured so that after one IntelliRupter fault interrupter opens to isolate a fault, those downstream of it open on loss of power and send SCADA exception reports indicating the status and reason for opening. When power returns, each IntelliRupter fault interrupter uses PulseClosing Technology to verify its line segment is unfaulted and then recloses to restore service. It will never close into a fault. Cold-load inrush is mitigated because only one line segment is energized with each closing. No communication system is required to take advantage of inrush mitigation.

**FULLY COMPATIBLE WITH S&C’S INTELLITEAM® SG AUTOMATIC RESTORATION SYSTEM**

The IntelliRupter fault interrupter can be readily integrated into an S&C IntelliTeam® SG Automatic Restoration System (see page 34). After an IntelliRupter fault interrupter has isolated a fault, the IntelliTeam SG system makes full use of multiple sources to restore unfaulted line segments. The IntelliTeam SG system minimizes the number of customers experiencing an extended power interruption, tremendously improving your System Average Interruption Duration Index. The IntelliTeam SG system can handle multiple contingencies, too.


**EASY UP—EASY ON**

IntelliRupter fault interrupters are totally self-contained. All major components—including current and voltage sensors and the control group, surge arresters, control power, and disconnect, if furnished—go up in one easy lift. The embedded high-accuracy sensors eliminate the cost, clutter, and complexity of separately mounted sensors. There’s no control enclosure or control cable to install, either.
38-kV Disconnect Style IntelliRupter PulseCloser Fault Interrupter in Upright-Crossarm Mounting Configuration

Optional factory-installed and wired surge arresters

Integrated voltage sensors on both sides of IntelliRupter fault interrupters — provide ±0.5% sensing accuracy across the entire operating temperature range; integrated current sensors provide unparalleled accuracy with +/-0.5% for metering and critical-system analysis and 2.0% for fault-current levels

Integrated pole-mounting bracket — easy installation; prevents tilting

Integral power module — fed from one side of an IntelliRupter fault interrupter or, optionally, two integral power modules can be fed from a different phase on each side

Integrated disconnect with optional wildlife protection — provides visible air-gap isolation for dead-line work and facilitates operational testing; mechanically interlocked with interrupters

---

**INTELLIRUPTER FAULT INTERRUPTER**

**60-Hz Ratings — 50-Hz Ratings in Parentheses**

<table>
<thead>
<tr>
<th>kV</th>
<th>Min</th>
<th>Max</th>
<th>BIL</th>
<th>Cont.</th>
<th>Amperes, RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>7</td>
<td>15.9</td>
<td>110</td>
<td>630</td>
<td>16 000</td>
</tr>
<tr>
<td>(9)</td>
<td></td>
<td>(15.5)</td>
<td>(110)</td>
<td>(630)</td>
<td>(16 000)</td>
</tr>
<tr>
<td>18.7</td>
<td>18</td>
<td>27.4</td>
<td>125</td>
<td>630</td>
<td>12 500</td>
</tr>
<tr>
<td>(18)</td>
<td></td>
<td>(26)</td>
<td>(125)</td>
<td>(630)</td>
<td>(12 500)</td>
</tr>
<tr>
<td>23.8</td>
<td>23</td>
<td>38</td>
<td>170</td>
<td>630</td>
<td>12 500</td>
</tr>
<tr>
<td>(23)</td>
<td></td>
<td>(38)</td>
<td>(170)</td>
<td>(630)</td>
<td>(12 500)</td>
</tr>
</tbody>
</table>

(1) 800 amperes with a minimum wind velocity of 2 feet (610 mm) per second.

---

**INTEGRATED DISCONNECT STYLE**

**INTELLIRUPTER PULSECLOSER FAULT INTERRUPTER IN UPRIGHT-CROSSARM MOUNTING CONFIGURATION**

**INTEGRATED DISCONNECT WITH OPTIONAL WILDLIFE PROTECTION**

**INTEGRATED POLE-MOUNTING BRACKET**

**INTEGRATED VOLTAGE SENSORS**

**INTEGRATED CURRENT SENSORS**

**INTEGRATED POLE-MOUNTING BRACKET**

**INTEGRATED DISCONNECT WITH OPTIONAL WILDLIFE PROTECTION**

---

For more information on IntelliRupter PulseCloser Fault Interrupters, see publications 766-30, 766-31, and 766A-31 at sandc.com.
A NEW CONCEPT IN CONTROLS

The IntelliRupter fault interrupter is available with several types of control groups. Each offers easy configuration and operation—plus examination of waveforms and events—using secure wireless communication to a nearby laptop computer.

Each control group includes a base-mounted, hookstick-removable protection and control module and communication module. This flexible, low-maintenance arrangement offers excellent immunity to surges and noise induced by normal power line events, such as faults and lightning strikes, and minimizes pole clutter. The IntelliRupter fault interrupter is powered from the distribution line through the integral power module(s) or by an external power supply, if furnished.

The protection and control module provides point-on-wave closing to minimize asymmetric fault current and inrush current. It features a complete set of protection and control functions, including:

- Simultaneous independent directional phase, ground, negative-sequence, sensitive-earth, time-overcurrent, instantaneous-overcurrent, and definite-time elements
- Directional blocking of overcurrent elements
- Over/under voltage elements
- Over/under frequency elements
- Phase-unbalance detection
- Synchronization check
- Cold-load pickup modifier

Comprehensive diagnostics are included, too. A sophisticated 20-channel Global Positioning System chip set provides 1-ms accurate time stamping of events to speed post-event analysis, plus IntelliRupter fault interrupter location data for your graphical information system.

The Standard Control Group is ideal for:

- IntelliTeam SG Automatic Restoration System applications
- Automatic source transfer using two IntelliRupter fault interrupters
- Automatic loop restoration using normally closed IntelliRupter fault interrupters or conventional reclosers, with a normally open IntelliRupter fault interrupter switching point
- Intelligent fuse-saving applications
- Wide-area SCADA
- Stand-alone (non-communicating) applications

27-kV Compact Style for substation application.

15.5-kV Pad-Mounted Style IntelliRupter fault interrupter for application in an underground segment of a feeder.
The IntelliRupter fault interrupter control group is configured and operated using a secure Wi-Fi communication link.

For IntelliTeam SG system, automatic source-transfer, or SCADA applications, an S&C SpeedNet™ Radio or other approved communication device must be furnished. Such devices permit configuration, operation, interrogation, and software maintenance of IntelliRupter fault interrupters from any location having access to the communication system using optional IntelliLink® Setup Software.

The IntelliRupter fault interrupter is also available with a Standard Control Group with Battery Backup, which supports operation for hours after loss of ac line voltage on both sides of IntelliRupter fault interrupters, thus permitting extended dead-line switching. The Universal Control Group also includes a battery and is suitable for basic closed-loop applications, IntelliTeam® II Automatic Restoration System applications, and applications on systems with three or more sources.

EASY OPERATION
The control group is easy to configure before installation. If desired, S&C can determine the appropriate settings for the control group and/or perform secondary injection testing to verify the settings, functions, and logic (see Analysis & Design on page 42).

And the control group is just as easy to configure after installation from the security of your vehicle parked up to 150 feet away. Just establish the secure Wi-Fi connection using your personal computer, and you’re ready to go.

The Wi-Fi transceiver in the communication module provides encrypted wireless point-to-point communication to your personal computer operating under the IEEE 802.11b standard. Extensive security features prevent unauthorized access. You can open and close IntelliRupter fault interrupters, set hot-line tags, and change protection profiles using the simple operation screens when your access permission allows operation.

Detailed logs, oscillography data, and other operational information can be readily accessed and transferred over the wireless link, as can software upgrades. If a wide-area network radio has been furnished—and it supports configuration through its serial port—it can be configured through the wireless link as well.

When an IntelliRupter fault interrupter is set for remote operation, your dispatcher can test its electrical operation as well as the entire SCADA control path, including communication.

If a personal computer isn’t available, IntelliRupter fault interrupters can be opened and closed and hot-line tags set using a hookstick from the ground or a bucket truck.

Should module replacement ever become necessary, it’s easily performed, too. No need to reconfigure IntelliRupter fault interrupters—a memory module in the base remembers all the settings.

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The IntelliRupter fault interrupter control group is configured and operated using a secure Wi-Fi communication link.
LATERAL PROTECTION
PREVIOUSLY REQUIRED CONCESSIONS
More than 90% of temporary faults on overhead distribution circuits occur on laterals. Over the years, utilities have dealt with lateral protection a couple of ways.

Some use a “fuse-blowing” philosophy: The lateral fuse clears any downstream fault within its rating. But this means service to customers on the lateral is permanently interrupted—even for a temporary fault. And the utility must deal with the high cost of service calls to replace lateral fuses.

Other utilities use a “fuse-saving” philosophy: The first trip of the substation feeder breaker is intentionally set so the breaker operates faster than the lateral fuse. But all customers on the feeder experience a momentary interruption for all faults.

A BETTER SOLUTION FOR OVERHEAD LATERAL PROTECTION
S&C’s TripSaver® II Cutout-Mounted Recloser, offered in system class voltage ratings of 15 kV and 25 kV, is ideally suited for lateral circuits that frequently experience temporary faults.

TripSaver II reclosers eliminate the permanent outages that can result when lateral fuses operate in response to these temporary faults. They also eliminate the momentary interruptions on feeders in instances where the substation breaker is tripped to save the lateral fuse during a temporary fault. Therefore, this device significantly reduces unnecessary truck rolls and feeder blinks to keep operating costs down and electricity users happy. This self-powered, electronically controlled, single-phase vacuum fault interrupter is available for installation in new or existing-production (“R10” or “R11”) S&C-provided Type XS Fuse Cutout Mountings.

The TripSaver II recloser can provide up to four tripping operations, with a wide variety of available time–current characteristic curves. The duration of the open interval between tripping operations is user-configurable. It has a range of 0.5 seconds to 5 seconds. An option with an extended open interval of up to 30 seconds is also available. The vacuum interrupter resets two seconds after a TripSaver II recloser drops open. The operator can then reclose a TripSaver II device into the mounting.

Using a personal computer, you can configure TripSaver II operating parameters, check functionality, and view historical data. The TripSaver II recloser now includes remote communication options that provide unsolicited alerts, GPS time and coordinates, device heartbeat, and remote mode-change capability.

OVERHEAD POLE-TOP STYLE TRIPSAYER II RECLOSER

<table>
<thead>
<tr>
<th>50/60-Hz Ratings</th>
<th>Leakage Distance to Ground, Minimum, Inches (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>kv</td>
<td>Amperes, RMS</td>
</tr>
<tr>
<td>System Class</td>
<td>Nom.</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>

■ Applicable for protection of single-phase-to-neutral circuits only in solidly grounded-neutral (multigrounded-neutral) 34.5-kV systems where leakage distance to ground meets the user’s requirement. Uses 25-kV 150-kV BIL mounting.
For more information on the TripSaver II Cutout-Mounted Recloser, see publications 461-32 and 461-33 at sandc.com.
Every utility can relate to sending crews out to replace blown fuses above overhead distribution transformers without being able to find the cause of the fault. In fact, industry sources reveal that 70% of overhead distribution transformer fuse operations are classified as nuisance outages, where no other repair work is needed.

‘EVEN AT THE EDGE OF THE GRID’
The VacuFuse Self-Resetting Interrupter solves both these unnecessary sustained outages and subsequent maintenance expenses, bringing fault-testing technology closer to the edge of the grid than had previously been possible.

This depth of lateral protection not only optimizes system performance but crews’ time as well by eliminating the opportunity cost from sending teams to work on unnecessary or nuisance repairs. Instead, crews can focus on the proactive, grid-modernization projects that advance system performance and ready it for the future.

HOW IT WORKS
VacuFuse Self-Resetting Interrupters solve the nuisance outages that occur on overhead distribution transformers. As a single-phase self-resetting interrupter intended for use on 5-kV, 15-kV or 25-kV distribution systems, it replaces fuses in these locations. When the self-resetting interrupter detects a fault, its vacuum interrupter will open to interrupt the fault current.

If the fault is temporary, the self-resetting interrupter will restore power. This saves temporary faults from becoming permanent outages—and the maintenance costs otherwise associated with refusing and restoration.

If the fault is permanent, the self-resetting interrupter will interrupt the fault current wait a user-designated number of seconds, reclose, and then interrupt the fault current and deenergize the transformer. (Unlike TripSaver® II Cutout-Mounted Reclosers, VacuFuse Self-Resetting Interrupters do not drop open on permanent outages and will remain in the cutout mounting.) After the fault has been cleared by the line crew, the self-resetting interrupter can be closed using the manual operating lever on the side of the self-resetting interrupter.

This self-resetting interrupter comes factory-configured with a user-designated time-current characteristic (TCC) curve. With the ability to be placed in several manufacturers’ approved cutouts, a VacuFuse Self-Resetting Interrupter can easily be placed above 5-kV overhead distribution transformers up to 25 kVA, 15-kV transformers up to 75 kVA, and 25-kV transformers up to 150 kVA when mounted in a 125- or 150-kV BIL cutout mounting.
VacuFuse Self-Resetting Interrupters come ready to install, streamlining the commissioning process and lessening the amount of training for line crews. Utilities can choose from any of the following fuse-link TCC curves: K, KS, T. Only one curve can be chosen per device, and the settings are permanently configured at the factory.

**VacuFuse Self-Resetting Interrupters are designed to work with S&C Type XS Fuse Cutout mountings, or they can be retrofitted in other approved mountings.**

<table>
<thead>
<tr>
<th>VACUFUSE SELF-RESETTING INTERRUPTER</th>
<th>Available Fuse Link Curves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>K Speed Curves</td>
</tr>
<tr>
<td>1K, 2K, 3K, 5K, 6K, 8K, 10K</td>
<td>1KS, 2KS, 3KS, 5K, S6KS, 7KS, 10KS</td>
</tr>
</tbody>
</table>

**50/60-Hz Ratings**

<table>
<thead>
<tr>
<th>kV</th>
<th>Amperes, RMS</th>
<th>With Porcelain Insulator</th>
<th>With Polymer Insulator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nom.</td>
<td>Max</td>
<td>BIL</td>
<td>Cont.</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>29</td>
<td>125</td>
</tr>
</tbody>
</table>

① Applicable on 5-kV, 15-kV, and 25-kV systems when mounted in an S&C 125- or 150-kV BIL cutout mounting.

② For S&C Type XS Fuse Cutout mountings.

For more information on the VacuFuse™ Self-Resetting Interrupter, see S&C publications 465-30 and 465-31, available on our website sandc.com.
**Birdproof-design insulator**—Composite-polymer silicone or porcelain materials avoid wildlife issues.

**Cypoxy™ Insulator**—The Cypoxy Insulator houses the vacuum interrupter.

**Vacuum interrupter**—Located in the upper Cypoxy Insulator, it quietly contains and interrupts the fault without exhaust or sparking.

**Hand grip**—This sturdy grip allows for easy handling and installation.

**OPEN/CLOSE lever**—This lever allows for manual opening and closing of the vacuum interrupter and is accompanied by directional open/close markers. **Note**: Because the VacuFuse Self-Resetting Interrupter will automatically trip if the operator closes into a fault, the lever only indicates the last manual operation, not the Open or Closed state of the vacuum interrupter.
**Construction—Bottom View**

- **MODE-SELECTOR lever**—This allows the VacuFuse Self-Resetting Interrupter to be placed in automatic **Reclosing** or **Non-Reclosing** mode. **Non-Reclosing** mode will trip on an instantaneous curve.

- **Tag-clip feature**—This provides a convenient location for crews to tag the VacuFuse Self-Resetting Interrupter, visually communicating intentional nonstandard conditions and zoned work areas. Tags can also be easily applied to the OPEN/CLOSE lever and the pull-ring.

- **Position indicator**—This indicates the position of vacuum interrupter, with the red flag signaling closed and the green flag signaling open. **Note:** Refer only to the POSITION indicator, not the OPEN/CLOSE lever, for vacuum interrupter status.

- **Non-Reclosing indicator**—When powered, this amber LED will flash in 2-second intervals when the self-resetting interrupter is in **Non-Reclosing** mode. It will turn off when in **Normal mode**.

- **System-healthy indicator**—When powered, this white LED will flash in 30-second intervals to indicate the self-resetting interrupter’s healthy state. It will turn off when in **Non-Reclosing** mode and when de-energized.
SCADA-MATE® SWITCHING SYSTEM

S&C’s Scada-Mate Switching System is ideal for automating overhead distribution feeders. All necessary functions—sensing, control, and communications—are provided in one economical, self-contained package. The performance capabilities, operating features, and integration of functions provided by the Scada-Mate Switching System make remote supervisory control of distribution feeders a practical, economical reality.

FEATURING THE SCADA-MATE SWITCH
Scada-Mate Switching Systems are integer-style three-pole, group-operated load interrupter switches available in voltage ratings of 14.4-kV through 34.5-kV. They’re factory-assembled on a one-piece base and include an integral stored-energy operating mechanism.

Circuit making and breaking are accomplished within sealed interrupters in a controlled SF6 environment. The high-speed linkages used to effect operation are housed within the base. With no external moving parts, full live-switching performance is ensured under any and all ice conditions.

Visible air-gap isolation of switched-open circuits—needed only when work on the feeder is required—is provided by an integral, hookstick-operated three-pole disconnect.

Scada-Mate Switching Systems feature a five-time duty-cycle fault-closing rating of 20,000 amperes, RMS, asymmetrical. The ability to close into a fault and remain capable of carrying and interrupting current is a must for any distribution-automation switching device.

Two S&C current sensors and one S&C current/voltage sensor provide three-phase monitoring of line current and single-phase monitoring of system voltage. The voltage sensor(s) also provides 20-VA continuous battery-charging power for the control, eliminating the need for a separate distribution transformer. All sensors are of S&C Cypoxy™ Insulator construction and serve as support insulators for the switch live parts—eliminating the cost, clutter, and complexity associated with separately mounted sensors.

CONTROLS TO MATCH YOUR AUTOMATION OBJECTIVES
A complete S&C Scada-Mate Switching System includes a Scada-Mate Switch and a control. S&C offers a variety of controls to match your automation objectives:

- The 6801 Automatic Switch Control provides remote reporting of switch status points, current, voltage, watts, and vars via the DNP 2 Level 3 protocol, and it supports S&C’s IntelliTeam® SG Automatic Restoration System.

After the Scada-Mate Switch has isolated a fault, the IntelliTeam SG system makes full use of multiple sources to restore unfaught line segments. The IntelliTeam SG system minimizes the number of customers experiencing an extended power outage, and it handles multiple contingencies, too.

- The control includes a high-output battery charger with a unique battery-management system, as well as rechargeable sealed-lead starved-electrolyte battery packs, powered from a user-supplied 120-Vac control source or three voltage sensors. The control additionally features a liquid-crystal display for viewing real-time data, settings, and fault events. It offers automatic sectionalizing and overcurrent fault-detection capabilities and selectable shots-to-lockout settings. All components of each device are neatly packaged in a single corrosion-resistant enclosure, simplifying installation and minimizing checkout time.

- The Communication and Control Unit is a custom-engineered package that includes a user-specified, factory-installed and -wired remote terminal unit and communication device; a temperature-compensated, constant-voltage battery charger with rechargeable sealed-lead starved-electrolyte battery packs; and a switch control with OPEN/CLOSE pushbuttons, switch-position indicating lamps, a disconnect Closed-and-Latched indicating lamp, a LOCAL/REMOTE switch, and an operation counter. All components are neatly packaged in a single 316L stainless steel enclosure, simplifying installation and minimizing checkout time.

The charger is powered by an S&C Voltage Sensor or, in a higher-output version with a unique battery-management system, from a user-supplied 120-Vac control source. The charger features integral load-disconnect circuitry to prevent deep discharge of the batteries on loss of the ac source, plus alarms for loss of the ac source, battery low voltage, and charger overvoltage. It also includes circuitry to effect a battery load-test feature when used in conjunction with a suitable remote terminal unit (RTU).
Scada-Mate Switch in the Upright Mounting Configuration

Sealed SF₆ interrupters—circuit making and circuit breaking are accomplished internally with no exposed moving parts.

Enclosed one-piece base—houses drive linkages for interrupters.

Two S&C Current Sensors and one S&C Current/Voltage Sensor—provide three-phase monitoring of line current and single-phase monitoring of system voltage (Three-phase voltage sensing (shown) is optionally available. Voltage sensors can be provided on both sides of the switch for designated normally open points on the system.)

Interupter OPEN/CLOSED indicator.

Disconnect operating lever—for hookstick opening and closing of integral disconnect; the disconnect may be locked or tagged in the Open position.

Integral stored-energy operating mechanism—with manual opening and closing capabilities.

Dead-ending provisions—allow convenient attachment of conductors.

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### SCADA-MATE SWITCHES

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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>14.4 (10) ♦</td>
<td>17.0 (15)</td>
<td>110 (110)</td>
<td>600 (630)</td>
<td>25 000 (25 000)</td>
<td>20 000 (20 000)</td>
</tr>
<tr>
<td>25 (20) ♦</td>
<td>29 (24)</td>
<td>150 (150)</td>
<td>600 (630)</td>
<td>25 000 (25 000)</td>
<td>20 000 (20 000)</td>
</tr>
<tr>
<td>34.5 (30) ♦</td>
<td>38 (36)</td>
<td>200 (200)</td>
<td>600 (630)</td>
<td>25 000 (25 000)</td>
<td>20 000 (20 000)</td>
</tr>
</tbody>
</table>

1. System-voltage restrictions apply when the control is powered by S&C Current/Voltage Sensors.
2. Up to 900 amperes continuous in ambient temperatures to 40°C (104°F) with a minimum wind velocity of 2 feet (0.6 m) per second.
3. Minimum voltage rating.

A variety of options are available—wildlife protection, extension-link assemblies, and others.

For more information on the Scada-Mate Switching System, see publications 768-30, 768-31, and 768-93 at sandc.com.
SCADA-MATE® SWITCHING SYSTEM

6801 Automatic Switch Control ...
... with swing-out panel open

- **Rechargeable, sealed-lead starved-electrolyte battery pack**
- **User-specified communication device**
- **High-output battery charger**—uses unique battery-management circuitry to provide a continuous float charge to the battery pack

For more information on the Scada-Mate CX Switching System, see S&C publications 768-34, 768-711, and 768-712, available on our website sandc.com.
Automation needs change and grow with increased load, capacity, and demand for more reliable service. Scada-Mate CX Switches economically meet these changing needs. These three-pole, group-operated interrupter switches are specifically designed for automating overhead distribution systems, either today or in the future. They feature a five-time duty-cycle fault-closing rating of 20,000 amperes, RMS, asymmetrical, plus full live-switching performance under any and all ice conditions. Circuit making and circuit breaking are accomplished internally, within sealed interrupters, in a controlled sulfur hexafluoride (SF₆) environment.

Scada-Mate CX Switches are factory-assembled on a one-piece base and include an integral stored-energy operating mechanism. Besides electrically operating the interrupters, the operating mechanism provides nonelectrical mechanical opening and closing of the interrupters by means of a manual-operation pull-ring. The switch can be locked open to prevent electrical or manual closing.

Scada-Mate CX Switches are also available in a manually operated version. On these switches, the stored-energy operating mechanism is replaced by a factory-adjusted, spring-wound hookstick operating mechanism.

**Sealed interrupters, fully enclosed base.** Scada-Mate CX Switches feature the same hermetically sealed, low-gas-volume interrupters, OPEN/CLOSE indicator, and operating mechanism as Scada-Mate® Switching Systems. They’re ideal for installation in areas prone to icing, polluted and coastal environments, and remote locales.

**Compact.** Scada-Mate CX Switches are 40% smaller than Scada-Mate Switching Systems, and they can be furnished without the disconnect to save additional space.

**Upgradable.** With Scada-Mate CX Switches, you can purchase the features you need today . . . and easily upgrade tomorrow. Switches can be furnished with factory-installed S&C Current Sensors or S&C Current/Voltage Sensors. Or, alternately, S&C sensors or sensors of other manufacture can be added later. And an S&C control unit or a control of other manufacture can be added at any time.

Hookstick-operated switches can be upgraded, too, with a motor operator. It permits remote operation in sectionalizing applications that don’t require sensing and intelligent controls.

**Visible-break disconnect.** If your system practices require a visible-break disconnect, Scada-Mate CX Switches can be furnished with an integral disconnect comprised of three single-phase, hookstick-operated blades, based on S&C’s proven Loadbuster Disconnect® Switch design (see page 80). The disconnect is interlocked to prevent opening when the interrupters are closed and closing the interrupters when the disconnect is open.

**Controls that meet your requirements.** Scada-Mate CX Switches are available with a wide range of controls to match your automation objectives.

For remote supervisory control applications, the 6801 Automatic Switch Control combines sophisticated automatic control schemes with remote terminal unit (RTU) functionality, data logging, and advanced communication capabilities in a single package (see page 18). It can manage switches and automatically sectionalize a feeder based on factors such as overcurrent, loss of voltage, and phase imbalance. Multiple controls can be programmed to communicate with each other using the optional IntelliTeam® SG Automatic Restoration System (see page 34).

Scada-Mate CX Switches can also be furnished with a custom-engineered communication and control unit that provides the interface between the switch and the master-station computer. It can accommodate a remote terminal device of any manufacture and can be powered by either a customer-supplied source or S&C Current/Voltage Sensors on the Scada-Mate CX Switch.

For source-transfer applications using two Scada-Mate CX Switches, a Micro-AT® Source-Transfer Control or 6802 Automatic Switch Control can be furnished. Both controls provide transfer in as little as 70 cycles.

**Simple installation.** Scada-Mate CX Switches are easy to install. Lifting means are provided for convenient rigging and hoisting. With their integral sensors and disconnect—and no vertical operating pipe—Scada-Mate CX Switches present a clean uncluttered look.
### 14.4-kV Scada-Mate CX Switch in the Upright Mounting Configuration

Also Available in Upright—Extra Mounting-Pole Clearance, Upright—Compact, and Tiered-Outboard Mounting Configurations

<table>
<thead>
<tr>
<th>SCADA-MATE CX SWITCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-Hz Ratings—50-Hz Ratings in Parentheses</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>kV</th>
<th>Amperes, RMS</th>
<th>Five-Time Duty-Cycle Fault Closing, Amperes, RMS, Asym.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cont. and Interr.</td>
<td></td>
</tr>
<tr>
<td>Nom.</td>
<td>Max</td>
<td>BIL</td>
</tr>
<tr>
<td>14.4 (10)</td>
<td>170 (15)</td>
<td>110 (110)</td>
</tr>
<tr>
<td>25 (20)</td>
<td>29 (24)</td>
<td>150 (150)</td>
</tr>
</tbody>
</table>

① System-voltage restrictions apply when the control is powered by S&C Current/Voltage Sensors.

② Switches furnished with optional visible-break disconnect can carry up to 900 amperes continuous in ambient temperatures to 40°C (104°F) with a minimum wind velocity of 2 feet (0.6 m) per second. Maximum allowable conductor temperature is 90°C (194°F). Without minimum wind velocity of 2 feet (0.6 m) per second, these switches can carry up to 630 amperes continuous.

★ Minimum voltage rating.

For more information on the Scada-Mate CX Switching System, see publications 768-34, 768-711, and 768-712 at sandc.com.
As energy demand and generation capacity continue to grow, utilities are looking for distribution switching systems that are reliable, resilient, and efficient. The Scada-Mate SD Switching System is particularly well-suited to meet these technical, operational, and economic challenges. It includes vacuum interrupting technology, uses no greenhouse gases, and is totally environmentally friendly.

This three-pole, group-operated Scada-Mate SD Switching System is designed for overhead distributed automation and to operate in 14.4-kV and 25-kV power-distribution systems. It is rated 900 amperes continuous and interrupting and features peak withstand of 41,600 amperes. This switching system has a five-time duty-cycle fault-closing rating of 12,500 amperes RMS symmetrical.

With smart and flexible controls, such as the S&C 6801 Automatic Switch Control, the system can minimize the load under outage conditions and maximize system uptime. Scada-Mate SD Switches are factory-assembled in a controlled environment where the vacuum interrupter is molded inside solid dielectric S&C Cypoxy™ Insulator material, giving the switching system pole-unit a robust construction that protects it from impact, wildlife, dust, moisture, and external damage. The Scada-Mate SD is ideal for installation in areas prone to icing, polluted and coastal environments, and remote locations.

Sealed vacuum interrupters, fully enclosed base. The Scada-Mate SD switching system uses vacuum interrupters that present no environmental concerns tied to greenhouse gas emission. They also are not subjugated to the same strict regulation governing the production of SF6 switches.

Models. The Scada-Mate SD Switching system is available in five mounting configurations, including: compact-crossarm upright, compact-crossarm upright with extra mounting-pole clearance, compact-crossarm upright compact (alley arm), compact-crossarm tiered outboard, and standard crossarm phase spacing models. Each of these configurations feature an OPEN/CLOSE indicator and an operating mechanism and can accommodate all switch-option configurations used in overhead distribution.

The Scada-Mate SD Switch is also available in a manually operated version; the stored-energy operating mechanism is replaced by a factory-adjusted, spring-wound hookstick operating mechanism.

Sensors: Sensing options for the Scada-Mate SD Switch include three-phase S&C Current Sensors on the pole-saddle side of the switch, and three-phase S&C Current/Voltage Sensors on the pole-saddle side or on both the front and pole-saddle sides of the switch.

Upgradable. Scada-Mate SD Switches can be furnished with factory-installed Current Sensors or S&C Current/Voltage Sensors. Or, other manufactures' sensors can be added later. Moreover, you can add an S&C control unit or a control from another manufacturer at any time.

Hookstick-operated versions of the switch also can be upgraded with a motor operator, permitting remote operation in sectionalizing applications that don't require sensing and intelligent controls.

Visible-break disconnect. For system practices that require a visible-break disconnect, S&C can provide Scada-Mate SD Switches furnished with an integral disconnect comprised of three single-phase, hookstick-operated blades, based on S&C's proven Loadbuster Disconnect® Switch design (see page 80). The disconnect is interlocked to prevent opening when the interrupters are closed and closing the interrupters when the disconnect is open.

Scada-Mate SD Switching System features:
- A stored-energy operating mechanism
- Three-phase current sensors and three-phase voltage sensors on one or both sides of the switch
- A hookstick-operable three-pole disconnect for visible air-gap isolation of switched-open circuits
- Lockout/tagout
- Interlocked disconnects that prevent inadvertent load switching
- Provisions for mounting six surge arresters (three on each side of the switch)
- Provisions for dead-ending
- Wildlife covers

For remote supervisory control applications, the 6801 Automatic Switch Control combines sophisticated automatic control schemes with remote terminal unit (RTU) functionality, data logging, and advanced communication capabilities in a single package (see page 18). Multiple controls can be programmed to communicate with each other using the optional IntelliTeam® SG Automatic Restoration System (see page 34).

Scada-Mate SD Switches can also be furnished with a custom-engineered communication and control unit that provides the interface between the switch and the master station computer.

For source-transfer applications using two Scada-Mate SD Switches, a Micro-AT® Source-Transfer Control or 6802 Automatic Switch Control can be furnished. Both controls provide transfer in as little as 70 cycles.
25-kV Scada-Mate SD Switch in the Compact-Crossarm Upright Mounting Configuration
Also available in Compact-Crossarm Upright—Extra Mounting-Pole Clearance, Compact-Crossarm Upright—Compact (alley arm), and Compact-Crossarm Tiered Outboard Configurations

For more information on the Scada-Mate SD Switching System, see publications 775-31 and 775-450 at sandc.com.

SCADA-MATE SD SWITCHES

<table>
<thead>
<tr>
<th>60-Hz Ratings</th>
<th>50-Hz Ratings in Parentheses</th>
</tr>
</thead>
<tbody>
<tr>
<td>kV (1)</td>
<td>Amperes, RMS</td>
</tr>
<tr>
<td>14.4 (10) 17.0 (15) 110 (110) 900 (900) 41 600 12 500</td>
<td></td>
</tr>
<tr>
<td>25 (20)  29 (24) 125 (125) 900 (900) 41 600 12 500</td>
<td></td>
</tr>
</tbody>
</table>

1 System-voltage restrictions apply when the control is powered by S&C Current/Voltage Sensors.
2 Switches furnished with optional visible-break disconnect can carry up to 900 amperes continuous in ambient temperatures to 40°C (104°F) with a minimum wind velocity of 2 feet (0.6 m) per second. Maximum allowable conductor temperature is 90°C (194°F). Without minimum wind velocity of 2 feet (0.6 m) per second, these switches can carry up to 630 amperes continuous.
3 Minimum voltage rating.
4 BIL equals 150-kV when there's no optional disconnect and the vacuum interrupter is closed. BIL equals 150-kV with the optional disconnect and both the vacuum interrupter and the optional disconnect are closed, or both the vacuum interrupter and the optional disconnect are open.

- Integral stored-energy operating mechanism—with manual opening and closing capabilities
- Interrupter OPEN/CLOSED indicator
- Manual-operation pull-ring
- Vacuum interrupters—circuit making and circuit breaking are accomplished internally with no exposed moving parts
- Enclosed one-piece base—houses drive linkages for interrupters
- Optional three-phase S&C Current/Voltage sensors
- Interrupter OPEN/CLOSED indicator
- Manual-operation pull-ring
Remote Supervisory Vista Underground Distribution Switchgear

Vista Underground Distribution Switchgear is available in Remote Supervisory and Source-Transfer models. Each offers the same features and benefits of manual Vista switchgear, discussed in detail on pages 56 through 59.

**REMOTE SUPERVISORY VISTA SWITCHGEAR**

Remote Supervisory Vista switchgear provides automated switching and fault protection, and it can also perform auto-sectionalizing without tripping the main breaker.

Up to six load-interrupter switches or fault interrupters can be motor-operated in a single unit of Vista switchgear. The motor operators may be battery powered or, optionally, self-powered using internal voltage transformers. The low-voltage compartment can be furnished with a user-furnished remote terminal unit or 6800 Series Automatic Switch Control that supports the IntelliTeam® SG Automatic Restoration System and a communication device.

The vacuum bottles of any three-phase fault interrupter way can be remotely tripped using external, user-specified relays. This capability permits advanced applications such as protective relay schemes using high-speed communication for closed-loop and open-loop systems.

**SOURCE-TRANSFER VISTA SWITCHGEAR**

Source-Transfer Vista switchgear provides fully automatic primary-selective service for one, two, or three critical loads. It includes an S&C Micro-AT® Source-Transfer Control, three-phase voltage sensing on source ways, and internal power provided by voltage transformers. It is available in common-bus and split-bus configurations.

---

**Remote Supervisory Vista Underground Distribution Switchgear**

**Motor operator** — provides power operation of load-interrupter switches and three-phase-tripping fault interrupters

**Communication and Control Equipment Group** — includes a user-specified remote terminal unit and communication device, battery charger(s), battery packs, switch controls, and a surge protector

**Switch Controls**

- Operation pushbuttons
- Position-indicating lamps
- Operation counter
- Connector for portable motor-operator control
- Push-to-test lamps
## Remote Supervisory and Source-Transfer Vista Underground Distribution Switchgear

### 50/60-Hz ANSI Ratings—IEC Ratings in Parentheses

<table>
<thead>
<tr>
<th>System Class</th>
<th>Max</th>
<th>Bil</th>
<th>Main Bus Cont. Current</th>
<th>Short-Circuit Sym.</th>
<th>Fault Interrupter</th>
<th>Load-Interrupter Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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### Micro-AT® Source-Transfer Control

- **Automatic-transfer Ready indicating lamp**
- **Source-voltage indicating lamp**
- **Manual/automatic operation selector switch**
- **Menu keys—Voltage, Current, Time, Event, Configure, Test, and Examine**
- **Keypad—for entering programming parameters**
- **Two-line x 24-character liquid-crystal display**
- **Overcurrent-lockout indicating lamp and reset key**—included with optional overcurrent-lockout feature
- **Last and next item keys**
- **Test keys—for simulating overcurrent and loss of voltage on source**

① Higher ratings are possible. Consult the nearest S&C Sales Office.
S&C offers pad-mounted gear in Remote Supervisory and Source-Transfer PMH and PME models. PMH models use directly accessible components (see pages 50 and 51). PME models use elbow-connected components (see pages 52 and 53). Both can be furnished with S&C’s unmatched choice of tap protection provided by S&C Fault Fiter® Electronic Power Fuses and S&C SMD-20 and SMD-40 Power Fuses (see pages 70 and 76).

All models reflect S&C’s uncompromising design and quality for ease of installation, operator convenience, and years of maintenance-free service.

Remote Supervisory PMH and PME Models
Remote supervisory models feature power-operated Mini-Rupter® Switches that respond to opening and closing signals from a remote location. These models can be specified with a communication and control equipment group for a completely integrated and self-powered automated switching and protection package.

The communication and control equipment group includes a battery and battery charger; a voltage sensor for single-phase voltage sensing and control power; three-phase current sensing on power-operated switches; a user-specified remote terminal unit or 6800 Series Automatic Switch Control, which supports the IntelliTeam® SG Automatic Restoration System; and a communication device.

No external wiring or control power is required. Just connect the power cables, configure the remote terminal unit (RTU), and the gear is ready for service.

Source-Transfer PMH and PME Models
Source-transfer models use power-operated Mini-Rupter Switches to provide fully automatic three-pole switching of the sources serving critical loads that require a high degree of service continuity. A field-programmable S&C Micro-AT® Source-Transfer Control continuously monitors the status of the two sources and, if voltage on the source serving the loads is lost, automatically initiates switching to transfer to the alternate source, thus restoring power to the loads.

Source-transfer models are totally self-contained switching and protection packages. Each is completely factory-assembled and ready for installation. No external wiring or control power is required.

### Communication and Control Equipment Group

#### 6800 Series Automatic Switch Control—or user-specified remote terminal unit and user-specified communication device (not shown)

### Remote Supervisory and Source-Transfer PME Pad-Mounted Gear

#### 60-Hz Ratings

<table>
<thead>
<tr>
<th>kV</th>
<th>Mini-Rupter® Switch, Amperes</th>
<th>Fuse</th>
<th>Short-Circuit, Amperes, RMS, Sym.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nom.</td>
<td>Max</td>
<td>BIL</td>
<td>Cont.</td>
</tr>
<tr>
<td>14.4</td>
<td>17.0</td>
<td>95</td>
<td>600</td>
</tr>
<tr>
<td>14.4</td>
<td>17.0</td>
<td>95</td>
<td>600</td>
</tr>
<tr>
<td>25</td>
<td>27</td>
<td>125</td>
<td>600</td>
</tr>
<tr>
<td>25</td>
<td>27</td>
<td>125</td>
<td>600</td>
</tr>
</tbody>
</table>

### Remote Supervisory and Source-Transfer PMH Pad-Mounted Gear

#### 60-Hz Ratings

<table>
<thead>
<tr>
<th>kV</th>
<th>Mini-Rupter® Switch, Amperes</th>
<th>Fuse</th>
<th>Short-Circuit, Amperes, RMS, Sym.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nom.</td>
<td>Max</td>
<td>BIL</td>
<td>Cont.</td>
</tr>
<tr>
<td>14.4</td>
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<tr>
<td>14.4</td>
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</tr>
<tr>
<td>25</td>
<td>27</td>
<td>125</td>
<td>600</td>
</tr>
<tr>
<td>25</td>
<td>27</td>
<td>125</td>
<td>600</td>
</tr>
</tbody>
</table>

① Consult the nearest S&C Sales Office for 50-hertz ratings.
② 25-kV models equipped with Fault Fiter® Electronic Power Fuses are rated 29 kV max.
③ SMU-20 Fuse Units are available in ratings through 200K amperes as well as 200E amperes.
④ Applicable to solidly grounded-neutral systems only, with fuses connected by a single-conductor, concentric-neutral type cable to a transformer or transformers. Rating is 9,400 amperes, RMS, symmetrical for all other applications.
Remote Supervisory PMH Pad-Mounted Gear

For more information on Remote Supervisory PMH Models, see publication 664-31. For Source-Transfer PMH Models, see publications 663A-30 and 663A-31. For Remote Supervisory PME Models, see publication 666-31. All of these publications are available at sandc.com.

Switch Operator

- Decoupler (behind protective cover)—provides a means to decouple switch from switch operator
- Switch control—includes OPEN/CLOSE pushbuttons, a LOCAL/REMOTE switch, and an operation counter
- Dual battery packs—provide power for the installation
- Battery charger—provides a continuous float charge to battery packs; features integral load-disconnect circuitry to prevent deep discharge of batteries after an extended loss of an ac source, and it includes a battery load-test feature and alarms for loss of an ac source (field selectable), battery low voltage, or charger overvoltage

Source-Transfer PMH Pad-Mounted Gear

- OPEN/CLOSE pushbuttons—permit local electrical operation
- Dual-purpose manual handle—for charging and tripping switch operators when control power is not available
- Operator targets—show switch-operator status (charged or discharged) and position (Open or Closed)
- Optional remote-control receptacle—for attaching remote-control station; permits Open/Close operations from adjacent area
- Charging shaft—for manual charging in the event power is lost
- Switch-position target—indicates whether a Mini-Rupter Switch is open or closed
- Decoupler indicator—shows whether the switch operator is coupled to a Mini-Rupter Switch
- Decoupler handle—permits convenient decoupling of the switch from the switch operator for functional testing of source-transfer schemes and exercising of the switch operator, without disturbing the power circuit
- Bolted covers—provide access to input connectors and receptacles and terminal blocks

S&C Micro-AT® Source-Transfer Control—microprocessor-based, field-programmable
Industrial and commercial power users are increasingly less tolerant to the frequency and duration of outages. Some utilities have lost such customers to competitors offering more reliable service.

S&C’s High-Speed Fault-Clearing System was specifically developed to address this issue. It can be configured to be essentially a no-interruption system for underground applications. A fault occurring on any segment of the system is automatically isolated. But service to the loads is not interrupted (or the interruption is minimal). Communication-dependent tripping is a key element of the design.

The system uses specially configured S&C Remote Supervisory Vista® Underground Distribution Switchgear (see page 24). Each fault-interrupter way of the gear associated with the backbone feeder is equipped with a multifunction, microprocessor-based relay. Each substation circuit breaker feeding the loop of switchgear units is also equipped with such a relay.

The relays communicate with each other through a high-speed fiber-optic cable network. Relays use the established transmission-relaying concepts of Permissive Overreaching Transfer Trip (POTT) and Directional Comparison Blocking (DCB) to ensure only the fault interrupters on either side of a faulted backbone cable section open. SCADA isn’t required but can be readily integrated.

Any number of switchgear units can be used in the system, applied in a closed-loop or an open-loop configuration. In either case, a backbone feeder fault is cleared in 6 cycles or less; there’s no need to trip the substation circuit breakers.

In a closed-loop application—such as the one shown on page 29—both ends of the loop must be fed from the same substation. Load will not be lost while a fault is being cleared, although some customers may experience a voltage dip.

In an open-loop application, feeders from different substations can be used; an open switching point is required in the loop. Some customers may experience a three- to four-second loss of voltage while the normally open switch is closed.
Typical operation of High-Speed Fault-Clearing System in a closed-loop application

1. Normal configuration.

2. Relay 5 detects fault current flowing in the direction of its respective arrow, as does Relay 6. Each relay sends a "forward fault detected" signal to the other relay.

3. If a fault occurs, current will flow to it through both substation circuit breakers.

4. Relays 5 and 6 each recognize the other has sensed fault current flowing in the direction of its respective arrow and trips its respective fault interrupter. The faulted cable section is de-energized, but service to the loads served by Vista Units B and C is uninterrupted.

LEGEND
- Relay sensing direction
- Directional relay with CT
- Fiber-optic cable
- Hard-wired input/output
- Substation circuit breaker

For more information on the High-Speed Fault-Clearing System, see publication 682-60 at sandc.com.
**INTELLICAP® 2000 & INTELLICAP® AUTOMATIC CAPACITOR CONTROLS, INTELLINODE™ INTERFACE MODULE**

**IntelliCap 2000 Automatic Capacitor Control**

IntelliCap 2000 Automatic Capacitor Controls are two-way communicating controls ideally suited for distribution capacitor bank applications with volt-var optimization systems. They can be furnished with a variety of factory-installed communication devices, including SpeedNet™ Radios (see page 40).

IntelliCap 2000 controls offer a wide range of software-selectable functions, including voltage, time, temperature, time-biased voltage, and time-biased temperature control strategies. Var and current control strategies are optionally available. Voltage/temperature and SCADA-override strategies are provided, too; when enabled, a control returns to its regular control strategy after receiving a SCADA command.

IntelliCap 2000 controls automatically calculate voltage change (and kvar change, if applicable) caused by capacitor-bank switching, and they offer automatic adjustment for daylight savings time and holidays, daily limits on automatic switching operations, and undervoltage and overvoltage protection.

Neutral input sensing is optionally available and can lock out the capacitor bank if blown fuses or stuck switch poles are detected.

**IntelliCap Automatic Capacitor Control**

For distribution capacitor switching applications that do not require an interface with the volt-var optimization systems or SCADA, IntelliCap Automatic Capacitor Controls offer an ideal solution. They provide local-control switching strategies based on time, temperature, voltage, and—optionally—vars and current.

**INTELLINODE INTERFACE MODULE**

With S&C’s IntelliNode Interface Module, the IntelliTeam® SG Automatic Restoration System (see pages 34 and 35) works with a wide array of new and existing DNP 3.0-compatible intelligent electronic devices from other manufacturers, including Cooper, Nu-Lec, SEL, and ABB protection relays, and recloser controls.
& 6801M AUTOMATIC SWITCH OPERATOR

6801M Automatic Switch Operator

The 6801M Automatic Switch Operator is a fully integrated, microprocessor-based operator that combines electromechanical components, a remote terminal unit (RTU), control circuitry, and communications in a single package for enhanced installation flexibility and reliability, and reduced cost.

The 6801M Automatic Switch Operator monitors the entire switching cycle and can automatically take corrective action in the event of a problem. It is particularly designed to operate Omni-Rupter™ Switches and Alduti-Rupter™ Switches, which are featured on pages 86 to 93. See also the discussion on S&C’s Smart Grid Services on page 47.

When the associated distribution switches or disconnects have been fitted with voltage and current sensing, the 6801M operator can be furnished with, or upgraded to, S&C’s IntelliTeam ™ SG Automatic Restoration System. This enables multiple 6801M operators to work together as teams with IntelliRupter® PulseClose® Fault Interrupters, 6800 Series Automatic Switch Controls, and IntelliNode™ Interface Modules.
IPERC GRIDMASTER® MICROGRID CONTROL SYSTEM

UNSURPASSED RESILIENCY AND ENERGY SECURITY
The GridMaster Microgrid Control System is a community of intelligent power controllers (IPCs) networked in a distributed architecture.

The GridMaster system operates as a hive concept, where each IPC represents a specific piece or group of equipment. All the IPCs are in constant peer-to-peer communication with each other. The combined computer-processing capabilities enable complex optimization algorithms and provide intelligent load balancing and prioritized microgrid operations.

The distributed design and construction ensures all electrical demand is satisfied while maximizing efficiency and eliminating single points of failure. Ultimately, the GridMaster system is an economical and effective way to achieve maximum energy independence by providing:

- Reduced energy costs
- Reduced fuel consumption and CO₂ emissions
- Reduced maintenance
- Optimal integration of renewable energy and energy storage assets

GRIDMASTER INTELLIGENT POWER CONTROLLER
Key features of the GridMaster IPC include:
- Industry-leading cybersecurity Authorization to Operate (ATO) accreditation by the U.S. Department of Defense
- Distributed peer-to-peer communications to eliminate the single points of failure common in centralized control systems
- Redundant-controls architecture to provide resiliency
- Automatic, intelligent optimization of generation and load assets
- Rapid re-integration of lost assets through self-healing
- Readily scalable to adapt to changing microgrid configurations
- Automatic demand response using internal algorithms or external signal
- Workability with new and legacy power generation equipment
- Compatibility with all common industrial communications protocols, including Modbus and CAN
- Wired or wireless encrypted control communications

CONTROLLER SPECIFICATIONS INCLUDE:
- Power requirement:
  - Input: 9 to 36 Vdc (< 20 W)
- Serial communications:
  - 8 bits / No stop / 1 parity
  - Minimum/maximum baud: 300 / 115200
- Ethernet communications:
  - IEEE 802.3 Ethernet interface
  - 1000/100/10 base-T
  - IPV6 standard; IPV4 compatible
- Control boot time:
  - Typical: 30 seconds; maximum: 120 seconds
- Front panel indicators:
  - Green power LED display illuminates when on
  - Recessed power switch
- Weight:
  - Base unit: 9.5 lbs. (4.3 kgs)
  - Communication modules: 0.21 lbs (0.1 kgs) each
- Mechanical vibration:
  - Vibration: 24 to 2000 Hz, all axis
  - Shock: capable of seismic Zone 4
- Environmental:
  - Humidity: 95% non-condensing
  - Operating temperature: -25°C to 70°C (-13°F to 158°F)
  - Storage temperature: -40°C to 85°C (-40°F to 185°F)
  - Passively cooled
  - Adequate for operation at altitudes up to 2,000 meters (6,562 feet)

IPERC is a wholly owned subsidiary of S&C Electric Company.
Intelligent Power Controller (Rack Mount)

Dimensions in inches (mm)

More information about IPERC Gridmaster Microgrid Control System is available at sandc.com.
Introduced in 1996, the IntelliTeam Automatic Restoration System was the first product of its kind. The system uses peer-to-peer communication with distributed intelligence to track system conditions and quickly initiate service restoration. It was way ahead of its time.

In 2003, S&C brought out the IntelliTeam® II Automatic Restoration System—an order of magnitude more powerful than the original. Highly scalable, it supports complex system architectures and multiple tie points from multiple sources. It uses teams of switches to restore service to affected circuit segments when faults or loss-of-source events occur, and it manages all of this based on allowable line loading. Moreover, each team can have up to eight switches, arranged in radial or looped circuits, or a combination of both.

Now, S&C has advanced IntelliTeam technology with the IntelliTeam SG Automatic Restoration System. It’s even more robust and easier to use and offers such important features as:

- **IntelliTeam® Designer**, which simplifies system configuration (Just draw a single-line diagram of your distribution circuits, and the IntelliTeam Designer application will apply all of the IntelliTeam SG settings to all of the associated team members automatically.)

- **Rapid Self-Healing**, which isolates faulted section and restores service to non-faulted sections in seconds (An example is shown on page 35.)

- **Communication Enhanced Coordination**, which improves feeder segmentation and reduces momentary interruptions (In a system where IntelliRupter® PulseCloser® Fault Interrupters share the same protection curve, only the IntelliRupter fault interrupter closest to a fault will open.)

- **Post-Restoration Load Management**, which protects reconfigured system from loading that exceeds the capabilities of the system

- **Closed-Loop Operation**, which eliminates the need for a normally open switching point in applications where the loop is served from two substations

- **Site Automation Testing**, which lets you emulate events using actual site parameters and peer-to-peer communication and—optionally—operate switches

- **Instant Replay**, which collects event logs from affected devices and provides the ability to replay the events on the systems single-line diagram
**A TRULY UNIVERSAL SOLUTION**

The IntelliTeam SG Automatic Restoration System is an open platform offering unmatched interoperability. It can automate new or existing circuits. It works with S&C IntelliRupter fault interrupters; Scada-Mate®, Scada-Mate CX™, and Scada-Mate® SD Switching Systems; Remote Supervisory PMH and PME Pad-Mounted Gear; and Remote Supervisory Vista® Underground Distribution Switchgear.

**IMPROVES SERVICE RELIABILITY**

With the IntelliTeam SG Automatic Restoration System, restoration proceeds without the delays inherent in a dispatcher-operated or centrally controlled system. The IntelliTeam SG system monitors real-time current and voltage throughout the system and uses this information to make smart switching decisions to restore service when outage events occur on the system.

Unlike time-coordinated restoration systems that must be carefully preprogrammed, the IntelliTeam SG Automatic Restoration System’s sophisticated operating logic can automatically restore service under multiple event contingencies. During storms or major outages, it quickly returns service to as many customers as possible, freeing your personnel to deal with system repairs. The system minimizes Customer Minutes of Interruption, improving your reliability ratings.

**MAXIMIZES EFFICIENCY OF YOUR SYSTEM**

Restoration capacity is based on real-time loading and actual feeder capacity, not often-outdated historical loading data. Circuits can be routinely loaded higher, and the IntelliTeam SG Automatic Restoration System prevents overloading during restoration. The excess capacity of adjacent sources is used to restore service to unfaulted segments, helping defer the need for system upgrades and allowing you to tie circuits that traditional planning criteria wouldn’t permit.

The illustration at the right shows an example of the IntelliTeam SG Automatic Restoration System’s Rapid Self-Healing feature. This feature, when enabled, can significantly decrease the self-healing response time by minimizing the number of switching operations.

If a fault occurs and there’s sufficient capacity in a single source, the IntelliTeam SG Automatic Restoration System will use Rapid Self-Healing, opening all switches surrounding the faulted team and then closing one switch to restore service to as many outaged sections as possible using that source.

If there isn’t sufficient capacity in a single source, the IntelliTeam SG Automatic Restoration System will instead use self-healing to restore service to as many outaged sections as possible using all available sources.
BENEFITS OF DEVICE MANAGEMENT
Advanced tools are needed to efficiently manage an entire fleet of automated devices, saving engineers and system operators time. This also allows them to work more effectively, thus further leveraging the smart grid investment to improve reliability.

To fully realize the benefits of a self-healing smart grid, S&C offers the IntelliTeam FMS Feeder Management System. This enterprise software can significantly improve a utility’s operational efficiency and overall reliability by managing devices and providing insightful data analytics from an entire fleet of S&C automated smart grid devices.

SAVING OPERATIONAL TIME
By leveraging IntelliTeam FMS software features to automate otherwise manual tasks done on a point-by-point, device-by-device basis, six to eight hours per device can be saved annually through improving and automating tasks in three operational areas:

DEVICE TRACKING & MAINTENANCE MONITORING
◆ **Device Details.** The IntelliTeam FMS displays data related to individual devices, enabling a user to diagnose many issues quickly. Available data include diagnostics, team status, calibration, settings, and more.
◆ **Dashboards.** Many utilities investigate devices manually or react to SCADA alarms. IntelliTeam FMS offers an automated and proactive approach with both table and graphical dashboards that automatically track Team Ready statuses and monitor battery health, firmware versions, and more.
◆ **Alert Management.** Addressing the numerous alerts devices generate can be a time-consuming task. IntelliTeam FMS makes it easy to filter down to only those devices and alert types that are relevant.

DEVICE DATA & FILE RETRIEVAL
◆ **File Retrieval.** Utilities often use traditional methods and tools to access waveform and event files—either one device at a time or by rolling a truck. IntelliTeam FMS facilitates bulk retrieval, both on demand and on a scheduled basis.
◆ **Data Collection.** Collecting, organizing, managing, and displaying relevant data is often done via SCADA and a historian, but IntelliTeam FMS does this automatically for S&C devices and does so while collecting points SCADA systems can’t access, such as setpoints.
◆ **Reporting.** Many utilities spend considerable time defining, generating, and maintaining basic device status reports. IntelliTeam FMS generates several key reports and custom dashboard displays, which can be exported.

DEVICE CONFIGURATION
◆ **Settings Management.** Configuring new devices and changing device settings all can be managed by IntelliTeam FMS. Settings changes also can be applied across multiple devices, saving many hours when a fleet-wide change is required.
◆ **Change Logs.** Without change logs, diagnosing a problem with a device becomes a matter of detective work. IntelliTeam FMS solves the mystery by logging who, when, and what was changed.
◆ **Device Filtering.** IntelliTeam FMS allows a user to work with almost any group of devices based on a wide array of filtering options. This saves a lot of time when working with a subset of devices.

INCREASING RELIABILITY
IntelliTeam FMS’s features help utilities identify issues before they result in a device not operating as intended. Misoperations can cause outages or lost opportunities to leverage grid automation to restore power. With a fleet of 400 devices, 10 such misoperations can be avoided annually in three process areas:

HISTORICAL TREND ANALYSIS
◆ **Dashboards.** Not all issues are easy to spot, whether they are intermittent or isolated. IntelliTeam FMS dashboards make it easy to spot hidden trends in device data.
◆ **Reporting.** Besides dashboards, IntelliTeam FMS reporting also provides insights into device data, ranging from maintenance needs to abnormal statuses.
◆ **Alert Management.** Alerts are generally used to identify specific issues quickly, but analyzing alert trends over time also can help identify systemic issues.
TEAM STATUS MONITORING

◆ **Dashboards.** Team-Ready statuses and reasons why teams aren’t in a Ready state are displayed. Communication issues are a leading cause of teams falling out of a Ready state, so IntelliTeam FMS offers a dedicated dashboard to track communication statuses.

◆ **Alerts.** IntelliTeam FMS enables a review of alerts related to devices falling out of a Ready state, such as being set to manual operation.

DEVICE CONFIGURATION

◆ **Settings Templates.** Utilities can create ideal configurations for their devices and then replicate those settings to their entire fleet using saved templates. This avoids manual settings errors and the use of factory default settings.

◆ **Device Filtering.** Filtering in IntelliTeam FMS is primarily used to allow working with specific sets of devices, but the system also can be used to find devices with certain statuses or settings that must be addressed.

◆ **Change Logs.** Knowing what was changed in a device can prevent an outage if the change wasn’t intended to be permanent.

SUPPORTED DEVICE TYPES

S&C’s IntelliTeam FMS Feeder Management System provides powerful monitoring and data analytics for S&C IntelliRupter® PulseCloser® Fault Interrupters, 5800 and 6800 Switch Controls, IntelliNode™ Interface Modules, and IntelliCap® Plus Automatic Capacitor Controls.

DEVICE COMMUNICATION

IntelliTeam FMS is designed to communicate with S&C devices via fiber-optic cables and radio, such as S&C SpeedNet™ Radios or those from third-party vendors. Several technologies help IntelliTeam FMS adapt to the bandwidth available:

◆ **User-configurable data-collection intervals.** The frequency at which IntelliTeam FMS contacts a device for various types of data can be adjusted from seconds to days based on a utility’s needs and the bandwidth available.

◆ **Staged Communications.** IntelliTeam FMS has the ability to communicate with only a single device at a time on each feeder. Communicating with random devices could cause bottlenecks at the head-end unit if multiple devices on a feeder are responding to requests concurrently.

◆ **Adaptive Communications.** IntelliTeam FMS communicates with a set number of devices concurrently for collecting various types of data, and it adapts to network-response time. If responses are delayed, then IntelliTeam FMS will not schedule new data-collection requests until the previous requests are completed.

For more information on the IntelliTeam FMS Feeder Management System, see S&C publication 1048-31, or visit sandc.com/FMS.
As the number of networked grid devices increases, so does the difficulty of managing network communication. Designed to meet the specialized needs of electric utilities, S&C’s IntelliTeam® CNMS Communication Network Management System simplifies monitoring and management of S&C SpeedNet™ Radio and SpeedNet™ SDR Software Defined Radio networks supporting SCADA and distribution automation applications.

The IntelliTeam CNMS Communication Network Management System provides utilities with a comprehensive view of network configuration and performance through a browser-based interface. It lets authorized users monitor near real-time and archived data on radio networks of all sizes. Users can manage each individual radio and effect configuration changes, data backup, and remote firmware upgrades.

Benefits include:

- **Better network awareness and control.** Periodic data are collected from each radio, with statistics and settings displayed in tables and dashboards. Radio-configuration settings for SpeedNet Radios can be changed easily from the CNMS interface.

- **Extensive network-visualization capabilities.** Interactive Google Maps interface with color-coded link strengths and Google Earth export capabilities for offline analysis.

- **Easier problem identification.** Data filters and visual indicators for alarms and link qualities help administrators quickly identify problem radios.

- **Greater operational efficiency.** Network administrators can perform their duties in a fraction of the time compared to using the Client Tool.

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**Interactive Deployment View with Color-Coded Links**
Radio Configuration Settings for SpeedNet Radios Can Be Changed Easily from the Radios Tab

Alarms Help Administrators Quickly Identify Problem Radios
SPEEDNET™ RADIOS & SPEEDNET™ CELL EDGE GATEWAY

Reliable communication networks are a critical component of SCADA and grid-automation systems. When choosing a communication solution, a few key parameters to consider are resiliency, latency, and security.

Built-in redundant paths and no single point of failure are inherent features of SpeedNet mesh radio networks, which provide the resiliency required by mission-critical grid applications. These radios also support point-to-point and point-to-multipoint modes of deployment. S&C’s SpeedNet mesh radios provide the reliable, high-throughput communications essential to the IntelliTeam® Automatic Restoration System, and SCADA-only applications.

SPEEDNET™ RADIOS
SpeedNet Radios deliver low-latency, self-healing performance. They are equipped for high-volume data transmission, enabling automation in difficult-to-access areas. A peer-to-peer mesh network of SpeedNet™ Radios is easy to set up and maintain. The radios automatically build routing tables that define message paths. If a node is lost, the radios quickly establish a new path.

Redundancy for head-end radios and gateways improves communication reliability. Such redundancy is important for head-end radios because they are the link to the customer enterprise network. Operating in the unlicensed 900-MHz ISM band, a SpeedNet Radio furnished with an omnidirectional antenna has a typical range of several miles, depending on the terrain and clutter. If needed, a SpeedNet Repeater can be installed to increase transmission range and provide alternate nodes for message routing, without the need to reach a point-to-multipoint tower to extend communication range.

SpeedNet 900 Radio

As part of the SpeedNet Radio family, the SpeedNet™ ME Mesh End-Point Radio is designed specifically for the communication needs of end-node SCADA devices. It provides a fast link to its next-hop neighbor(s), which can be a SpeedNet Repeater Radio that is part of a SpeedNet Radio mesh network or the actual destination. Because it is used as an end point only, the SpeedNet ME Mesh End-Point Radio does not have the ability to perform as a repeater, headend, or gateway. It does, however, connect to a SpeedNet Radio mesh network that is capable of providing secure, long-range communication with high message rates.

SPEEDNET™ SDR SOFTWARE DEFINED RADIOS
The S&C SpeedNet SDR Software Defined Radio is available in the 400-MHz and 900-MHz licensed bands. Both bands support a single-channel as well as a dual-channel radio. These radios optimize parameters across three axes: power output, channel size, and link speed.

The adjustable link speed allows for variable data-transfer rates. The SpeedNet SDR radio offers performance second to none in the commercial market today. The SpeedNet SDR radio over-the-air data rate provides the bandwidth that can enable Ethernet connectivity within as small as a 12.5-kHz channel, which provides easier application-integration support, including emerging automation applications.

The SpeedNet SDR radio uses a mesh-routing protocol to eliminate single-point network failures. It also uses S&C expertise in high-speed, low-latency communication systems to meet the specific needs of the IntelliTeam® SG Automatic Restoration System and other grid automation and control protocols.
By offering the flexible balance of data rates, propagation range, and interference mitigation, S&C’s SpeedNet SDR radio provides a resilient mesh network for grid automation.

**SpeedNet SDR Software Defined Radio**

**SPEEDNET™ CELL EDGE GATEWAY**
The SpeedNet Cell Edge Gateway provides a flexible way for devices to securely leverage a cellular network. Data-intensive applications are better managed by an alternative network because backhauling large volumes of data over the distribution automation network could compromise self-healing during an outage. Cellular networks already in your service area provide a cost-effective opportunity for utilities to monitor and control grid devices over a secondary communication network.

**COMPARISON FOR SCADA AND INTELLITEAM® FMS FEEDER MANAGEMENT SYSTEM**
Utilities without a private wireless network can use the SpeedNet Cell Edge Gateway as their primary network for SCADA and/or IntelliTeam FMS connectivity.

**CONNECTIVITY FOR MONITORING AND CONTROL**
When used in conjunction with a private field area network, the SpeedNet Cell Edge Gateway allows the IntelliTeam FMS Feeder Management System and other applications such as IntelliLink® Setup Software to use a secure, high-speed cellular path.

**EXTEND CONNECTIVITY TO REMOTE DEVICES**
The SpeedNet Cell Edge Gateway also provides flexibility to expand connectivity to remote devices outside the coverage area of existing utility field area networks. By adding communication to devices, you enable monitoring and control functions. The SpeedNet Cell Edge Gateway can be deployed in many unique cases to provide connectivity where previously there was none.

**SpeedNet Cell Edge Gateway**

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**COMPARISON MATRIX**

<table>
<thead>
<tr>
<th></th>
<th>SpeedNet 900 Radios</th>
<th>SpeedNet SDR Software Defined Radios</th>
<th>SpeedNet™ Cell Edge Gateway</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>902-928 MHz</td>
<td>406-430 and 450-470 MHz</td>
<td>928-960 MHz</td>
</tr>
<tr>
<td><strong>Data Rate</strong></td>
<td>600 kbps</td>
<td>300 kbps</td>
<td>56.7 kbps @12.5 kHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>113.4 kbps @ 25 kHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>114 kbps @25 kHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>228 kbps @50 kHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 Mbps downlink, 5 Mbps uplink①</td>
</tr>
<tr>
<td><strong>Idle Channel Latency</strong></td>
<td>10 milliseconds</td>
<td>28 milliseconds</td>
<td>14 milliseconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14 milliseconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 milliseconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100-200 milliseconds①</td>
</tr>
<tr>
<td><strong>Encryption</strong></td>
<td>128-bit AES</td>
<td>256-bit AES</td>
<td>256-bit AES</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>256-bit AES, ECC</td>
</tr>
<tr>
<td><strong>Certifications</strong></td>
<td>FCC, IC, Brazil, Australia, New Zealand</td>
<td>FCC, IC, ETSI/CE, South Africa</td>
<td>FCC, IC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FCC, IC</td>
</tr>
</tbody>
</table>

① Many factors affect the speed and performance of cellular devices, including proximity to a cell site, the capacity of the cell site, the surrounding terrain, placement of the cellular device inside equipment, radio-frequency interference, the number of other devices attempting to use the same spectrum resources, the data plan from wireless carrier, and weather.
S&C’s Power Systems Solutions team of automation-system planning, energy storage, renewable energy, and engineering experts has vast expertise in the real-world application of technology for improved grid reliability. They’re well-suited to perform the study, engineering and design, project management, and field services needed to deliver a complete smart grid solution. These services can be furnished individually or as a complete solution.

ANALYTICAL STUDIES
S&C’s highly trained Power Systems Solutions staff can assist you with a variety of substation and distribution system analytical services. These services can be furnished individually or as part of a complete EPC solution with equipment. S&C also supports a variety of important studies, including but not limited to:

- **Overcurrent protective device coordination studies.** Use this research to select appropriately rated protective devices and their settings. The objective is to minimize the impact of short-circuits by isolating faults as quickly as possible while maintaining power to the rest of the system.

- **Short-circuit studies.** These help determine currents flowing in a power system under fault conditions.

- **Arc-flash studies.** S&C evaluates the incident energy and arc-flash boundary of energized electrical equipment, calculated in accordance with the IEEE 1584 and NFPA-70E standards.

- **Power quality studies.** These include site surveys and measurements to evaluate the impact of voltage sags, interruptions, motor starting, or flicker on end-user equipment.
- **Power-flow studies.** S&C determines whether system voltages remain within specified limits under various contingency conditions, and whether transformers and conductors are overloaded.

- **Reliability studies.** Such research helps to maximize the reliability, efficiency, and safety of a power system.

- **Switching transient studies.** S&C will analyze the transients associated with the switching of utility or industrial capacitor banks or shunt reactors, or the performance of transient mitigation devices during capacitor bank or transmission-line energization.

- **Voltage-stability analysis and model development.** This research is associated with generator interconnection, including renewable power plants, and is often performed during the generator interconnection application process to evaluate impact of the generator on system voltage stability.

- **Harmonic studies.** Such research assesses the impacts of harmonic-producing loads, such as inverters and other power-electronic equipment, on the levels of harmonic voltage and current on the utility system.

- **Filter design studies.** These are performed to determine passive harmonic filter design parameters in cases where it is necessary to convert shunt capacitor banks to harmonic filters.

- **Insulation coordination studies.** These confirm whether surge arresters applied for equipment transient overvoltage protection caused by lightning and switching surges provide sufficient margins of protection. In renewable power plants, insulation coordination studies also include temporary overvoltage analysis to determine sizing for grounding transformers to ensure effective grounding during plant or feeder islanding conditions.

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**ENGINEERING SERVICES**

S&C’s engineering and system design services provide the best long-term value to your toughest power system challenges. Our professional engineers dedicate themselves to being specialists in their fields and applying that knowledge toward your project vision. S&C engineers hold professional engineering licenses throughout the United States. Let us show you how we differentiate ourselves through S&C’s commitment to quality and in delighting our customers through world-class services.

**Preliminary and Detail Design**
- Single-line drawings
- Civil, electrical, and structural engineering
- 30%, 60%, and 90% design packages
- Dc and ac schematics
- Grounding drawings
- Lightning protection drawings
- Wiring diagrams
- Control room design
- Physical layouts, sections, and details
- Foundation layouts and details
- Equipment and construction specifications
- Bills of material

**Protection and Control Design**
- Bus arrangement and layout drawings
- Protection and control logic diagrams
- Relay panel layout and settings

**SCADA Engineering**
- System programming and commissioning
- SCADA points lists
- SCADA screen development and design
- Historian design
- Configuration files
- ISO, developer, and utility integration

**Construction Support**
- On-site engineering support
- Issued for construction (IFC) drawings
- System programming and commission
- Project close-out manuals
- Indexed As Built Drawing Packages
ENGINEERING, PROCUREMENT, AND CONSTRUCTION
S&C’s Power Systems Solutions team takes projects from initial system study and design through to start-up and commissioning in the field. After commissioning, most engineering, procurement, and construction (EPC) work for companies is done, but S&C continues to support its solutions by offering comprehensive asset-management services, including preventative maintenance and 24x7 remote monitoring.

S&C offers comprehensive EPC services for a variety of major project settings, including microgrids, substations, and renewable energy plants.

S&C offers the following services when executing complex EPC projects:

Engineering & Project Management
S&C’s engineering and project management success is founded on expert planning, commitment to safety, and problem-solving. Engineers produce designs for diverse and complex projects, and our project managers oversee the scope, schedule, cost, quality, and completion of these projects.

Procurement
S&C has the resources and capabilities to procure the equipment, materials, skilled labor, and services needed to get the job done. S&C has established databases of suppliers and subcontractors with whom we’ve worked around the world and on a variety of projects and project types.

Construction
S&C’s construction managers oversee on-the-ground execution of projects around the world. They are dedicated to providing expert guidance and solutions for all phases of the construction process and ensure proper equipment installation for every project.

FIELD SERVICE
S&C’s field-service specialists take our expertise in electrical power systems into the real world with a comprehensive range of services to support your project needs. From equipment start-up and personnel training through long-term maintenance, we’re committed to sustaining the life of your equipment and improving power reliability.

Installation Support
S&C’s technical experts have years of hands-on experience in the proper installation, testing, and commissioning of S&C’s products. S&C will bring this unique expertise to the customer’s project, ensuring equipment is ready for operation.

S&C’s experts manage the installation of electric power equipment, such as circuit-switchers, automatic source-transfer switchgear, metal-enclosed switchgear, overhead distribution equipment, automation systems, power quality and energy storage equipment, and pad-mounted equipment, performing all essential testing and commissioning procedures. Installation services can vary in scope, from providing technical assistance to the customer’s crew through complete turnkey support from S&C.

Mechanical Checkout, Start-up, and Commissioning
For equipment such as automated distribution switching packages, our field-service specialists can provide the testing necessary to ensure the system is functioning properly. Typical commissioning activities include:

- System and component inspection prior to energization
- Field adjustments
- Calibration and programming
- Equipment start-up
- System evaluation to ensure conformance to performance specification

![Field Service Image]
S&C is the only company in North America able to provide an entire suite of in-house facilities and services to address your testing needs. Most common testing practices include material analyses, electrical testing, mechanical testing, and forensic testing.

At the heart of S&C’s state-of-the-art, 43,000-square-foot Advanced Technology Center (ATC) is the Nicholas J. Conrad Laboratory, which has two 850-megawatt electrical short-circuit test generators that can test up to 80 kA and up to 230 kV. The facility also provides a high-speed video system, showing real-time data as testing events occur.

S&C also offers onsite testing in the field by our experienced service professionals, including site automation testing, operational testing, and radio validation surveys.

**S&C Equipment Factory Acceptance Testing**
S&C routinely provides customer-witnessed factory acceptance testing on various pieces of S&C equipment before shipment to ensure the equipment performs as required. Factory acceptance testing will vary depending on the equipment being tested. Examples include routine tests, such as circuit board and subassembly functionality; mechanical inspection, wiring, insulation resistance, Hi-Pot, and other tests; or the testing can include customer-specified tests.

**IntelliTeam® SG Automatic Restoration System Factory Acceptance Testing**
Factory acceptance testing on devices running S&C’s IntelliTeam SG Automatic Restoration System ensures that all information required for a successful IntelliTeam SG implementation is gathered and understood before commissioning. Each test is customized to the customer’s needs. Scenarios can include:
- A loss of source for each source
- A fault simulation for each line segment
- Contingency events

**Site Automation Testing**
Site automation testing validates the IntelliTeam SG implementation in the field. It provides significant insight into how the IntelliTeam SG system will work on the user’s system using their specific settings. The field engineer assigned to a site automation test works closely with users to develop customized and meaningful test scenarios.

**Operational Testing**
S&C field service technologists can coordinate on-site operational testing procedures, including opening energized load ways to observe proper system operation. S&C can also coordinate site-specific test procedures.

**Radio Validation Survey**
S&C’s field service personnel can perform an on-site radio-validation survey to properly locate radios for optimum system startup and performance. The survey determines individual links that make up the mesh radio network. The scope of work includes identifying ideal locations for a mesh radio network and temporarily installing radios while measurements are made. S&C will evaluate the results of the survey and provide a written report of recommendations.

**NETA Electrical Testing**
NETA Electrical Testing can be performed on a site-specific basis with the input from the site supervisor.
S&C’s regional service centers are located across the nation, offering timely support and expertise for necessary repairs and restoration services.

REMOTE MONITORING & TECHNICAL SUPPORT
Through the Global Support & Monitoring Center (GSMC), S&C provides 24/7 condition-based monitoring of equipment using pre-installed monitoring hardware. When conditions fall outside of normal parameters and a notification is issued, our support staff immediately begin the troubleshooting process to resolve issues.

The list below highlights some of the major equipment types S&C can monitor:

- **Transformers**
  - Dissolved gas analysis (DGA)
  - Bushing partial discharge

- **Circuit breakers**
  - Gas pressure and temperature
  - Bushing partial discharge
  - Open/Close operations

- **PureWave® DSTATCOM Distributed Static Compensator and PureWave SMS Storage Management System**
  - Real and reactive power
  - System voltages and currents
  - System and inverter availability

- **IntelliTeam® CNMS Communication Network Management System**
  - S&C SpeedNet™ Radios

- **PureWave® UPS Systems**
  - System availability
  - Run cycles

- **IntelliTeam® SG Automatic Restoration System Products**
  - Remote Supervisory Vista® Underground Distribution Switchgear
  - IntelliRupter® PulseCloser® Fault Interrupters
  - Other S&C products with IntelliTeam SG connectivity

ROUTINE MAINTENANCE
S&C provides preventative maintenance on numerous types of electrical equipment to maximize operating life, including inspection, testing, and repair. Services can be provided as part of an ongoing asset-management program or on a task-by-task basis. Routine maintenance includes:

- Safety checkout and visual inspection
- Operational testing

- **Cleaning**
- **Lubrication**
- **Adjustment**
- **Equipment troubleshooting**
- **Repair of non-functional or damaged equipment**

EQUIPMENT RETROFIT AND UPGRADE
S&C upgrade and retrofit programs can include all parts, project coordination, engineering services, and field support necessary to execute the work.

Upgrade and/or retrofit programs are available for:

- Circuit-switchers
- Metal-enclosed switchgear
- Pad-mounted gear
- Source-transfer controls
- Automation systems:
  - Switching equipment including overhead and underground distribution switchgear
  - Software
  - Automatic switch control
  - Communication

EXTENDED WARRANTY
Besides a standard two-year warranty for new equipment, S&C offers an extended-warranty program to help extend the life of new and existing equipment. S&C provides dedicated service visits, equipment troubleshooting, and parts repair and replacement for the duration of the warranty. Contact your local S&C representative for more information.

TRAINING
Our comprehensive training programs are designed to thoroughly familiarize customer personnel with the operations and maintenance of their equipment.

S&C can provide training on a variety of topics, including:

- **On-site training services**
  - Equipment general overview
  - Equipment operation, maintenance, and troubleshooting
  - Refresher courses as required

- **S&C Global Headquarters training**
  - IntelliTeam SG system hands-on operation
  - IntelliTeam fault-simulation training (performed in S&C’s IntelliLab)
  - SCADA training (performed on-site or in S&C’s IntelliLab)
  - Refresher courses as required
APPLICATIONS

SUBSTATIONS
S&C provides turnkey services for building substations, including physical design engineering, protection and control design engineering, detailed installation drawings, contractor selection and oversight, on-site testing and commissioning, and asset-management services.

RENEWABLE ENERGY PROJECTS
For both wind and solar applications, S&C works with you and the local utility to find the most economical and feasible solutions to deliver the best long-term value. S&C is an industry leader in renewable energy solutions, providing:
- Medium-voltage protection and control equipment specifically for renewable energy installations
- Extensive working experience and strong relationships with local utilities and ISOs
- Full EPC approaches to reduce system footprints, construction costs, and project schedules
- Standard equipment packages to help reduce equipment and installation lead times by up to 60%

SMART GRIDS
S&C’s smart grid solutions feature best-in-class software, switching, and communications products to provide advanced system-automation capabilities. From S&C metal-enclosed switchgear to service-restoration software, customers get the most out of S&C smart grid products when combined with our engineering, installation, commissioning, monitoring, and asset-management services.

MICROGRIDS
Microgrids are inherently complex. Integrating a variety of distributed generation sources together into one electrical system is a challenging task, which is further complicated by achieving microgrid functionality such as load shedding, islanding, and self-healing. From analysis and engineering to monitoring and maintenance, S&C works with customers to design and implement complex microgrid systems for various applications. In addition to providing comprehensive EPC services, S&C also manufactures the core components of a microgrid: the controller and the switchgear. While competitors package these components in a variety of ways, S&C is the only integrator in the industry to provide all key components necessary for a total microgrid project.
S&C Pad-Mounted Gear is available in 68 manual and power-operated models and in a wide variety of circuit configurations, ratings, and options, offering unsurpassed flexibility to your underground distribution system. All models reflect S&C’s uncompromising design and classic quality for ease of installation, operator convenience, and years of maintenance-free service. You can choose PMH gear with directly accessible components or PME gear with elbow-connected components.

Both PMH and PME gear feature S&C Mini-Rupter® Switches. These rugged switches are specifically designed to handle all three-phase live-switching duties, including load dropping and fault closing. Tap protection is provided by S&C Power Fuses or Fault Fiter® Electronic Power Fuses. Permanently and fault closing. Tap protection is provided by S&C Power Fuses—available in a wide choice of ampere ratings and time-current characteristics (TCCs)—provide superb protection against the full spectrum of fault currents and precise coordination with all upstream and downstream devices. S&C Fault Fiter Electronic Power Fuses, with their exceptional TCC versatility, provide features and performance previously unavailable in any protective device.

MANUALLY OPERATED MODELS

Manual PMH Models with directly accessible components are available in ratings of 14.4 kV and 25 kV. They feature 600-ampere three-pole switching of source circuits using external handle-operated Mini-Rupter Switches and 200-ampere single-pole switching of tap circuits using S&C’s Uni-Rupter® Interrupter. Tap protection is provided by S&C Type SML-20 or SML-4Z Power Fuses, Fault Fiter Electronic Power Fuses, or a variety of current-limiting fuses.

With the PMH gear’s readily accessible components, circuits are quickly and easily switched and tested for voltage. Grounding provisions are simple, direct, and visible. The operator can easily visualize the circuitry and see all components being operated. Each circuit is segregated by barriers, as is the interconnecting bus.

Manual PME Models with elbow-connected components are also available in ratings of 14.4 kV and 25 kV. They bring 600-ampere three-pole switching using Mini-Rupter Switches and tap protection through 200 amperes using S&C Type SME-20 or SME-4Z Power Fuses, Fault Fiter Electronic Power Fuses, or a variety of current-limiting fuses.

In PME gear, switch and fuse components are enclosed and protected within an inner air-insulated, grounded steel compartment that keeps out foliage, wildlife, and contaminants, and it reduces exposure to energized live parts. Viewing windows in switch-termination compartments allow visual verification of the Mini-Rupter Switch blade position. There’s no need to move 600-ampere elbows to establish working clearances.

Source-transfer models are available in the same ratings and design features as Manual PMH and PME Models, but they feature Mini-Rupter Switches powered by stored-energy operators.

Source-transfer models are totally self-contained switching and protection packages. Each is completely factory-assembled and ready for installation. No external wiring or control power is required.

Construction details of Source-Transfer PMH and PME Models are shown on pages 26 and 27.

Remote Supervisory PMH and PME Models feature power-operated Mini-Rupter Switches that respond to opening and closing signals from a remote location. These models can be specified with a communication and control equipment group for a completely integrated and self-powered automated switching and protection package.

The communication and control equipment group includes a battery and battery charger; a voltage sensor for single-phase voltage sensing and a control-power source; three-phase current sensing on power-operated switches; a user-specified remote terminal unit or 6800 Series Automatic Switch Control, which supports the IntelliTeam® SG Automatic Restoration System; and a communication device. No external wiring or control power is required. Just connect the power cables, configure the remote terminal unit (RTU), and the gear is ready for service.

Construction details of Remote Supervisory PMH and PME Models are shown on pages 26 and 27.

The Rural Utilities Service has accepted suitably equipped PMH Models and all PME Models of S&C Pad-Mounted Gear.
Circuit Configurations

**MANUAL PMH MODELS**

- PMH-3
- PMH-4
- PMH-5
- PMH-6
- PMH-7
- PMH-8
- PMH-9
- PMH-10
- PMH-11
- PMH-12
- PMH-13
- PMH-14
- PMH-15
- PMH-16
- PMH-17
- PMH-18
- PMH-19

**SOURCE-TRANSFER PMH MODELS**

- PMH-6
- PMH-9

**SOURCE-TRANSFER PME MODELS**

- PME-6
- PME-9

**MANUAL PME MODELS**

- PME-4
- PME-5
- PME-6
- PME-7
- PME-8
- PME-9
- PME-10
- PME-11
- PME-12

**REMOTE SUPERVISORY PMH MODELS**

- PMH-3
- PMH-5
- PMH-6 with 1 or 2 Switch Operators
- PMH-7 with 1 or 2 Switch Operators
- PMH-8 with 1 or 2 Switch Operators
- PMH-9 with 1 or 2 Switch Operators
- PMH-10 with 1 or 2 Switch Operators
- PMH-11 with 1, 2, or 3 Switch Operators

**REMOTE SUPERVISORY PME MODELS**

- PME-5
- PME-6 with 1 or 2 Switch Operators
- PME-7 with 1 or 2 Switch Operators
- PME-8 with 1 or 2 Switch Operators
- PME-9 with 1 or 2 Switch Operators
- PME-10 with 1, 2, 3, or 4 Switch Operators
- PME-11 with 1, 2, or 3 Switch Operators
PMH Models—Fuse* and Switch Compartments

**S&C’s Uni-Rupter® Interrupter**—provides the ultimate in single-pole live switching—just a firm opening pull on the fuse interrupts the circuit with a quick-break action; the Uni-Rupter Interrupter self-resets for the next opening operation. Separate current-carrying and fault-closing contacts are provided.

**Cypoxy™ Insulators**, S&C’s cycloaliphatic epoxy resin system, insulate all live parts from ground.

**S&C’s Ultradur™ II Outdoor Finish** provides superb corrosion resistance.

**Dual-purpose front barriers of GPO3-grade, fiberglass-reinforced polyester**—guard against inadvertent contact with live parts when in the normal vertical position; inserted into the open gap of a switch or fuse, the barrier provides isolation from bus and upper contacts.

**Corrosion-resistant non-ferrous door hinges and hinge pins**

**Insulated roof**—“No-drip” compound on the underside of the roof guards against formation of condensation that could drip onto energized parts.

**Segregated circuits**—Full-length steel barriers separate side-by-side compartments; GPO3-grade, fiberglass-reinforced polyester barriers separate front compartments from rear compartments and isolate the interconnecting bus.

**Optional base spacer**—increases elevation of the gear up to 24 inches to provide additional cable-training space or additional distance above the ground.

**Dual-purpose front barriers of GPO3-grade, fiberglass-reinforced polyester**—guard against inadvertent contact with live parts when in the normal vertical position; inserted into the open gap of a switch or fuse, the barrier provides isolation from bus and upper contacts.

**Grappler™ Handling Tool**—takes the work out of fuse handling; it provides sure grip, perfect balance, and ready control that operators appreciate.

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**Optional cable guides**—assist in cable training and provide protection against damage from excessive cable or foundation movement.

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**Also Available:**
- Optional stainless steel enclosure
- Optional key-interlock schemes
- Optional inner-barrier panel—meets Rural Utilities Service “dead-front” requirements
- Optional Canadian Standards Association Certification
- Optional UL Listing

* Fuse compartments illustrate a nonstandard combination of Fault Fiter® Electronic Power Fuses (on left) and SML-20 Power Fuses (on right) for comparison only.
**PMH PAD-MOUNTED GEAR**

<table>
<thead>
<tr>
<th>kV</th>
<th>Mini-Rupter® Switch, Amp</th>
<th>Fuse Type</th>
<th>Short-Circuit, Amperes, RMS, Sym.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nom.</td>
<td>Max</td>
<td>BIL</td>
<td>Cont.</td>
</tr>
<tr>
<td>14.4</td>
<td>17.0</td>
<td>95</td>
<td>600</td>
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<td>25</td>
<td>27</td>
<td>125</td>
<td>600</td>
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</tbody>
</table>

① Consult the nearest S&C Sales Office for 50-hertz ratings.

- 25-kV models equipped with Fault Fiter® Electronic Power Fuses are rated 29 kV max.
- SMU-20® Fuse Units are available in ratings through 200K amperes as well as 200E amperes.

- Applicable to solidly grounded-neutral systems only, with fuses connected by single-conductor, concentric-neutral-type cable to a transformer or transformers. Rating is 9,400 amperes, RMS, symmetrical for all other applications.
PME Models—Fuse and Switch Compartments

- **Viewing windows**—allow easy checking of blown-fuse indicators
- **Generous spacing of bushing wells and parking stands**—accommodates a full spectrum of elbows, portable feed-thrus, and accessories
- **200-A Cypoxy™ Insulator bushing wells**—have interfaces in accordance with ANSI/IEEE Standard 386
- **Storage racks**—hold spare Fault Fiter® Fuse Interrupting Modules, SMU-20® Fuse Units, or SM-4® Refill Units, enabling operators to restore service without delay
- **Ground rings**—readily accessible in an up-front location; enclosure doors may be closed with grounding clamps in place
- **Up-front access to fuses**—takes the hassle out of fuse changeout; with an almost effortless pull, the TransFuser™ Mounting unlatches and pivots to its open position, making the de-energized and isolated fuse accessible for easy replacement
### PME PAD-MOUNTED GEAR

<table>
<thead>
<tr>
<th>60-Hz Ratings ①</th>
<th>Mini-Rupter® Switch, Amperes</th>
<th>Fuse</th>
<th>Short-Circuit, Amperes, RMS, Sym.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>kV</strong></td>
<td><strong>Nom.</strong></td>
<td><strong>Max</strong></td>
<td><strong>BIL</strong></td>
</tr>
<tr>
<td>14.4</td>
<td>17.0</td>
<td>95</td>
<td>600</td>
</tr>
<tr>
<td>14.4</td>
<td>17.0</td>
<td>95</td>
<td>600</td>
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<tr>
<td>25</td>
<td>27</td>
<td>125</td>
<td>600</td>
</tr>
</tbody>
</table>

① Consult the nearest S&C Sales Office for 50-hertz ratings.

- **Segregated compartment**—steel barriers isolate side-by-side cable compartments
- **Wide-view, unbreakable, mar-resistant windows**—let the operator verify Mini-Rupter® Switch position and check for a visible break
- **600-A Cypoxy™ Insulator bushings**—have interfaces in accordance with ANSI/IEEE Standard 386
- **Parking stands**—accommodate a variety of accessories
- **Ground rod**—extends full width of each switch compartment; doors may be closed with grounding clamps in place
- **Hinged roof**—allows cable to be pulled up through the roof opening, making installation quicker and easier

**S&C’s Ultradur™ II Outdoor Finish** provides an extremely tough, multistage, baked-on finish with exceptional performance proven by the most rigorous battery of tests in the industry. Featured on both PMH and PME Models.

FUSES
S&C Pad-Mounted Gear offers a wide variety of S&C Power Fuses for protection of your distribution system.

With SML and SME Power Fuses, you can select from a range of ampere ratings and time-current characteristics (TCCs) to achieve close fusing for maximum protection and optimum coordination. TCCs are precise, with only 10% total tolerance in melting current compared with the 20% tolerance of many fuses. The design and construction features of the fusible elements ensure SML and SME Power Fuses conform to their TCCs not only initially but on a sustained basis. They’re nondamageable; TCCs are unaffected by age, corrosion, vibration, or surges that heat the element nearly to the severing point. SML and SME Power Fuses provide superior protection against the full spectrum of fault currents; they detect and interrupt all faults—large, medium, and small (even down to the minimum melting current).

S&C Power Fuses with the Uni-Rupter® Interrupter feature single-pole live switching of single-phase or three-phase load circuits. TransFuser™ Mountings are furnished with 200-ampere bushing wells for loadbreak or non-loadbreak elbow connections to cable.
**Fault Fiter® Electronic Power Fuses** combine an innovative high-tech electronic control module with a unique interrupting module to solve difficult protection and coordination applications. The control module incorporates a current transformer and circuitry to provide current sensing and the TCC as well as the energy to initiate interruption. The Fault Fiter fuse’s unprecedented variety of unique electronically derived TCCs provide superior protection and precise coordination for a wide range of applications. Because the TCC isn’t determined by a fusible element, the Fault Fiter fuse is not susceptible to the protection vagaries of traditional current-limiting fuses.

### SMU-20® Fuse Unit and SM-4® Refill Unit Ratings

<table>
<thead>
<tr>
<th>Speed</th>
<th>Available Ratings, Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&amp;C “K”</td>
<td>SMU-20 Fuse Units: 3K—200K</td>
</tr>
<tr>
<td>S&amp;C Standard</td>
<td>SM-4 Refill Units: 1—200E</td>
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<tr>
<td>S&amp;C Slow</td>
<td>15E—200E</td>
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<tr>
<td>S&amp;C Very Slow</td>
<td>50E—200E</td>
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<tr>
<td>S&amp;C Coordinating</td>
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*Available in 14.4-kV PMH and PME Models only.*

### Fault Fiter® Electronic Power Fuse Ratings

<table>
<thead>
<tr>
<th>Curve Type</th>
<th>Available Ratings, Amperes</th>
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<tbody>
<tr>
<td>Inverse</td>
<td>Max Continuous Current: 600</td>
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<tr>
<td></td>
<td>Minimum Pickup, RMS: 400—1500</td>
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<tr>
<td>Type-Delayed Compound</td>
<td>600</td>
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<tr>
<td></td>
<td>400—1100</td>
</tr>
<tr>
<td>Underground Subloop</td>
<td>600</td>
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<tr>
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<td>400—500</td>
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<tr>
<td></td>
<td>3000, 6000</td>
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<td></td>
<td>3000</td>
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</tbody>
</table>

*For selection and application information or for other curve types, refer to the nearest S&C Sales Office or your S&C Authorized Distributor.*

### Current-Limiting Fuses Accommodated in Fault Fiter Electronic Power Fuse Mountings

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
<th>Current-Limiting Fuse</th>
<th>Rating</th>
<th>Maximum Voltage, kV</th>
<th>Maximum Current, Amperes</th>
<th>For Use in S&amp;C Pad-Mounted Gear Rated, kV</th>
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<tbody>
<tr>
<td>Cooper</td>
<td>Kearney B</td>
<td>8.3</td>
<td>30—112</td>
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<td>Kearney Q</td>
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<td>6.5C—400C</td>
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<td>RTE® ELX</td>
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<td>Combined Technologies X Limiter™</td>
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<td>12—140</td>
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<td>Eaton</td>
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<td>Cutler Hammer CXN</td>
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<td>60C—200C</td>
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<td>15.5</td>
<td>45C—100C</td>
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</table>

*Available in PME models only.*
S&C Vista Underground Distribution Switchgear, available in ratings through 38 kV, features elbow-connected components enclosed in a compact, submersible, SF₆-insulated, welded-steel tank, completely protected from the environment.

Vista switchgear is offered in five styles—the innovative UnderCover™ Style as well as pad-mounted, vault-mounted, manhole, and wind turbine styles. Manual, source-transfer, and remote supervisory versions are available. All models use the same basic components, cutting your operator-training and inventory costs.

Construction details of source-transfer and remote supervisory models are shown on pages 26 and 27. Wind Turbine Style is shown on page 59.

HANDLES MORE LOADS PER UNIT
Vista switchgear is furnished with up to six “ways” per unit, each consisting of one of the following:

- **Bus terminals**
- **A load-interrupter switch** for switching up to 900-ampere main feeders
- **A microprocessor-controlled, resettable arc-spinner or vacuum fault interrupter** for switching and protecting main feeders up to 900 amperes, and 600-ampere or 200-ampere taps, laterals, and subloops

By handling more loads per unit, you need fewer units, saving you money.

PLACE GEAR JUST WHERE IT’S NEEDED
Vista switchgear is submersible and considerably smaller than traditional air-insulated gear, so it can be installed exactly where needed—even subsurface—without compromising aesthetics. Your customers are happier, and you save money through reduced trenching and shorter cable runs.

SAFER TO OPERATE
Ordinary elbow gear does isolate operating personnel from medium-voltage components—that is, until you need to operate it! Consider a routine operation such as isolating a downstream cable for repair. With conventional switchgear, two or more specially trained operators need to:

1. Remove the elbows from their bushings using shotgun clamp sticks, which is a tedious, awkward task.
2. Test the cables using an ungainly clamp-stick-mounted voltage tester.
3. Move the elbows to parking stands, along with grounding bushings or elbows, which also is an unwieldy task.

But with Vista switchgear, just one person using a simple operating handle merely needs to:

1. Rotate the switch operating shaft to the Open position and confirm the open gap through the large viewing window. Because the hinge end of the switch is connected to the bushings, the bushings—and hence the cables—are isolated from other medium-voltage components in the gear.
2. Test for voltage *simply* by using the pushbutton voltage indicator that’s capacitively coupled to the bushings.
3. Rotate the switch operating shaft to the integral Grounded position and confirm grounding through the viewing window.

Vista switchgear is certified arc-resistant per IEC 298, Appendix AA, for arcs occurring internal to the gear.

COMPLETE SYSTEM COORDINATION
Vista Switchgear’s unique microprocessor-based overcurrent control features special, customizable “coordinating” speed time-current characteristic curves (TCCs) that provide complete coordination with upstream relays and downstream fuses. Conventional “E,” “K,” and “T” speed curves are available, too (see page 58).

Separate phase- and ground-overcurrent curves coordinate with source-side breakers having ground-trip settings. Both main and tap curves are provided for complete coordination between fault interrupters applied on main feeders and those applied on subloop taps.

The overcurrent control is programmed with a PC in the shop or in the field … no knobs or dials to compromise security. Simply connect your PC to the USB port covered by a protective cap. All programming software is loaded on the overcurrent control and is easily accessed via a browser. The control also features a handy event recorder that captures information on the last 64 trip events, along with control status and diagnostic information. External trip provisions are optionally available, permitting the fault interrupters to be tripped remotely by external controls or relays.
15-kV UnderCover Style Model 422

Operating panel—located near grade level so UnderCover Style gear is easily operated from a standing position—away from medium-voltage cables

Optional portable motor operator (not shown)—lets you operate any load-interrupter switch or fault interrupter from a remote location

Overcurrent control—readily programmed with your PC

Fault interrupter terminals—equipped with 600-ampere bushings or 200-ampere bushing wells

Large viewing windows—let you see open gap and grounded positions on load-interrupter switches and fault interrupters. Trip indicators are easily checked, too

Switch terminals—equipped with 600-ampere bushings or 200-ampere bushing wells

Bushings and bushing wells—located on one side of the gear, reducing operating space required for elbows and cables

Optional voltage indicator with liquid-crystal display—See detail on page 59; you can check the integrity of the voltage indicator by shining a flashlight on the photocell-powered test circuit while placing a gloved finger over the test button, and no flashlight is needed in daylight

VISTA® UNDERGROUND DISTRIBUTION SWITCHGEAR

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<td>15.5 (12)</td>
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<td>600 (630)</td>
<td>12 500 (12 500)</td>
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</tbody>
</table>

① Main bus rating up to 1200 amperes and fault interrupter and load-interrupter switch rating up to 900 amperes are possible. Consult the nearest S&C Sales Office.

For more information on Vista Underground Distribution Switchgear, see publications 680-30, 681-31, and 681-700 through 681-708 at sandc.com.
**SELECT THE TCC YOU NEED**

The Vista switchgear overcurrent control lets you choose these time-current characteristic curves:

- **“E” speed**—from 25E through 400E amperes
- **“K” speed**—from 25K through 200K amperes
- **“T” speed**—from 8T through 200T amperes

- **Coordinating speed tap**—with minimum pickup settings from 15 through 400 amperes (Perfect for fault interrupters feeding subloop taps, and it optimizes coordination with load-side weak link/backup current-limiting fuse combinations and source-side relays with low time-dial settings.)

- **Coordinating speed main**—with minimum pickup settings from 25 through 800 amperes (Ideal for fault interrupters on main feeders. Curves have longer minimum response times and different shapes to coordinate with tap-interrupter curves.)

Coordinating-speed TCCs can be customized into hundreds of different curves using a variety of definite-time delay (0 through 1,000 seconds) settings.

Negative sequence and sensitive earth fault protection settings are also included.

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**Circuit Configurations**

**MANUAL AND REMOTE SUPERVISORY MODELS**

![Diagram of manual and remote supervisory models]

**MANUAL STYLE MODELS**

![Diagram of manual style models]

**SOURCE-TRANSFER STYLE MODELS**

![Diagram of source-transfer style models]

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① Model number indicates the total number of ways as well as the number of load-interrupter switch ways and fault-interrupter ways. For example, Model 431 has “4” ways—“3” load-interrupter switch ways and “1” fault-interrupter way. Other configurations are available; consult the nearest S&C Sales Office.
Operating panel of Vista switchgear. Viewing windows, for confirming the open gap and grounded position on load-interrupter switches and fault interrupters, are located under the hinged covers of the voltage indicators.

**Vista Models**

- **15-kV Manhole Style Model 110**
- **15-kV Vault-Mounted Style Model 422**
- **38-kV Pad-Mounted Style Model 321**
- **38-kV Wind Turbine-Style Model 101**

---

**Optional voltage indicator with liquid-crystal display**—includes test feature

**Compact welded-steel tank**—protects switching and protection components from the environment; stainless steel construction standard in UnderCover™ Style

**Gas-fill port**

**Pressure gauge** (located under window)—temperature- and altitude-compensated

**Operating mechanisms for switches and fault interrupters**—padlockable in any position

**Operation selector**—prevents inadvertent operation from Closed position directly to Grounded position, and vice versa.

**Microprocessor-based overcurrent control**—housed in watertight enclosure. Current transformers (CTs) (not visible) provide power and signal inputs.
S&C’s Vista SD Underground Distribution Switchgear is solid-dielectric switchgear that reduces the time and complexity of routine switching procedures. It was designed with the user in mind. Key features include:

- **Easy-to-achieve visible break.** No moving cables or using other accessories are needed to achieve a visible break. The isolating disconnect, readily visible through a large 3×5-inch window, provides a true visible break in the circuit.

- **Simple operation.** The manual handle is easy to operate and can be operated by hand, rope, or universal pole with the appropriate fitting. Portable motor operators and accessory pendants are also available.

- **High reliability in challenging applications.** It’s completely submersible and dust-tight.

S&C Vista SD switchgear can be tailored to meet specific installation requirements, with configurations available in any combination of Visi-Gap® Load Interrupter Switches and Visi-Gap® Fault Interrupters, up to six ways in total. Visi-Gap switches are three-pole vacuum load-interrupter switches that provide live switching of 600-ampere main feeders. Visi-Gap Fault Interrupters are microprocessor-controlled vacuum fault interrupters that provide three-pole live switching and protection of 600-ampere main feeders and 200- or 600-ampere taps, laterals, and sub-loops.

The elbow-connected switches and fault interrupters are encapsulated in an environmentally friendly solid-dielectric insulating material.

Each load-interrupter switch and fault interrupter includes a manually operated, two-position isolating disconnect. An easy-to-follow mimic bus and indicators on the front of the switchgear convey the position of each switch and fault interrupter and its isolating disconnect—and whether a fault interrupter has tripped in response to a fault.

Vista SD switchgear can be furnished with up to six “ways” (load-interrupter switches and/or fault interrupters) in ratings through 29 kV and 16 kA symmetrical interrupting. By handling more loads per unit, fewer units of Vista SD switchgear are required.

Each way includes an easy-to-operate manual operating mechanism. Operating mechanisms for fault-interrupter ways are “trip-free,” meaning the opening spring is charged when the closing spring is charged and will open the fault interrupter—based on the time-current characteristic (TCC) curve in the overcurrent control—if the fault interrupter is closed into a fault. Factory-installed and factory-wired motor operators to facilitate remote power operation are optionally available. The operators can be easily decoupled without removing any hardware to permit testing of the motor and controls.

Vista SD switchgear is completely submersible and suitable for application in subsurface vaults subject to flooding. It is also available for above-grade application in pad-mounted style enclosures.

Vista SD switchgear is considerably smaller than traditional air-insulated gear, so it can be installed exactly where it’s needed without compromising aesthetics. Consumers are happier, and you save money through reduced trenching and shorter cable runs.

**SIMPLE TO OPERATE**

With Vista SD Underground Distribution Switchgear, routine operation, such as isolating a downstream cable for repair, is easy. Just one person, using either the manual handle or a suitable user-furnished universal pole equipped with a standard fitting, merely needs to:

1. Place the load-interrupter switch operating mechanism in the Open position and confirm the open gap of the isolating disconnect through the large viewing window.
2. Test for voltage using the optional potential indication feature.

Vista SD switchgear is furnished with a ground-connection pad on each load-interrupter switch and fault interrupter for attaching an elbow ground cable. Continuous ground bus for the entire switchgear assembly is optionally available.

**COMPLETE SYSTEM COORDINATION**

Vista SD Underground Distribution Switchgear is furnished with the same microprocessor-based overcurrent control used in S&C Vista® Underground Distribution Switchgear. It offers special, customizable “coordinating” speed time current characteristic curves that provide complete coordination with upstream relays and downstream fuses. Conventional “E,” “K,” and “T” speed curves are available, too (see page 62).

The overcurrent control is programmed with a PC in the shop or in the field. There are no knobs or dials to compromise security. Simply connect your PC to the USB port covered by a protective cap. All programming software is loaded on the overcurrent control and is easily accessed via a browser. The control features an event recorder that captures information on the last 64 trip operations.

External trip provisions are optionally available, permitting the fault interrupters to be tripped remotely by external controls or relays.
Vista® SD Underground Distribution Switchgear

Vault-Mounted Style

Pad-Mounted Style


All terminals are equipped with 600-ampere bushings with threaded studs. Bushings without studs are optional. Fault interrupters can be optionally furnished with 200-ampere bushing wells. Interfaces conform to ANSI/IEEE 386 and accept all standard insulated connectors and inserts.

<table>
<thead>
<tr>
<th>VISTA® SD UNDERGROUND DISTRIBUTION SWITCHGEAR</th>
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<tbody>
<tr>
<td><strong>System Class</strong></td>
</tr>
<tr>
<td><strong>kV</strong></td>
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<tr>
<td>15 (12)</td>
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<td>27 (24)</td>
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</table>

① Parallel or loop switching. Load-interrupter switches and fault interrupters can switch the magnetizing current of transformers associated with this rating. Unloaded cable switching capability: 10 amperes at 17.5 kV; 20 amperes at 29 kV. Load-interrupter switches and fault interrupters can also switch single capacitor banks through 1800 kvar.

② Applicable to fault closing into closed position.

◆ 200 amperes if fault interrupters are furnished with optional 200-ampere bushing wells.

◆ 12 500 amperes if fault interrupters are furnished with optional 200-ampere bushing wells.
MULTIPLE TCC OPTIONS
The Vista SD Underground Distribution Switchgear overcurrent control lets you choose these time-current characteristic curves:

- **“E” speed**—from 7E through 200E amperes
- **“K” speed**—from 8K through 200K amperes
- **“T” speed**—from 8T through 200T amperes
- **Coordinating speed tap**—with minimum pickup settings from 15 through 400 amperes (Perfect for fault interrupters feeding subloop taps. Optimizes coordination with load-side weak link/backup current-limiting fuse combinations and source-side relays with low time-dial settings.)
- **Coordinating speed main**—with minimum pickup settings from 25 through 800 amperes (Ideal for fault interrupters on main feeders. Curves have longer minimum response times and different shapes to coordinate with tap-interrupter curves.)

Coordinating-speed TCCs can be customized into hundreds of different curves using a variety of definite-time delay (0 through 1,000 seconds) settings. Ground, negative sequence, and sensitive earth fault protective settings are also available.

CIRCUIT CONFIGURATIONS

Vista SD Underground Distribution Switchgear

Model number indicates the total number of ways as well as the number of load-interrupter switch ways and fault-interrupter ways. For example, Model 431 has “4” ways—“3” load-interrupter switch ways and “1” fault-interrupter way. Other configurations are available at sandc.com.
For more information on Vista SD Underground Distribution Switchgear, see S&C publications 695-30 and 695-31 at sandc.com.
THE FUNCTIONALITY OF BREAKER GEAR AT A MUCH LOWER COST

System VI Switchgear, available in ratings through 38 kV, combines the innovative features of Vista® Underground Distribution Switchgear (see pages 56 through 61) with the versatility of Custom Metal-Enclosed Switchgear (see pages 66 through 69). It’s offered in manual, remote supervisory, and source-transfer models.

System VI Switchgear features a modular arrangement of Vista Underground Distribution System sections. Each section includes load-interrupter switches and fault interrupters sealed in an SF₆-insulated, elbow-connected tank. Using gas-tight air-insulated bushings on one or both sides of the tank, multiple sections are joined together with air-insulated transition bays, which can be furnished with metering transformers and other equipment. Transition bays can also be used to connect a System VI Switchgear lineup to Custom Metal-Enclosed Switchgear or to a transformer.

ALL THE ADVANTAGES OF VISTA UNDERGROUND DISTRIBUTION SWITCHGEAR

Like Vista Underground Distribution Switchgear, System VI Switchgear offers:

◆ **Compact, low-profile design.** Even at 34.5 kV, System VI gear can be as little as 37 inches (94 cm) tall. And System VI gear has a significantly smaller footprint than breaker gear.

◆ **Single- or three-phase protection through 900 amperes continuous.** Protected by resettable vacuum fault interrupters.

◆ **No exposure to energized cables and elbows during routine operations.** All switching and grounding operations—even voltage testing—can be performed quickly and easily by a single person from the operating panel.

◆ **Microprocessor-based overcurrent control.** This provides advanced, flexible protection. An external-trip option allows fault interrupters to be tripped from transformer-secondary or sudden-pressure relays.

◆ **It’s affordable.** System VI gear offers significant savings over breaker gear.

System VI Switchgear lineup featuring two four-way Vista Underground Distribution System units, with provisions for future expansion. Transition bays house air-insulated bushings.
### System VI Switchgear with Vista Underground Distribution Switchgear Incoming and Outgoing Sections and Air-Insulated Metering Bay

**Voltage indicators**—lift up to reveal large viewing windows

**Incoming section**—any combination of load-interrupter switches and fault interrupters can be furnished, for a total of five ways per modular tank; unit shown has two load-interrupter switches

**Metering bay**—includes voltage and current transformers (door removed to show internal components)

**Outgoing section**—Unit shown has four ways, each with single-pole fault interrupters; three-pole fault interrupters are also available

**Operating panel with operating mechanisms, viewing windows, optional voltage indicators, and optional low-voltage phasing provisions**—all isolated from medium-voltage cables

**Padlockable lift-up covers**—hinged for convenient access to the operating and termination compartments

**Termination compartment**—accommodates cables, elbows, surge arresters, and feed-thru inserts

**S&C’s Ultradur™ II Outdoor Finish**—the industry’s best finish—protects enclosure from corrosion

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### SYSTEM VI SWITCHGEAR

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① Higher ratings are possible. Consult the nearest S&C Sales Office.

For more information on System VI Switchgear, see S&C publications 691-700 and 691-701 at sandc.com.
CUSTOM METAL-ENCLOSED SWITCHGEAR

Custom Metal-Enclosed Switchgear, rated 4.16 kV through 34.5 kV, features reliable, time-tested fuses and manual or power-operated interrupter switches in rugged 11-gauge steel enclosures. These enclosures are configured into integrated packages that provide application flexibility, operating simplicity, and superior dependability in switching and protecting medium-voltage power circuits in commercial, institutional, industrial, and high-rise installations. S&C’s expertise in this field has been established through nearly 75 years of metal-enclosed switchgear design and manufacture. UL and arc-resistant designs are available.

POWER SYSTEM-MATCHED SWITCHING AND PROTECTION

Full-load switching, plus S&C’s unique one-time and two-time duty-cycle fault closing. S&C interrupter switches carry and interrupt rated load currents, even after being inadvertently closed into available fault currents corresponding to their fault-closing ratings. You can restore power quickly without first having to repair the switches.

One-cycle total clearing with S&C SM Power Fuses. Compare this to the 5 cycles or more required by circuit breakers. This simplifies upstream coordination, minimizes short-circuit stresses on the system.

Choice of unique response curves with maintenance-free S&C Electronic Power Fuses. They provide protection unavailable with any other device—even circuit breakers, with their relays and batteries.

Three-phase protection for three-phase loads. S&C open-phase detectors and overcurrent relays isolate three-phase loads from single-phasing and other open-phase conditions.

Single-phase protection for single-phase loads. Fuses—unlike circuit breakers—selectively isolate only faulted phases of feeders serving single-phase loads.

THREE-FOLD ECONOMY

Low purchase cost. Economies inherent in the interrupter switch and fuse-protection concept translate into significant first-cost savings.

Low installation cost. Metal-enclosed switchgear, light in weight in comparison with breaker gear, is easy to handle and needs no foundation or support channels, only a level floor or pad. Multibay lineups assemble with a minimum of interbay bolting, and inter-unit bus connections need no taping. Simple field assembly—with no relays to set and test—means less time, equipment, and manpower. Future additions are readily accommodated as your system expands.

Low maintenance cost. S&C fuses are nondamageable and do not require any maintenance or calibration to perpetuate the accuracy of their time-current characteristics. S&C interrupter switches are maintenance-free, requiring only an occasional exercising. S&C gear just needs a check of the insulators and, if necessary, a simple cleaning.

SIMPLIFIED POWER-SYSTEM PLANNING

Simple, reliable, economical—Custom Metal-Enclosed Switchgear is readily configured into basic circuit arrangements that make power-system planning and design easy, and implementation is logical and straightforward. The basic arrangements shown on page 69 are often combined to handle even the most complex distribution system needs, ensuring maximum service continuity for extremely critical loads.

<table>
<thead>
<tr>
<th>Switchgear Ratings</th>
<th>Voltage, kV</th>
<th>Nominal</th>
<th>4.16</th>
<th>4.8</th>
<th>13.8</th>
<th>25</th>
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<td></td>
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<td>4.8</td>
<td>5.5</td>
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<td>BIL</td>
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<td>60</td>
<td>60</td>
<td>95</td>
<td>125 or 150</td>
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<td>Main Bus, Continuous, Amperes</td>
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<td>600, 1200, or 2000</td>
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<td></td>
<td>Short-Circuit, and Duty-Cycle Fault-Closing</td>
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<td></td>
<td>Amperes, RMS, Symmetrical</td>
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<td>40 000</td>
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<td></td>
<td>MVA, Three-Phase Symmetrical at Nominal Voltage</td>
<td></td>
<td>270</td>
<td>290</td>
<td>210</td>
<td>330</td>
<td>600</td>
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<tr>
<td>Maximum Three-Phase Load per Fused Feeder (at nominal voltage)</td>
<td>Continuous Load, kVA</td>
<td></td>
<td>5 200</td>
<td>4 300</td>
<td>6 000</td>
<td>5 000</td>
<td>17 200</td>
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<tr>
<td></td>
<td>Permissible Peak Load, kVA</td>
<td></td>
<td>5 700</td>
<td>5 800</td>
<td>6 600</td>
<td>6 700</td>
<td>18 900</td>
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① Consult the nearest S&C Sales Office for 50-hertz ratings.
A radial system is the simplest system and is economical—permits extensive use of dedicated radial circuits. The direct circuitry facilitates quick location and repair of faulted circuits. Segmentation of a distribution system with multiple radial circuits limits the extent of service interruption caused by faults. In this example, the service-entrance bay of the S&C Custom Metal-Enclosed Switchgear is provided with electronic power fuses to achieve full coordination with the upstream protective device.

Common-bus primary-selective S&C Custom Metal-Enclosed Switchgear—ensures a higher level of service continuity (Two utility sources—one source preferred, the other alternate—supply power to the metal-enclosed switchgear. A power-operated interrupter switch for each source plus a source-transfer control effect automatic two-way transfer in primary-selective switchgear. Interrupter switches with power fuses switch and protect the load circuits. In this example, two are manually operated, while the third is power operated, with an electronic overcurrent relay and switch operator providing automatic three-phase isolation when a fuse operates.)

Split-bus primary-selective S&C Custom Metal-Enclosed Switchgear—allows large in-plant systems to be supplied power through one switching center because both utility sources are fully used under normal operation, with the two source interrupter switches closed and the bus-tie switch open; each source, in effect, is the preferred source for its bus section and the alternate source for the other bus section.
CUSTOM METAL-ENCLOSED SWITCHGEAR

MATCHLESS CONSTRUCTION FEATURES ENSURE LONG SERVICE LIFE

**Rugged unitized 11-gauge steel construction.** Each bay is a monocoque unit with an integral channel base around all four sides. There are always double walls between adjoining bays. Accurately formed matching enclosures ensure perfect alignment in multibay lineups.

**No exposed bolts on enclosure sheets or roofs to attract vandals.** Even future bus extensions are internally secured.

**Comprehensive access controls.** All doors have heavy-duty latches and hinges and are padlockable. Manual switch handles are padlockable in Switch-Closed and Switch-Open positions. Snaplocks or interlocks further limit access.

**Wide bulkhead-type doors.** These doors provide convenient front access for cable termination. No need for rear access; gear can be placed back to back or against a wall, in minimal floor space.

**Inner screen doors.** Bolted closed, these doors are a second barrier against inadvertent entry.

**Category A enclosures.** With the simple addition of padlockable covers over windows and meters, S&C gear provides the industry’s highest security for this class of equipment.

**Unique Ultradur® II Outdoor Finish.** The system provides lasting corrosion protection that cuts maintenance costs. And all hardware is galvanized, zinc-nickel plated, or of stainless steel or nonferrous materials to resist corrosion.

**Special gasketing or sealants.** These provide weathertight seals at door openings, top and side edges of adjoining bays and interbay bus openings, and the roof.

**Insulating “no-drip” compound.** Located on the underside of the roof, checks condensation.

**Cypoxy™ Insulators, S&C’s cycloaliphatic epoxy resin system.** These insulate all live parts from ground and provide greater leakage distances. Optional through-bushings provide isolation between bays.

**Heavy-duty bails on all cable-termination points and the ground bus.** These accommodate portable grounding equipment.

**Bus connections.** Protected by an oxide-inhibiting compound, these connectors are bolted to a uniform torque. Special-purpose washers and bolts maintain optimum contact pressure.

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Arc-resistant models—minimize the potential for injury to nearby operating personnel if a fault occurs within the gear (Passes rigorous certification testing requirements of EEMAC Standard G14.1; can be installed outdoors or indoors with suitable venting.)
Interrupter Switches—handle all live-switching duties and feature duty-cycle fault-closing ratings, a requisite for automatic control schemes.

The Mini-Rupter® Switches (pictured)—rated through 600 amperes continuous and interrupting; Alduti-Rupter® Switches rated through 1200 amperes continuous and interrupting are also available.

Type MS Switch Operators—provide high-speed automatic trip-open operation of Mini-Rupter Switches … interrupting time is 4 cycles; these operators are available in a choice of manual or automatic trip-closed operation.

The Type MS-2 Switch Operators (pictured)—ideal for use with the Micro-AT® Source-Transfer Control.

SM Power Fuses—offered in a wide variety of ampere ratings and time-current characteristics, permitting close fusing ratios for optimal coordination and maximum protection; their time-current characteristics are precise and permanently accurate.

The Type SM-40 Power Fuses (pictured)—rated 400 amperes max continuous; other Type SM Power Fuses are available in ratings from 200 through 720 amperes max continuous.

Micro-AT® Source-Transfer Controls—minimize interruptions resulting from loss of one source … transfer is achieved in as little as 20-25 cycles.

The Micro-AT Source-Transfer Controls (pictured)—available with a wide choice of options.

Fault Fiter® Electronic Power Fuses—with their exceptional TCC versatility and higher continuous current ratings, provide features and performance previously unavailable in any protective device.

The Fault Fiter Fuse (pictured)—rated 600 amperes max continuous. Paralleled Fault Fiter Fuses provide 1200-ampere protection.

Electronic Relays—applied on individual load feeders, protect three-phase loads from single-phasing resulting from blown fuses and other open-phase conditions.

The Type ZSD Overcurrent Relays (pictured)—superior to ordinary overcurrent relays; they can distinguish between fault current and transformer inrush current.

A wide choice of S&C components—exhaustively tested, field-proven, and of unequaled performance and operational dependability—all expressly designed to solve your power distribution problems.
THE NEW GENERATION OF PROTECTION FOR POLE-TOP TRANSFORMERS

S&C’s Fault Tamer Fuse Limiter combines a series fuse and backup limiter in one powerful package that can be easily incorporated into new or existing installations of 14.4-kV, 25-kV, and 34.5-kV overhead pole-top transformers. Fault Tamer Fuse Limiters provide short-circuit protection to the system, limit let-through current to a level that will minimize catastrophic transformer failures caused by high-magnitude internal faults, and minimize damage from high-magnitude external faults such as bushing flashovers. Fault Tamer Fuse Limiters offer major benefits over conventional fuse cutouts, including cutouts appended with bolt-on backup current-limiting fuses.

IMPROVED SERVICE CONTINUITY

Conventional fuse cutouts have limitations that can compromise service continuity. For example, close to substations—where fault currents can be high—complete coordination frequently is not possible between the fuse link protecting a pole-top transformer and the upstream lateral fuse link. As a result, a large-magnitude fault, such as a wildlife-induced flashover of a transformer bushing, cannot only cause the transformer fuse link to operate but the lateral fuse link as well, exposing all customers on the lateral to an extended outage. Fault Tamer Fuse Limiters eliminate this problem because they coordinate with lateral fuse links over the full range of fault currents.

And, unlike conventional cutouts, a Fault Tamer Fuse Limiter’s current-limiting action provides clearing characteristics that coordinate with the instantaneous setting of the substation circuit breaker, thus eliminating unnecessary momentary interruptions for transformer faults exceeding the breaker’s instantaneous setting.

ENHANCED POWER QUALITY

High-magnitude faults near a substation can suppress the voltage on the substation bus and on feeders emanating from the substation. The Fault Tamer Fuse Limiter’s current-limiting action clears high-magnitude transformer faults before voltage dips can damage or shut down sensitive electronic equipment served by adjacent feeders.

MAXIMUM SURGE PROTECTION

Voltage surges are a major cause of overhead transformer failure. Maximum protection from overvoltages can be achieved by mounting the surge arrester on the transformer tank, thus shortening the lead from the arrester to the transformer winding and to ground. But with the surge arrester connected to the load side of a conventional cutout, the fuse link is more susceptible to nuisance operation from lightning strikes. The Fault Tamer Fuse Limiter’s high inrush-withstand capability eliminates this problem because arresters can be tank-mounted without concern for nuisance fuse operations.

IMPOSSIBLE TO MISMATCH SERIES FUSE AND LIMITER

In cutouts with bolt-on backup current-limiting fuses, it’s possible to inadvertently apply the wrong size fuse link, thus jeopardizing the integrity of your coordination plan. But the clearing characteristics of the Fault Tamer fuse cartridge are matched to that of the backup limiter so coordination is ensured.

SIMPLER HANDLING

Re-fusing a bolted-in backup current-limiting fuse means climbing the pole, or using a bucket truck, to remove the fuse with a wrench—a time-consuming procedure that requires wearing gloves and other safety garb.

But re-fusing Fault Tamer Fuse Limiters is quick and easy. Because the device’s combination fuse tube and backup limiter drops open after a fault-clearing operation, it can be removed from the mounting from the ground using an extendostick. The process is made even easier by use of S&C’s Talon™ Handling Tool.

RETROFIT EXISTING INSTALLATIONS

Fault Tamer Fuse Limiters are designed to fit into all vintages of S&C and MacLean Power Systems Type XS Fuse Cutout Mountings. You can upgrade to the Fault Tamer Fuse Limiter’s superior current-limiting protection at minimal cost.

HEIGHTENED SAFETY

The Fault Tamer device’s backup limiter features internal exhaust control, which prevents fuse-cartridge parts from being expelled during a fault-clearing operation. In contrast, conventional fuse cutouts—even fuse cutouts with bolted-on backup current-limiting fuses—can violently expel fuse-link parts during operation, creating a potential exhaust hazard to operating personnel.

As such, the Fault Tamer Fuse Limiter provides an extremely significant reduction in fire hazard when compared with conventional fuse cutouts. The device complies with Spark Production Class A in Australian Standard AS 1033.1-1990, which requires that no sparks may be produced during a fault-clearing operation.

MATES PERFECTLY WITH LOADBUSTER®—THE S&C LOADBREAK TOOL

Using S&C’s portable loadbreak tool, live switching can be done at the point that minimizes the length of planned outages and the number of customers affected.
For more information on the Fault Tamer Fuse Limiter, see publications 451-30 and 451-31 at sandc.com.

### Fault Tamer Fuse Limiter TCC Curves

![TCC Curve Diagram]

**Optional features** include NEMA Type B and extended mounting brackets, and stainless steel inserts and hardware.

**Attachment hooks for Loadbuster** — The S&C Loadbreak Tool — also guide tube during closing

**Spring-and-cable assembly** — Stainless steel spring provides high-speed elongation of arc when fuse cartridge operates; copper cable inside spring carries load (and fault) current

**Trunnion**

**Fuse-cartridge** — replaced after a fault-clearing operation

**Dropout mechanism** — provides dropout indication of operation

**Fuse-tube cap**

**Backup limiter** — replaced after a high-magnitude fault-clearing operation

**Parallel-groove connector** — other styles are available

**Birdproof-design porcelain insulator** — exceeds insulation requirements specified in ANSI cutout and IEC high-voltage fuse standards

---

### FAULT TAMER FUSE LIMITER

**50/60-Hz Ratings**

<table>
<thead>
<tr>
<th>System Class, IEEE (IEC)</th>
<th>Voltage, kV</th>
<th>Amperes, RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60 Hz</td>
<td>50 Hz</td>
</tr>
<tr>
<td>15 (12)</td>
<td>15</td>
<td>8.7</td>
</tr>
<tr>
<td>15 (12)</td>
<td>15</td>
<td>8.7</td>
</tr>
<tr>
<td>25 (24)</td>
<td>29</td>
<td>16.8</td>
</tr>
<tr>
<td>25 (24)</td>
<td>29</td>
<td>16.8</td>
</tr>
<tr>
<td>25 (24)</td>
<td>29</td>
<td>16.8</td>
</tr>
<tr>
<td>22/38 (20.8/34)</td>
<td>—</td>
<td>22</td>
</tr>
</tbody>
</table>

1. Also applies to phase-to-phase applications. Applications involving single-phase transformers connected phase-to-phase, as well as three-phase applications, require the use of a Fault Tamer Fuse Limiter in each lead.


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Also available with composite-polymer silicone insulator — lighter and more rugged, and provides better dielectric performance in hostile environments.
**TYPE XS FUSE CUTOUTS**

**AN UNEXCELLED CUTOUT**
Type XS Fuse Cutouts, when fused with S&C Positrol® Fuse Links, provide full fault-spectrum protection for overhead distribution systems rated 4.16 kV through 25 kV, whether applied to overhead transformers, capacitors, cables, or lines. This performance also extends to solidly grounded systems rated 26.4 kV through 34.5 kV for protection of single-phase-to-neutral lines and transformers and grounded-wye connected capacitor banks. “Full fault-spectrum protection” means Type XS Fuse Cutouts interrupt all faults—from the lowest current that will melt the fuse link to the maximum rated interrupting current—under all realistic transient recovery-voltage conditions.

**SINGLE VENTING – DOWN AND AWAY**
All Type XS Fuse Cutouts use an S&C-developed innovation: single venting… down and away only … an especially important feature where exhaust must be kept out of other phases in overbuilt circuits. There are no costly-to-replace expendable fuse-tube caps.

**VOLTAGE RATINGS**
Type XS Fuse Cutouts are assigned single-value nominal voltage ratings and can be applied without restriction on all three-phase systems having a system maximum operating voltage (line to line) less than or equal to the cutout maximum voltage. In highly contaminated environments, a cutout with a higher voltage rating may be used to provide extra leakage distance.

**RUGGEDNESS**
The mechanical construction of the Type XS Fuse Cutout is rugged and strong: it is designed to withstand the interruption forces of heavy fault currents and the typically forceful closing-in by operating personnel.

The upper contact and the hinge are attached to husky steel supports by means of ½-inch galvanized steel carriage bolts and are further secured by a key-and-slot construction designed to resist torsional forces during closing operations.

**SUPERB CURRENT TRANSFER**
Upper and lower contacts feature heavily silver-clad, spring-loaded, embossed surfaces for built-in wiping action, resulting in minimum electrical resistance.

**SUPERIOR MECHANICAL PERFORMANCE FEATURES**
- **Simple fuse-link installation.** Even with gloved hands, the carefully proportioned flipper can be readily held in place while the large, easy-to-grasp cable clamping nut is being tightened.
- **Easy fuse-tube insertion and removal.** Careful steering or manipulation is not required to hang the tube in the cutout or to remove it. The fuse-tube lower ferrule can be hookstick-engaged either by its large, accessible lifting ring or its equally accessible hookstick keyhole.
- **Superb alignment when closing.** From the front or side and from the pole, the ground, or a bucket truck. In the first stage of closing, the fuse tube is restrained from tilting left or right by broad guiding surfaces at the hinge. When the tube is slammed into the upper contact, it is further controlled by Loadbuster®—The S&C Loadbreak Tool attachment hooks. At the end of the closing stroke, the fuse-tube cap wipes in and seats squarely in the detent-type latch, which won’t rebound and release like so-called “positive” latches.
- **No fuse-link breakage.** The high reduction ratio of the Type XS Fuse Cutout flipper lever system allows the high-impact forces on closing to be absorbed before they reach the fuse link.
- **Completely reliable dropout action.** Regardless of fault-current level. As the high-speed, spring-loaded flipper rapidly withdraws the fuse-link cable, the hinge toggle is released, permitting the upper-contact spring to drive the fuse tube down and away into the open position.

**EVERY TYPE XS FUSE CUTOUT IS A LOAD-SWITCHING POINT**
When used with the Loadbuster tool, the cutout becomes a switching device for no-external-arc live switching of transformers, capacitors, lines, or cables. There’s no need for complex dead-switching procedures. You can minimize the length of planned outages and the number of customers involved.

The XS Fuse Cutout’s Loadbuster attachment hooks keep the portable tool positively anchored throughout its entire opening stroke, yet allow for easy removal of the Loadbuster tool. Attaching the Loadbuster tool to the XS Fuse Cutout cannot cause the fuse tube to drop open prematurely.

*Single-shot Overhead—Pole-Top Style Type XS Fuse Cutouts are sold in the United States and Canada by MacLean Power Systems, macleanpower.com.*
For more information on Type XS Fuse Cutouts, see publications 351-30, 351-31, and 351-705 at sandc.com.

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### TYPE XS FUSE CUTOUTS

#### 50/60-Hz Ratings

<table>
<thead>
<tr>
<th>kV</th>
<th>Nom. Max BIL</th>
<th>Cont.</th>
<th>Intern. Asym. 60 Hz</th>
<th>Asym. 50 Hz</th>
<th>Leakage Distance to Ground, Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.4</td>
<td>15</td>
<td>110</td>
<td>10,000</td>
<td>8,000</td>
<td>8½ inches</td>
</tr>
<tr>
<td>25</td>
<td>27</td>
<td>125</td>
<td>10,000</td>
<td>8,000</td>
<td>11 inches</td>
</tr>
<tr>
<td>150</td>
<td>100</td>
<td>8,000</td>
<td>6,400</td>
<td>17 inches</td>
<td>432 mm</td>
</tr>
<tr>
<td>Disconnect 300</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

- Meets 170-kV BIL rating requirement of IEC Publication 282-2.

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Optional features include NEMA Type B and extended mounting brackets and a sea-coast design featuring stainless steel components and hardware.
Positrol Fuse Links, with their precise time-current characteristics (TCC), nondamagable fusible elements, and superior fault-interrupting ability, give you the ultimate in fuse-link performance. They eliminate “sneakouts” (uncoordinated blowings caused by TCC shifts) and the need to call on upstream protective devices to do the fuse link’s work, thereby saving operating dollars and improving service reliability—two factors that are crucial in today’s competitive environment. The exceptional features of Positrol Fuse Links make all of these benefits possible.

**Nondamagable and Permanently Accurate**

Positrol Fuse Links aren’t affected by aging, vibration, or surges that heat the element nearly to the severing point. They’re nondamagable, so they operate only when they should—not when they shouldn’t. They won’t sneak out.

To a utility, the savings are significant. Positrol Fuse Links eliminate those costly excursions to find and replace needlessly blown fuse links.

And because Positrol Fuse Links are nondamagable, there’s no need for “safety zones” or “setback allowances.” Close fusing is achievable without fear that changes in time-current characteristics will occur—causing troublesome departures from your carefully orchestrated protection and coordination plans. The enduring permanency of Positrol TCCs has been repeatedly demonstrated by exhaustive full-scale laboratory testing.

**Tight Tolerances**

Positrol Fuse Links have exceptionally tight tolerances—typically half those of other fuse links—which means they can be counted on to clear faults faster. Tight tolerances and nondamagability combine to allow you to choose a minimum-size link for each application, ensuring maximum protection and enhanced coordination. With Positrol Fuse Links, you can even coordinate adjacent ampere ratings.

These superb performance characteristics of Positrol Fuse Links are the result of uncompromising design, plus diligent attention to manufacturing details. The fusible elements of silver, silver-copper eutectic, and nickel-chrome (depending on rating) are inherently nondamagable. Wire materials of carefully checked purity and conductivity are drawn through precision dies to exact cross sections confirmed by laser micrometer. And painstaking assembly ensures no nicks, no kinks, and no necking down that might compromise TCC accuracy. Elements are swaged to their terminals for permanent, nondamagable connections.

**Superior Fault-Interrupting Performance**

The fuse link—not the cutout fuse tube—determines the ability of a cutout to interrupt low-magnitude fault currents, particularly transformer secondary-side faults with their severe transient recovery voltages (TRVs). Extensive testing through the full spectrum of secondary faults—with realistically severe TRVs—has proved the matchless performance of Positrol Fuse Links, whether applied in single-vented or double-vented cutouts. These links, with their controlled-burst-strength extruded thermoplastic sheaths, reliably interrupt all levels of secondary-fault currents on systems through 27 kV and in single-phase-to-neutral applications on systems through 38 kV.

**Broad Selection of Speeds**

Positrol Fuse Links are available in six speeds: T, K, QR (interchangeable with “QA” speed offerings), N, Standard, and Coordinating.

All these speeds, plus a selection of current ratings from 1 through 200 amperes, make optimal coordination and maximum protection a practical reality at every sectionalizing point, riser pole, distribution transformer, and capacitor bank.

**Easy to Apply**

Easy-to-use application information, developed with the same attention to detail as the Positrol Fuse Links themselves, is available to facilitate selection of S&C Fuse Links. Request S&C Data Bulletin 350-110 for transformer protection, S&C Data Bulletin 350-130 for capacitor protection, or S&C Information Bulletin 352-170 for series coordination. These comprehensive application guides take the work out of selecting the fuse link best suited to each protection requirement.

Positrol Fuse Links are Rural Utilities Service accepted.
POSITROL FUSE LINK RATINGS

<table>
<thead>
<tr>
<th>Speed</th>
<th>Available Ratings, Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>1 – 200</td>
</tr>
<tr>
<td>K</td>
<td>6K – 200K</td>
</tr>
<tr>
<td>T</td>
<td>6T – 200T</td>
</tr>
<tr>
<td>N</td>
<td>5N – 200N</td>
</tr>
<tr>
<td>QR</td>
<td>1QR – 200QR</td>
</tr>
<tr>
<td>Coordinating</td>
<td>101 – 103</td>
</tr>
</tbody>
</table>

Removable buttonhead—permits use of Positrol Fuse Links in cutouts with or without arc-shortening rod.

Helically coiled fusible element—not subject to mechanical or thermal stresses or damage from vibration.

Strain wire—restrains static force of the cutout flipper spring.

Terminals are swaged—not soldered, providing nondamageable element connections plus a permanent grip of the strain wire and cable.

Swaged cable section—prevents splaying of strands and wadding of cable during the interrupting process, ensuring positive withdrawal of the cable from the sheath.

Controlled-burst-strength sheath—for unmatched full-fault-spectrum interrupting performance.

Tinned copper stranded cable—resists corrosion and is of a diameter sized to resist corona.

For more information on Positrol Fuse Links, see S&C publications 352-30 and 352-31 at sandc.com.
SMD Outdoor Distribution Fuses are internationally recognized for their superb protection of transformers, lines, cables, and capacitor banks in distribution substations and on overhead feeders. SMD-20 and SMD-40 Power Fuses, with their SMU Fuse Units, provide full-fault-spectrum protection. They detect and interrupt all faults—large, medium, and small (even down to minimum melting current)—with line-to-line or line-to-ground voltage across the fuse, whether the fault is on the primary or secondary side of the transformer and regardless of the transformer-winding connection.

SMD-20 Power Fuses are designed expressly for today’s distribution systems, where higher fault currents, higher voltages, and higher loads commonly push cutouts beyond their capabilities. SMD-40 Power Fuses are specially suited to the high continuous-current and fault-interrupting requirements of distribution substations.

SMD-20 Power Fuses are offered in the pole-top style for overhead use as well in four different station styles, in voltages through 38 kV and a continuous-current rating of 200 amperes. Interrupting ratings are as follows:

<table>
<thead>
<tr>
<th>SMD-20 POWER FUSES</th>
<th>Voltage Rating, kV</th>
<th>Interrupting Rating, Amperes, RMS, Sym.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nom.</td>
<td>Max.</td>
<td>60 Hz</td>
</tr>
<tr>
<td>14.4</td>
<td>17.0</td>
<td>14 000</td>
</tr>
<tr>
<td>25</td>
<td>27</td>
<td>12 500</td>
</tr>
<tr>
<td>34.5</td>
<td>38</td>
<td>10 000</td>
</tr>
</tbody>
</table>

SMD-20 Power Fuses use a unique solid-material, low-arc-energy technique of fault interruption that produces a mild exhaust, with only 20% the arc energy of a cutout. Clearances can be keyed to fuse-handling requirements, not fuse-exhaust behavior, allowing structures to shrink to minimum phase spacings.

SMD-40 Power Fuses are offered in vertical and cluster styles for substation use, in voltages through 29 kV and a continuous-current rating of 400 amperes. Interrupting ratings are as follows:

<table>
<thead>
<tr>
<th>SMD-40 POWER FUSES</th>
<th>Voltage Rating, kV</th>
<th>Interrupting Rating, Amperes, RMS, Sym.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nom.</td>
<td>Max.</td>
<td>60 Hz</td>
</tr>
<tr>
<td>4.8</td>
<td>5.5</td>
<td>25 000</td>
</tr>
<tr>
<td>14.4</td>
<td>17.0</td>
<td>25 000</td>
</tr>
<tr>
<td>25</td>
<td>29</td>
<td>20 000</td>
</tr>
</tbody>
</table>

SMD-40 Power Fuses use the same time-proven low-arc-energy fault-interrupting technique as SMD-20 Power Fuses. A stainless steel outdoor silencer virtually eliminates the noise and reaction forces ordinarily associated with outdoor power fuses. These lightweight fuses are easily handled using a universal pole equipped with an S&C Large Clamp.

SMU Fuse Units … Precise Performance
SMU-20® and SMU-40 Fuse Units have silver or pretensioned nickel-chrome fusible elements that are drawn through precision dies to very accurate diameters and are of solderless construction, brazed into their terminals. Melting time-current characteristics are precise, with only 10% total tolerance in melting current, compared to the 20% tolerance of most fuses.

… Nondamageable Construction
Helical coiling of the fusible elements and the absence of constraining filler materials result in elements that are free from mechanical and thermal stresses. SMU Fuse Units conform to their time-current characteristics—not only initially, but on a sustained basis. Neither age, corrosion, or vibration, nor surges that heat the element nearly to the severing point, will affect the characteristics of these fuse units. With nondamageable construction, there is no need to adjust the minimum melting curves for “safety zones” or “setback allowances” as required for other fuses.

… Superior Loading Capability
SMU Fuse Units are designed to accommodate, not interrupt, all anticipated loading levels, including daily and repetitive peak loads as well as hot- and cold-load inrush currents. Unlike current-limiting fuses, SMU Fuse Units have peak-load capabilities in excess of their normal ampere rating. This generous loading capability, combined with precise conformance to time-current characteristic (TCC), nondamageability, and a broad selection of fuse-unit ampere ratings and speeds, permits the ultimate in close fusing for maximum protection and optimal coordination.

… Outstanding Protection for Transformers
The exceptional peak-load capabilities of SMU Fuse Units permit the use of low fusing ratios while accommodating the high loading and inrush currents of distribution transformers. These low fusing ratios mean fast clearing of faults. Transformer mechanical and thermal stresses are minimized, extending transformer life, and the faulted
transformer is quickly isolated, minimizing the impact on the
distribution system. In contrast, current-limiting fuses provide
significantly less through-fault protection because their
susceptibility to damage, limited loadability, and steep TCCs
result in the need for markedly higher ampere ratings.

… FOR CAPACITOR BANKS
In protecting pole-top and small-station capacitor banks, the
high peak-load capabilities again allow exceptionally close
fusing, so even evolving faults within individual capacitor
units can be detected and cleared.

… AND FOR SECTIONALIZING POINTS
When installed at sectionalizing points and cable risers, these
fuses protect against permanent faults and coordinate easily
with reclosers. The low fusing ratios possible with SMU-20
and SMU-40 Fuse Units permit upstream protective devices
to be set for faster operation, reducing system short-circuit
stresses. And SMU Fuse Units’ TCC curve shapes facilitate
complete coordination with downstream protective devices.

EVERY SMD-20 AND SMD-40
POWER FUSE IS A LOAD-SWITCHING DEVICE
When used with Loadbuster®—The S&C Loadbreak Tool,
SMD-20 and SMD-40 Power Fuses become switching devices
for no-external-arc live switching of transformers, lines,
cables, and capacitors. There’s no need for complex system-
switching procedures—you can minimize the length of
planned outages and the number of customers involved.

<table>
<thead>
<tr>
<th>SMU Fuse Unit Ratings</th>
<th>Available Ratings, Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SMU-20 Fuse Units</td>
</tr>
<tr>
<td>S&amp;C K</td>
<td>3K—200K</td>
</tr>
<tr>
<td>S&amp;C Standard</td>
<td>1—200E</td>
</tr>
<tr>
<td>S&amp;C Slow</td>
<td>15E—200E</td>
</tr>
<tr>
<td>S&amp;C Very Slow</td>
<td>50E—200E</td>
</tr>
<tr>
<td>S&amp;C DR</td>
<td>3DR—200DR</td>
</tr>
</tbody>
</table>

SMD-20 and SMD-40 Power Fuses are Rural Utilities Service accepted.
**Overhead—Pole Top-Style SMD-20 Mountings**

**Latch and upper-contact assembly**—prevents the fuse unit from dropping open because of vibration or shock or when hot-washed; ensures positive latch release for the dropout when the fuse unit operates.

**Models through 25 kV are available with a composite-polymer silicone insulator**—lighter and more rugged, and it provides better dielectric performance in hostile environments.

**Models through 35 kV are available with porcelain insulator**—provides insulation characteristics higher than IEEE distribution-cutout standards and equal in most cases to IEEE switch and bus standards; available with stainless steel inserts and hardware.

Mounting bracket and hardware are included for both insulator models.

**Silver-clad contacts throughout**—backed by prestressed loading springs, feature built-in wiping action.

**Hinge-and-lower-contact assembly**—guides fuse unit during closing for on-center approach, even when operated from an adverse angle.

**Station-Style SMD-20 Mountings**

Available with Cypoxy™ or porcelain station-post insulators.

---

**OVERHEAD—POLE-TOP STYLE SMD-20 MOUNTINGS**

<table>
<thead>
<tr>
<th>kV</th>
<th>Nom.</th>
<th>Max</th>
<th>BIL</th>
<th>Inter., Sym.</th>
<th>Polymer Insulator</th>
<th>Porcelain Insulator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amperes, RMS</td>
<td>60 Hz</td>
<td>50 Hz</td>
<td>Inches</td>
<td>mm</td>
<td>Inches</td>
</tr>
<tr>
<td>14.4</td>
<td>17.0</td>
<td>125</td>
<td>200E or 200K</td>
<td>14 000</td>
<td>11 200</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150</td>
<td>200E or 200K</td>
<td>14 000</td>
<td>11 200</td>
<td>19</td>
</tr>
<tr>
<td>25</td>
<td>27</td>
<td>150</td>
<td>200E or 200K</td>
<td>12 500</td>
<td>10 000</td>
<td>—</td>
</tr>
<tr>
<td>34.5</td>
<td>38</td>
<td>200</td>
<td>200E or 200K</td>
<td>10 000</td>
<td>8 000</td>
<td>—</td>
</tr>
</tbody>
</table>

**STATION STYLE SMD-20 MOUNTINGS**

<table>
<thead>
<tr>
<th>kV</th>
<th>Nom.</th>
<th>Max</th>
<th>BIL</th>
<th>Inter., Sym.</th>
<th>Leakage Distance to Ground, Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amperes, RMS</td>
<td>60 Hz</td>
<td>50 Hz</td>
<td>Inches</td>
<td>mm</td>
</tr>
<tr>
<td>14.4</td>
<td>17.0</td>
<td>110</td>
<td>200E or 200K</td>
<td>14 000</td>
<td>11 200</td>
</tr>
<tr>
<td>25</td>
<td>27</td>
<td>150</td>
<td>200E or 200K</td>
<td>12 500</td>
<td>10 000</td>
</tr>
<tr>
<td>34.5</td>
<td>38</td>
<td>200</td>
<td>200E or 200K</td>
<td>10 000</td>
<td>8 000</td>
</tr>
</tbody>
</table>
**Station—Vertical-Style SMD-40 Mountings**

Similar to SMD-20 Cluster Station-Style Mounting (see page 78), the **SMD-40 Mounting** is available in a cluster-style configuration with Cypoxy™ or porcelain station post insulators.

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**STATION—VERTICAL STYLE SMD-40 MOUNTINGS**

<table>
<thead>
<tr>
<th>Nom.</th>
<th>Max</th>
<th>BIL</th>
<th>Max</th>
<th>Amperes, RMS</th>
<th>Leakage Distance to Ground, Minimum</th>
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<tr>
<td></td>
<td></td>
<td></td>
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<td>4.8</td>
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<td>95</td>
<td>400E</td>
<td>25 000</td>
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<tr>
<td>14.4</td>
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<td>110</td>
<td>400E</td>
<td>25 000</td>
<td>20 000</td>
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<td>29</td>
<td>150</td>
<td>400E</td>
<td>20 000</td>
<td>16 000</td>
</tr>
</tbody>
</table>
Loadbuster Disconnect Switches are double-duty devices. They’re unexcelled as straight disconnects and, when used with Loadbuster®—The S&C Loadbreak Tool, are the ultimate devices for low-cost, universal live switching. Loadbuster Disconnect Switches are available in voltage ratings from 14.4 through 34.5 kV, with continuous current ratings of 630 and 900 amperes and a momentary rating of 40,000 amperes. All models, except those in the overhead pole-top style, are available with a choice of Cypoxy™ or porcelain insulators. Overhead pole top-style models are available with a porcelain or polymer insulator.

**AS A STRAIGHT DISCONNECT**

Loadbuster Disconnect Switches, in branch-feeder, main-feeder, and crossarm styles, are specifically designed to meet the high-performance requirements of today’s outdoor distribution systems. With their rugged station-type reliability, they accommodate the prevailing heavier loads and higher fault currents. Through excellence of concept and construction, Loadbuster Disconnect Switches have stepped up the standard for hookstick-operated distribution-type disconnects.

The high momentary ratings of Loadbuster Disconnect Switches are made possible by the silver-to-silver contacts at the attachment-hook end. Contacts won’t weld, burn, or pit on overcurrents. Loadbuster Disconnect Switches will carry rated load, opening and closing without difficulty, even after long exposure of contacts to atmospheric contamination.

Loadbuster Disconnect Switches feature double-member, hard-drawn, round-edged copper blades, formed for extra rigidity to ensure positive engagement with the stationary tongue contact when closing, even when closed from the side.

**AS A LOW-COST LOAD SWITCHING DEVICE**

Loadbuster Disconnect Switches, when used with the Loadbuster tool, provide the ultimate in distribution live-switching versatility, economy, and universality. Loadbuster Disconnect Switches give you the operating flexibility of a system with multipoint interrupter switches, but without the cost associated with having an interrupting unit built into every switch.

Together, Loadbuster Disconnect Switches and the Loadbuster tool not only switch load currents through 900 amperes at distribution voltages through 34.5 kV, they also break associated transformer-magnetizing currents, line-charging currents, and cable-charging currents. And they switch single capacitor banks typically found on distribution systems.

Loadbuster tool switching helps keep service interruptions to a minimum. There’s no need for complex dead-switching procedures. Loadbuster Disconnect Switches make every disconnect a sectionalizing point, minimizing the length of planned outages and the number of customers involved. And Loadbuster Disconnect Switch operation is simple and positive—there’s no external arc and no contact burning.

### LOADBUSTER DISCONNECT SWITCHES—
**Branch Feeder, Main Feeder, Crossarm, and Station Styles**

<table>
<thead>
<tr>
<th>Rating (kV)</th>
<th>Nom. Amps</th>
<th>BIL (kV)</th>
<th>Cont) Amps</th>
<th>Peak Withstand (kA)</th>
<th>Disconnect Gap (Inches)</th>
<th>Disconnect Gap (mm)</th>
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<tbody>
<tr>
<td>14.4</td>
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<td>110</td>
<td>900</td>
<td>65,000</td>
<td>8</td>
<td>203</td>
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<td>150</td>
<td>900</td>
<td>65,000</td>
<td>10½</td>
<td>267</td>
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<td>34.5</td>
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<td>14½</td>
<td>381</td>
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### LOADBUSTER DISCONNECT SWITCHES—
**Overhead Pole-Top Style**

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<th>Rating (kV)</th>
<th>Nom. Amps</th>
<th>BIL (kV)</th>
<th>Cont) Amps</th>
<th>Peak Withstand (kA)</th>
<th>Disconnect Gap (Inches)</th>
<th>Disconnect Gap (mm)</th>
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</thead>
<tbody>
<tr>
<td>14.4</td>
<td>630/900</td>
<td>110</td>
<td>900</td>
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<td>900</td>
<td>65,000</td>
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<tr>
<td>34.5</td>
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<td>150</td>
<td>900</td>
<td>65,000</td>
<td>11½</td>
<td>293</td>
</tr>
</tbody>
</table>

▲ S&C’s tested value for a disconnect with a porcelain insulator. The IEEE rating for a disconnect with a porcelain insulator is 150 kV. The IEEE rating and S&C tested value for a disconnect with a polymer insulator is 150 kV.

■ S&C rating for ambient temperature through 40°C (104°F), with a minimum wind velocity of 1.4 mph. The IEEE rating for this disconnect switch is 630 amperes continuous.

*The Rural Utilities Service has accepted S&C Loadbuster Disconnect Switches in all feeder- and station-style models.*
Loadbuster Disconnect Switches are available in two-insulator branch-feeder (pictured above), main-feeder, crossarm, and station styles, 630 and 900 amperes continuous, to 34.5 kV nominal.
**A BETTER WAY OF SWITCHING**

Loadbuster—The S&C Loadbreak Tool is the original lightweight, easy-to-use loadbreak tool for use with disconnects, cutouts, and power fuses. It brings load-switching capability through 34.5 kV and 630 amperes nominal, 900 amperes maximum, to a wide variety of devices on your distribution system.

**GREATER FLEXIBILITY AT LOWER COST**

Having an arc-interrupting device built into every disconnect, cutout, and power fuse on your distribution system is needlessly expensive. The Loadbuster tool brings the interrupter to the disconnect, cutout, or power fuse whenever load-switching capability is needed—but only when needed. Costs are limited to one Loadbuster tool for each line truck. An acceptable minimal cost is spread across your entire system.

**POWER CONSUMERS BENEFIT**

Loadbuster switching helps keep service interruptions to a minimum. There’s no need for complex switching procedures involving opening and reclosing of line and feeder breakers to permit dead switching. There’s no need for one or more line crews to travel and retravel miles of system. Every disconnect, cutout, and power fuse becomes a sectionalizing point. Live switching can be done at the point that minimizes the length of the planned outage and that affects the fewest consumers.

**FOOLPROOF OPERATION**

Operation is simple and positive. The Loadbuster tool’s anchor is simply hung on the attachment hook of the disconnect, cutout, or power fuse. The pull-ring is then engaged with the tool’s pull-ring hook, held fast by the pull-ring latch. A firm, steady downward pull opens the switching device and trips the Loadbuster tool, interrupting the circuit; there’s no external arc, no contact burning. The Loadbuster tool can be instantly reset for the next operation.

There are no “booby trap” arc chutes and auxiliary blades on Loadbuster tool-operable switching devices to concern operating personnel, nor “gingerbread” mechanisms to challenge them.

The Loadbuster tool can handle 1,500 to 2,000 operations between inspections. Just a minimum of attention keeps it in top-notch condition. And with the Loadbuster tool’s operation counter, monitoring use is easy.

**UNIVERSALITY**

Not only can the Loadbuster tool switch load currents up through 630 amperes nominal, 900 amperes maximum, at distribution system voltages up through 34.5 kV, it can break the associated transformer-magnetizing, line-charging, and cable-charging currents. And it can switch single capacitor banks typically found on distribution systems within its voltage rating.
Switching with the Loadbuster tool is quickly learned. Its one-two-three simplicity is illustrated here with a Type XS Cutout and a Loadbuster Disconnect® Switch. The same procedure applies with Fault Tamer® Fuse Limiters, TripSaver® II Cutout-Mounted Reclosers, and power fuses.

1. **ATTACH** the Loadbuster tool’s anchor to the attachment hook on the far side of the cutout or disconnect. Then, engage the pull-ring with the tool’s pull-ring hook. The Loadbuster tool’s pull-ring latch prevents inadvertent disengagement.

2. **PULL** the Loadbuster tool to its maximum extended length—opening the switching device in the normal manner and breaking the circuit positively.

3. **REMOVE** the Loadbuster tool’s anchor from the attachment hook and use a “roll-off” movement to disengage from the pull-ring of the switching device. The Loadbuster tool is easily reset for the next opening operation.

For more information on Loadbuster—The S&C Loadbreak Tool, see publications 811-30 and 811-31 at sandc.com.
Regulator Bypass Switches are used to bypass and isolate voltage regulators for maintenance. Recloser Bypass Disconnects are used in combination with separately mounted Loadbuster Disconnect Switches to bypass and isolate automatic circuit reclosers for maintenance. Both station-type devices are suitable for other applications, such as bypassing and isolating current transformers.

Regulator Bypass Switches and Recloser Bypass Disconnects offer the exceptionally sturdy construction features needed to ensure years of reliable, easy operation:

- **All blades are of double-member, hard-drawn copper construction.**
- **Silver-to-silver contacts are used at all current-transfer points.** The surface structure of the stationary contacts differs from that of the blade contacts, preventing sticking, galling, or seizing. Contacts won’t weld, burn, or pit on overcurrents.
- **Stainless steel or beryllium-copper loading springs behind the contact areas of the blades.** These springs keep the contacts under constant pressure and provide smooth, positive wiping action during opening and closing. This feature is especially important for Regulator Bypass Switches because the bypass blade is normally in the Open position. The bypass blade must carry full load current after the contacts have endured long periods of exposure to the elements.

Regulator Bypass Switches and Recloser Bypass Disconnects are offered with a choice of Cypoxy Insulators or porcelain station-post insulators. Cypoxy station-post insulators are nontracking, self-scouring, and nonweathering, and they meet or exceed the electrical and mechanical-strength requirements established in ANSI Standard C29.9 (1983) for porcelain station-post insulators.

**Type XL Regulator Bypass Switches**, rated 600 amperes, provide built-in mechanical interlocking, sequencing, and synchronization. Only a single pull of a hookstick is required to isolate the regulator. The bypass blade closes first, bypassing the regulator to prevent interruption of service. Then, the disconnect blade opens the regulator series-winding circuit. Finally, the interrupter blade opens; interruption of shunt-winding magnetizing current takes place within the no-external-arc interrupter, and the regulator is isolated from the line. This switching sequence is reversed automatically during the closing stroke, putting the voltage regulator back into operation without interrupting service.

Special attention has been given to the operation and alignment of the disconnect blade through the use of stainless steel hardware and rigid anchoring of the disconnect blade to the interrupter blade. Ease of operation is ensured by floating contact alignment and a carefully positioned and proportioned pull ring.

**Type NL Regulator Bypass Switches** perform the same functions as Type XL switches, but the sequence of operation is done by the operator. Type NL switches are used in applications where a 1200-ampere rating is needed or where it is desired to bypass the voltage regulator with its shunt winding energized (bypass blade closed, disconnect blade open) so mechanical and electrical testing can be carried out.

To isolate the regulator, the operator first closes the bypass blade to prevent interruption of service. Then, the disconnect blade is opened to open the regulator series-winding circuit. Finally, the interrupter blade is opened; shunt-winding magnetizing current is interrupted within the interrupter, and the regulator is isolated from the line. The procedure is reversed to place the regulator back into service.

**Recloser Bypass Disconnects**, rated up through 900 amperes, consist of a fuse—a Type SMD-20, Type SMD-40, or Type SM-5 Power Fuse, or a Type XS Fuse Cutout (depending on the available fault and continuous current levels of the application)—in series with an integral Loadbuster Disconnect Switches. The fuse is inserted into the device to protect the circuit while the recloser is out of service. The readily accessible trunnion pocket of the rugged cast bronze hinge makes inserting the fuse easy. Guiding surfaces on the inner surface of the hinge ensure “on-center” approach of the fuse to the upper live parts during closing. And a carefully positioned and proportioned brass pull-ring makes opening with a conventional hookstick a simple operation.

Recloser Bypass Disconnects are alternately available with a second Loadbuster Disconnect Switch (in place of the fuse) for applications where devices other than protective equipment are being bypassed for maintenance or inspection.

**Type XL Regulator Bypass Switches and Recloser Bypass Disconnects are Rural Utilities Service accepted.**
For more information on Regulator Bypass Switches, see publications 841-30 and 841-31. For more information on Recloser Bypass Disconnects, see publications 842-30, 842-31, and 842-700. All of these publications are available at sandc.com.
S&C Omni-Rupter and Alduti-Rupter Switches provide no-external-arc circuit interruption for overhead distribution feeders and outdoor distribution substations. They’re specially designed for these live-switching duties:

- **Line switching**—Load splitting (parallel or loop switching), load dropping, and associated charging currents
- **Transformer switching**—Load currents and associated magnetizing currents
- **Cable switching**—Load splitting (parallel or loop switching), load dropping, and associated charging currents

**OVERHEAD DISTRIBUTION FEEDERS**

S&C’s switches provide the utmost flexibility in distribution system switching. Lines may be readily extended and additional load accommodated because Omni-Rupter and Alduti-Rupter Switches can handle heavier-duty loads—typically up through the emergency overload rating of the line conductor.

S&C switches can drop or split the entire connected load without complicated breaker-and-switch sequencing. There’s no need to drop individual loads as a preliminary operation.

Increasingly greater load densities have resulted in more load per mile of line, and more interconnections, laterals, and branches. Interrupter switches provide more sectionalizing points to simplify switching procedures, curtail the scope of outages, and facilitate post-outage cold-load pickup.

Omni-Rupter Switches are tailored for overhead-line switching through 29 kV. These 900-ampere switches are offered in the integer style, with all three switch poles preassembled on a one-piece steel or insulated base, factory-assembled and factory-adjusted, and all necessary clearances are built in. A variety of mounting configurations are available, tailored to the most popular overhead-distribution line designs.

Omni-Rupter Switches bring unsurpassed live-switching performance to overhead distribution feeders. They offer a two-time duty-cycle fault-closing capability of 42,000 amperes, peak, and a 10-time duty-cycle fault-closing capability of 21,000 amperes, peak—plus ice-breaking capability on opening and closing and substantial emergency overload capabilities. Omni-Rupter Switches are shipped as a single package. They are easy to hoist using the single-point lifting bracket, and they mount quickly and easily using two through-bolts—no pole bands are required. With the simple addition of the vertical operating mechanism and handle, installation is complete.

Power operation is possible with the addition of an S&C 6801M Automatic Switch Operator (see page 87). Hookstick-operated models are available, too, in upright, vertical, tiered-outboard, and inverted mounting configurations, providing the ultimate solution for simple, quick, and cost-effective installation.

Integer-style Alduti-Rupter Switches are also available for switching overhead distribution feeders at system voltages through 46 kV and 1200 amperes continuous. They can be power operated through the addition of an S&C Type AS-1A, AS-10, LS-2, or 6801M switch operator, as appropriate.

**OUTDOOR DISTRIBUTION SUBSTATIONS**

The economics of power distribution have forced heavier loading of substation transformers through the addition of new feeders and increased loading of existing ones. S&C’s Alduti-Rupter Switch is the ideal switching device for these heavier duties; it can split load and drop lines or cables, or even the entire load. Its no-external-arc interrupting performance is essential in substations, where close phase spacings rule out the use of arc-producing disconnects.

S&C Alduti-Rupter Switches are available in voltage ratings through 69 kV, in six rugged three-pole group-operated styles. They’re offered in ratings of 600 amperes and 1200 amperes, continuous and interrupting. For applications where simultaneous three-phase switching isn’t needed, single-pole Alduti-Rupter Switches are an excellent alternative; they’re conveniently operated with a conventional hookstick.

**NO-EXTERNAL-ARC INTERRUPTION**

Every S&C Alduti-Rupter and Omni-Rupter Switch incorporates built-in interrupters; there’s no need to rig S&C switches with “add-ons.” Operation is simple and straightforward. Interrupter contacts separate at high speed. The contacts and blade are synchronized to coordinate dynamic internal dielectric strength with the interrupter’s external striking distance, eliminating any chance of flashover. Arc-extinguishing deionizing gases are quietly vented through a labyrinthine muffler. There’s no oil, no vacuum, and no maintenance.

**EXHAUSTIVELY TESTED, UTILITY PROVEN**

Every S&C switch rating is based on full-scale testing: load splitting, load dropping, line and cable switching—all at maximum voltages and rated currents, and with test circuits tuned to duplicate the most severe transient recovery voltages likely to be encountered in service. Rated performance is ensured for all live-switching duties. The validity of S&C’s testing has been confirmed by more than 60 years of reliable operation of S&C switches on utility systems worldwide.
The 6801M Automatic Switch Operator is a fully integrated, microprocessor-based operator that combines electromechanical components, a remote terminal unit, control circuitry, and communications in a single package for enhanced installation flexibility and reliability and reduced cost. The 6801M Automatic Switch Operator monitors the entire switching cycle and can automatically take corrective action in the event of a problem.

When the associated distribution switches or disconnects have been fitted with voltage and current sensing, 6801M Operators can be furnished with, or upgraded to, S&C’s IntelliTeam® SG Automatic Restoration System. This unique system enables multiple 6801M operators to work together as teams with IntelliRupter® PulseCloser® Fault Interrupters, 6800 Series Automatic Switch Controls, and IntelliNode™ Interface Modules.

Using peer-to-peer communication, the teams can quickly transfer load and minimize the number of customers affected by a fault or outage. Teams use true distributed intelligence; no central processing or SCADA supervision is required. The IntelliTeam SG system works with other reclosers equipped with an IntelliNode module, too; each team can include multiple types of control platforms.
OMNI-RUPTER® SWITCHES & ALDUTI-RUPTER® SWITCHES

Omni-Rupter Switch Construction

- No-external-arc interrupter—interrupter contacts and blade are synchronized to coordinate dynamic internal dielectric strength with the interrupter’s external striking distance, eliminating any chance for flashover.

- Single-member, square-section, heavy-gauge, galvanized-steel base—supports switch poles in permanent perfect alignment. Fiberglass-reinforced insulated base offers the same performance; it’s finished with two-component polyurethane enamel for superior resistance to weathering.

- Factory-adjusted hookstick operating handle—features large U-shaped pull-rings for smooth operation through the full opening or closing stroke; it’s easy to operate from under the switch, at an angle, or even from behind the pole (Lockout tab is front and center on the operating handle).

- One-piece interphase drive—factory-adjusted for close three-phase switching simultaneity; it’s nonconducting on insulated-base models.

- Stainless steel shaft and drive lever and bronze flange bearings—provide all-weather durability and performance.

A 14.4-kV Three-Pole Side-Break Integer Style Omni-Rupter Switch, with steel base, in an upright hookstick-operated mounting configuration. Other configurations include vertical, triangular, tiered-outboard, and inverted. All are factory-assembled and factory-adjusted to ensure reliable operation. The Omni-Rupter Switch features a compact, lightweight design with built-in lifting means—unsurpassed for ease and speed of installation.

S&C Cypoxy™ Insulators provide nontracking, self-scouring, nonweathering performance, so there’s never a compromise of insulation integrity. Porcelain station-post insulators and silicone insulators are also available.
A variety of options are available, including an insulating section in the vertical shaft, dead-ending extension-link assemblies, provisions for mounting surge arresters, wildlife protection, and greaseless graphite-impregnated contacts.
Alduti-Rupter Switch Construction

One pole-unit of 14.4-kV Three-Pole Side-Break Heavy-Duty Style Alduti-Rupter Switch, 600 amperes continuous. This group-operated design is offered in a variety of standard mounting arrangements, including vertical and upright, making it ideal for substation applications.

Various optional features are available:

- **S&C Cypoxy™ station-post insulators**—also available with porcelain station post insulators
- **Stationary contact**—features a thermally sprayed pure silver contact surface, coined for hardness, contour, and low porosity
- **Spring-backed silver-nickel multifinger blade contacts**—provide four independent points of contact for optimum performance and contact pressure
- **No-external-arc interrupter**—interrupter contacts and blade are synchronized to coordinate dynamic internal dielectric strength with the interrupter’s external striking distance, eliminating any chance for flashover
- **Articulated-drive operating mechanism**—accommodates a wide selection of mounting arrangements
- **Double-member, hard-drawn copper blades**—formed and trussed for extra rigidity; they’re permanently aligned for trouble-free switching
- **Hinge contacts**—feature embossed contact surfaces, nickel plated and flash coated with silver, plus a silver-clad hinge pivot; stainless steel loading spring is engineered to optimize contact pressure, operating ease, and blade stability
- **Corrosion-resistant zinc-nickel-chromate plated bearing**—provides smooth, maintenance-free performance; bearing elements are packed in special MIL-spec grease
- **Formed channel base**—\( \frac{1}{16} \)\text{-inch (4.8 mm) galvanized steel; numerous mounting holes suit any structure}
One pole-unit of 34.5-kV Three-Pole Vertical-Break Style Alduti-Rupter Switch, 1200 amperes continuous. Group-operated vertical-break style switches are available in voltage ratings of 14.4 kV through 34.5 kV, and continuous current ratings of 600 amperes and 1200 amperes. They’re offered in vertical and upright standard mounting arrangements.
### OMNI-RUPTER® SWITCHES

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<thead>
<tr>
<th>Style</th>
<th>50/60-Hz Ratings</th>
<th>Available Mounting Configurations</th>
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- **ALDUTI-RUPTER ® SWITCHES**

<table>
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<tr>
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<th>Available Mounting Configurations</th>
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<td>Three-Pole Group-Operated—Factory-Assembled and Adjusted</td>
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<td></td>
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<td>48.3</td>
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</table>

- **OMNI-RIPTER® SWITCHES & ALDUTI-RUPTER® SWITCHES**

- 1600 amperes, RMS, load interrupting. This model is specifically designed for switching the secondary of single- or double-transformer substations.
- 600 amperes, RMS, load interrupting. This model is specifically designed for load splitting (parallel or loop switching).
S&C’s SMD® Power Fuses provide reliable and economical protection for transformers and capacitor banks in outdoor substations. They are offered in these ratings:

<table>
<thead>
<tr>
<th>SMD POWER FUSES</th>
<th>50/60-Hz Ratings</th>
<th>Amperes, RMS</th>
<th>Interr., Sym</th>
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<td>Max</td>
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</table>

As with all S&C fuse designs, SMD Power Fuses have undergone exhaustive full-scale testing to establish their ratings and to confirm their full fault-spectrum protection capability. These fuses detect all faults—large, medium, and small, even down to the minimum melting current—and they provide reliable circuit interruption under the most severe transient recovery voltages that may be encountered.

At the heart of every SMD® Fuse Unit is S&C’s specially designed current-responsive fusible element. It’s exceptionally precise, with a total tolerance in melting current of only 10 percent. This precision, plus a wide selection of ampere ratings in three different speeds—S&C Standard, Slow, and Very Slow—lets you achieve optimal coordination and maximum protection for both the source-side system and the downstream equipment.

The superior element design also ensures the permanence of response characteristics. SMD Fuse Units are unaffected by aging, corrosion, vibration, or surges that heat the element nearly to the severing point. They’re nondamageable, ensuring continued integrity of carefully engineered system protection and coordination plans.

TRANSFORMER PROTECTION

SMD Power Fuses provide a reliable, economical means to protect small to medium-sized load transformers installed in utility and industrial substations. The considerable economies inherent to power fuse protection are possible because the fuse itself is much less costly than other types of protective equipment, and there is no need for auxiliary equipment such as station batteries and protective relays. Further benefits of a compact fuse-protection package are low installation costs and a space-saving design that will fit on almost any structure. The dropout action of these power fuses provides the additional benefit of visible air-gap isolation for the transformer after fuse operation.

SMD Power Fuses are designed to accommodate—not interrupt—all anticipated transformer-loading levels. This loadability, combined with fuse element nondamageability, permits close fusing for fast clearing of all faults. Moreover, mechanical and thermal stresses on the transformer from secondary-side faults are minimized so transformer life is extended.

S&C’s power fuses provide prompt, reliable operation without disrupting service to source-side loads. Other protection alternatives involving transfer-trip relaying, automatic grounding switches, or sacrificial switches result in extensive interruption of service to other loads in the event of a fault at the transformer. In addition, grounding-switch and sacrificial-switching schemes result in severe bolted-fault stress to the system and source transformers, plus undue fault testing of line-terminal circuit breakers for all faults—even low-magnitude secondary-side faults.

CAPACITOR BANK PROTECTION

When applied for fusing of station capacitor banks, the substantial loading capability of SMD Power Fuses permits the use of smaller ampere ratings than may be possible with other makes of power fuses—without risking nuisance fuse operations caused by capacitor-bank inrush or outrush currents. Close fusing ensures rapid isolation of faulted capacitor banks.

OTHER APPLICATION CONSIDERATIONS

The exhaust of SMD Power Fuses is nonconducting, unlike the highly ionized blast of expulsion-type fuses that use fiber-lined fuse tubes. Consequently, it is possible to use standard phase spacings and clearances to ground.

The operation of S&C fuses—from the sensing of current to the interruption of faults—is the essence of simplicity. Minimal physical maintenance is required, such as periodic checking of the condition of the fuse-unit bore and occasional refinishing of fuse tubes exposed to severe weathering. There is no possibility of introducing the protection vagaries commonly associated with maintenance of breakers, relays, and control-power batteries. S&C fuse TCCs are maintenance-free.

SMD Power Fuses are Rural Utilities Service accepted.
**Vertical Style Mounting**

- Compression-loaded silver-clad contacts—provide superb current transfer
- Release tube—weather-sealed
- Latch and upper-contact assembly—features a “floating” roller-latch mechanism that prevents accidental fuse dropout yet releases without resistance when operated intentionally
- Hinge and lower-contact assembly—also features compression-loaded silver-clad contacts
- Rugged, galvanized steel base
- Standard station post insulators—also available with silicone-housed composite insulators or Cypoxy™ Insulators

**How It Works …**

- **Solid arc-extinguishing materials.** Fault is quickly and positively interrupted by high-speed elongation of the arc and by efficient deionizing and cooling of the arc path with turbulent nonconductive gases released.
- **Single arcing rod of SMD Fuse Unit.** High-fault currents are interrupted in a lower large-diameter bore section (A) that relieves pressure buildup, resulting in a milder exhaust. Low to moderate fault currents are interrupted in the upper small-diameter bore section (B) where deionizing gases are effectively concentrated for arc extinction.
- **Fusible element.** The element senses an overcurrent condition and melts. The strain wire then severs, initiating an arc and releasing the spring-loaded arcing rod to effect fault interruption; the arc is extinguished as it is drawn upward through solid materials.

**Other Available Mounting Styles**

- Vertical-Offset
- Right-Angle
- Upright

**SMD®Fuse Unit Ratings**

<table>
<thead>
<tr>
<th>Speed</th>
<th>Available Ratings, Amperes for Fuse Unit Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD-1A</td>
<td>SMD-2B, SMD-2C, SMD-3</td>
</tr>
<tr>
<td>S&amp;C Standard</td>
<td>1–200E</td>
</tr>
<tr>
<td>S&amp;C Slow</td>
<td>15E–200E</td>
</tr>
<tr>
<td>S&amp;C Very Slow</td>
<td>50E–200E, 50E–300E</td>
</tr>
<tr>
<td>S&amp;C Slow</td>
<td>15E–300E</td>
</tr>
<tr>
<td>S&amp;C Very Slow</td>
<td>15E–100E</td>
</tr>
<tr>
<td>S&amp;C Slow</td>
<td>15E–100E</td>
</tr>
</tbody>
</table>

For more information on SMD Power Fuses, see publications 212-30 and 212-31 at sandc.com.
CIRCUIT-SWITCHERS

CIRCUIT-SWITCHER: THE MULTIPURPOSE TRANSMISSION VOLTAGE SWITCHING AND PROTECTION DEVICE

S&C Circuit-Switchers are ideal for:

- Transformer switching and protection
- Capacitor-bank switching and protection
- Reactor switching and protection
- Line and cable switching

They’re suitable for frequent operation over a long period of time with minimal maintenance. They can close, carry, and interrupt fault currents as well as load currents, and they are available in voltage ratings from 34.5 kV through 230 kV, with continuous-current ratings of 1200, 1600, and 2000 amperes.

S&C Circuit-Switchers provide high-speed circuit interruption of overloads and secondary faults, and they protect transmission circuits from all types of transformer faults. Circuit-Switcher economics make it practical to provide protection at each load-tap transformer without resorting to remote tripping arrangements, such as transfer-trip relaying or automatic grounding-switch or sacrificial switching schemes.

S&C Circuit-Switchers can switch and protect all practical sizes of load-tap transformers and single and back-to-back shunt capacitor banks up through the following applications:

<table>
<thead>
<tr>
<th>System Voltage, kV</th>
<th>Transformer Nonforced-Cooled Rating, MVA</th>
<th>Capacitor Bank Rating, Mvar</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>15</td>
<td>33</td>
</tr>
<tr>
<td>46</td>
<td>25</td>
<td>36</td>
</tr>
<tr>
<td>69</td>
<td>40</td>
<td>54</td>
</tr>
<tr>
<td>115</td>
<td>70</td>
<td>87</td>
</tr>
<tr>
<td>138</td>
<td>90</td>
<td>108</td>
</tr>
<tr>
<td>161</td>
<td>110</td>
<td>126</td>
</tr>
<tr>
<td>230</td>
<td>160</td>
<td>180</td>
</tr>
</tbody>
</table>

138-kV Series 2000 Circuit-Switcher Model 2010 with horizontal interrupters and a vertical-break power-operated disconnect applied for switching and protection of an oil-insulated shunt reactor at a substation belonging to a large southeastern utility.

138-kV Mark VI Circuit-Switcher applied for capacitor-bank switching and protection. Optional pre-insertion inductors dramatically reduce inrush current and tame damaging overvoltages that can shut down sensitive adjustable-speed drives.
S&C Circuit-Switchers are offered in several versions:

**Mark V Circuit-Switchers** use in-series circuit-breaking interrupters and a high-speed circuit-making and isolating disconnect. They can be custom tailored to fit any structure, phase spacing, or bus height. And they can be furnished with pre-insertion inductors for unsurpassed capacitor switching.

**Mark VI Circuit-Switchers** combine the Trans-Rupter II® Transformer Protector’s innovative interrupter technology (see pages 98 and 99) with the Mark V’s high-speed circuit-making and isolating disconnect. Mark VI Circuit-Switchers can also be furnished with pre-insertion inductors—the industry standard for reducing inrush current and transient overvoltages when switching capacitor banks.

**Series 2000 Circuit-Switchers** feature interrupters designed to close the circuit, interrupt the circuit, and maintain rated dielectric strength when open. They’re available in mounting configurations suiting the broad spectrum of substation layouts and profiles, with or without an integral power-operated disconnect.

All Circuit-Switcher interrupters use no-maintenance single-pressure SF₆ puffer technology for restrike-free, noncurrent-chopping, minimum-voltage surge performance. They’re field-proven through 50 years of superior service. Isolating disconnect blades feature current-carrying contacts with built-in wiping action, ensuring a clean, low-resistance path. Operators are designed to ensure the full inherent mechanical and electrical performance characteristics of Circuit-Switchers.
The Trans-Rupter II Transformer Protector is designed exclusively for primary-side application on distribution substation transformers. This revolutionary device combines the three-phase tripping, high interrupting ratings, and sophisticated protection capabilities of higher-cost circuit-switchers and circuit breakers with the simple installation procedures and minimal maintenance requirements of lower-cost power fuses.

**CHOOSE THE VERSION THAT FITS YOUR NEEDS**

Model EX is tripped by an external signal provided by a user-furnished differential, sudden-pressure, or overcurrent relay. Model EX is perfect for new installations and for retrofitting outdated circuit-switcher, circuit breaker, and high-speed grounding switch installations where protective relays and control power are already in place. It’s available with optional motor operators that provide remote-resetting capability.

Model SE features a self-powered overcurrent-protection system activated by current transformers on the primary bushings of the transformer. Digital overcurrent relays provide complete time-overcurrent and instantaneous-overcurrent protection; they’re field-settable and include user-selectable time-current characteristics.

*With Model SE, there’s no need for external relays, substation batteries, or a control house … you can save tens of thousands of dollars over the installed cost of a circuit-switcher or circuit breaker. Model SE is ideal for new installations as well as for retrofitting outdated power fuse installations.*

**NO-MAINTENANCE INTERRUPTERS, NO-MAINTENANCE OPERATING MECHANISM**

Trans-Rupter II interrupters are factory-filled and hermetically sealed, eliminating the hassle and expense of field-filling with SF6. These electrically tripped, resettable interrupters provide 31.5-kA, 3-cycle fault-interrupting performance. There’s no mechanical linkage to adjust or maintain. The Trans-Rupter II Transformer Protector’s operating mechanisms are likewise sealed for life, protected from the environment.

**SHATTERPROOF COMPOSITE-POLYMER SILICONE INSULATION**

The Trans-Rupter II Transformer Protector’s interrupter and insulating support column stand up to the most severe environment. The unique patented skirt arrangement on 115-kV and 138-kV pole-units provides enhanced dielectric performance.

**SPACE-SAVING, LIGHTWEIGHT DESIGN WITH SUPERIOR MOUNTING FLEXIBILITY**

Trans-Rupter II Transformer Protectors install on nearly any structure—even on the transformer or source-side disconnect switch. They are ideal for retrofit of older equipment and for mobile-transformer applications.

A user-furnished, three-pole, group-operated disconnect switch is required to provide visible air-gap isolation during maintenance and to pick up transformer magnetizing inrush current. Alternately, Trans-Rupter II protectors can be furnished with a space-saving integral vertical-break style disconnect.

S&C Mounting Pedestals are available, too, in a variety of heights and phase spacings.
For more information on Trans-Rupter II Transformer Protector, see publications 731-30, 731-31, and 731-700 through 731-705 at sandc.com.

### TRANS-RUPTER II TRANSFORMER PROTECTORS

#### 50/60-Hz Ratings

<table>
<thead>
<tr>
<th>Nom.</th>
<th>Max</th>
<th>BIL</th>
<th>Fault-Interrupting Ampere, RMS</th>
<th>Suitable for Transformers Rated, MVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>69</td>
<td>72.5</td>
<td>350</td>
<td>31 500</td>
<td>30/40/50</td>
</tr>
<tr>
<td>115</td>
<td>123</td>
<td>550</td>
<td>31 500</td>
<td>37.5/50/62.5■</td>
</tr>
<tr>
<td>138</td>
<td>145</td>
<td>650</td>
<td>31 500</td>
<td>50/66.5/83■</td>
</tr>
</tbody>
</table>

■ Based on 8% impedance. Larger-size transformers can be accommodated at higher impedance levels.

A 138-kV Trans-Rupter II Transformer Protector Model EX, shown on S&C Mounting Pedestals. Low-voltage connection enclosure provides connections for user-furnished relays and control power.

Control cabinet of Model SE includes a self-powered, self-contained package that can save thousands of dollars for substations where there's no control house.

An easy-to-use charging tool is included for closing and charging pole-units to restore service. Optional motor operators provide three-phase remote-resetting capability.

Temperature-compensated gas-pressure gauge—indicates gas pressure; provides two alarm levels.

Operating shaft for charging tool.

Closed-and-charged indicator.

Optional motor operator.