Rethinking Your Lateral Protection Strategy

TripSaver® II Cutout-Mounted Reclosers

Excellence Through Innovation

Dispatching truck rolls to respond to overhead faults may be a frequent side-effect of your organization's existing lateral-protection strategy. But, did you know **more than 80% of faults on overhead distribution circuits occur on laterals?** Depending on your existing lateral-protection strategy, this can pose a range of challenges to your system.

Sustained outages resulting from temporary faults may cause unnecessary truck rolls, boosting costly O&M expenses and negatively impacting overall system reliability.

Even momentary outages have a major effect on your system. Customers are accustomed to an always-connected world and are even growing intolerant of momentary outages, which may last only a few seconds. A couple of seconds may seem trivial, but they end up costing the U.S. economy twice as much as sustained interruptions.*

Past reliability improvements on your system have likely focused on feeders and neglected the modernization of lateral lines—to the detriment of end-customers. As the grid advances, it's time to reevaluate this approach. Examining your existing protection strategy on the last miles of your grid can reveal **significant customer-reliability improvement opportunities**.

* U.S. Department of Energy, Lawrence Berkeley National Laboratory.

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1 What Systemwide Problems Do You Need to Solve?

Reliability

Depending on your existing lateral-protection strategy, faults may either cause sustained outages or widen the impact of momentary interruptions on your system, regardless of whether they were temporary. These interruptions have a detrimental impact on SAIDI, SAIFI, and MAIFI scores, preventing you from improving overall system reliability. Additionally, distributed generation resources are becoming more prevalent on distribution feeders and are easily knocked offline by short interruptions.

Operations & Maintenance

Frequent outages caused by temporary faults may be causing your organization thousands in unnecessary truck rolls. Or you may have a large inventory of devices that need regular servicing, requiring you to pull equipment down and transport it to a service shop. Time-consuming O&M tasks rack up monumental costs over time and take your line crews away from addressing more important jobs.

Customer Satisfaction

Frequent outages place undue burden on your end-customers—especially those at the edge of the grid who wait longer for power to be restored. Customer complaints cause headaches for your customer service representatives, public relations team, and line crews who are coming face to face with frustrated customers in the field. On top of this, low customer satisfaction levels are linked to less support for future system improvements.*

Environmental Concerns

Oil-based byproducts from hydraulic reclosers can have harmful health effects on wildlife, human operators, and local ecosystems. Other devices, such as fuses, carry high spark risks.

* J.D. Power Electric Utility Residential Customer Satisfaction Study, 2001-2014 and Regulatory Research Associates, a division of SNL Energy.

Truck Rolls: O&M Costs You May Be Overlooking

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It's easy to dismiss how much truck rolls for standard maintenance operations cost your organization. If your organization is making a guess at the cost, you're likely underestimating it. With all costs included, truck rolls can be as expensive as $1,000. If you are skeptical, consider these expenditures you may be overlooking:

Variable Costs

Crew Costs

Crew costs include those you would typically expect when considering truck-roll costs, such as each crew member's salary or hourly wages and benefits. Additionally, repair work typically takes place after a storm hits, when you're paying a storm or hazard duty premium for your crew. Overtime premiums also often apply for truck rolls.

Trip Costs

The cost of the trip itself includes the price of fuel multiplied by the distance you typically travel to and from the location of the fault, otherwise known as your average trip length. Don't forget to account for the average miles per gallon your utility vehicle gets, as well as the amount of time crews spend making stops along the way.

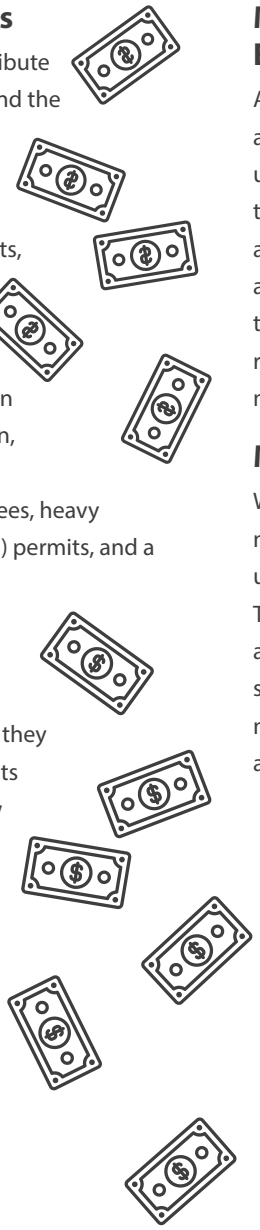
Inventory Costs

When responding to faulted laterals, your crew needs to have replaceable parts on hand to provide a 1:1 replacement for spent equipment. This contributes to warehouse inventory costs as well as the costs and hassle of stocking every truck with an array of sizes and types of spare fuses.

Fixed Costs

Operating Costs

Fixed costs that contribute to truck rolls go beyond the cost of contracting or owning the vehicles themselves. They also include insurance costs, such as liability premiums and collision and workers compensation premiums. In addition, you'll likely have various licenses and fees, heavy vehicle use tax (HVUT) permits, and a utility garage storage allocation. It's easy to overlook counting fixed costs in your calculation. However, they are crucial components that enable your crew to do their jobs during every truck roll.



Additional Costs

Miscellaneous Overhead Expenses

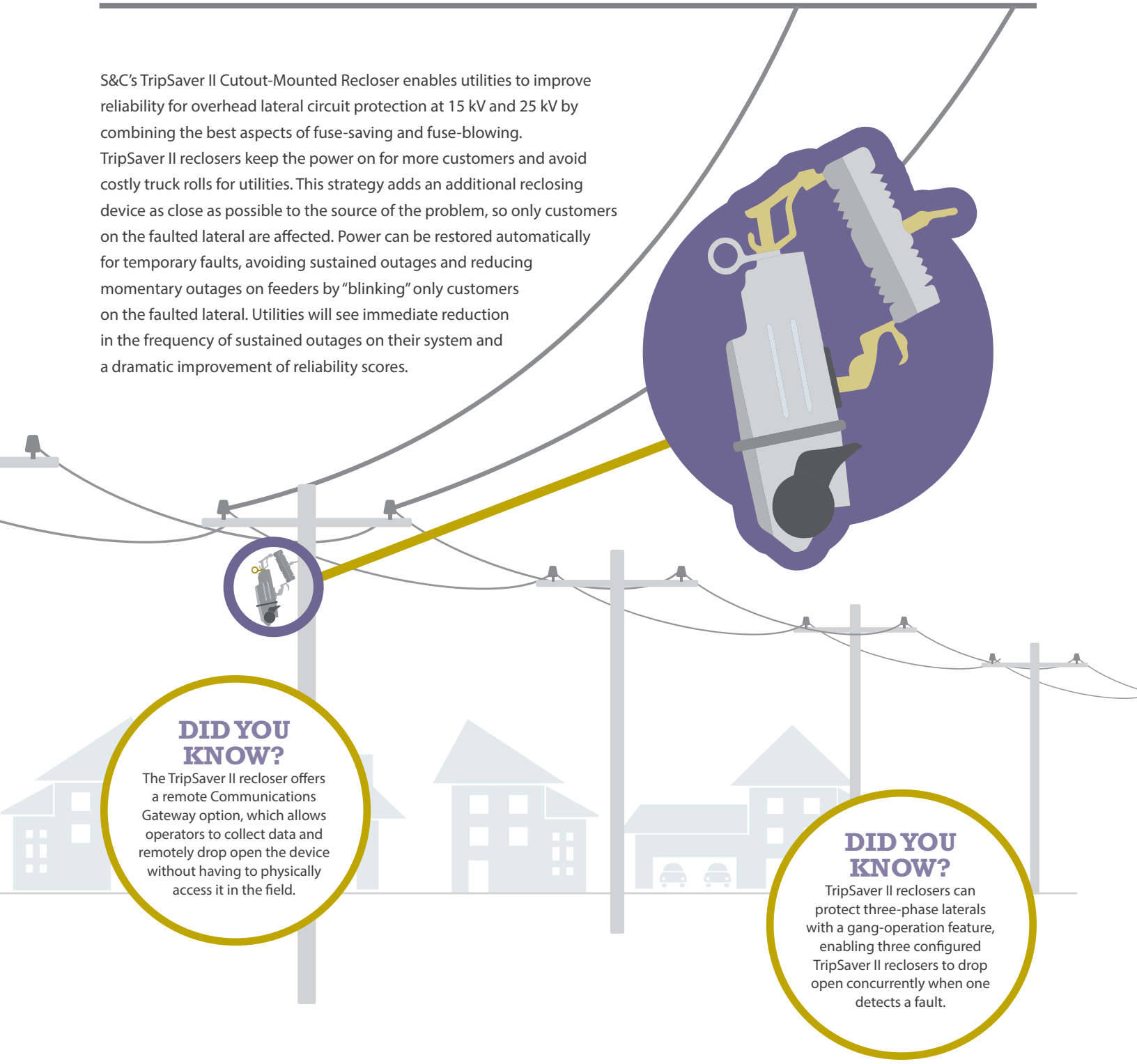
Additional expenses to reflect on are annual maintenance and upkeep for utility fleet vehicles as well as a variety of taxes, such as road use tolls, fuel taxes, and property taxes for fleet housing. In addition, accidents are unexpected, but they happen, and sometimes vehicle repairs or health care costs for crew members injured on the job are needed.

Mutual Aid Crews

When severe storms hit, you may need to request assistance from other utility crews to quickly restore power. This often requires housing, feeding, and caring for outside crews as well as spending additional time to provide necessary briefings so they can safely and effectively do their jobs.

3 What is the TripSaver II Cutout-Mounted Recloser?

S&C's TripSaver II Cutout-Mounted Recloser enables utilities to improve reliability for overhead lateral circuit protection at 15 kV and 25 kV by combining the best aspects of fuse-saving and fuse-blowing. TripSaver II reclosers keep the power on for more customers and avoid costly truck rolls for utilities. This strategy adds an additional reclosing device as close as possible to the source of the problem, so only customers on the faulted lateral are affected. Power can be restored automatically for temporary faults, avoiding sustained outages and reducing momentary outages on feeders by "blinking" only customers on the faulted lateral. Utilities will see immediate reduction in the frequency of sustained outages on their system and a dramatic improvement of reliability scores.



DID YOU KNOW?

The TripSaver II recloser offers a remote Communications Gateway option, which allows operators to collect data and remotely drop open the device without having to physically access it in the field.

DID YOU KNOW?

TripSaver II reclosers can protect three-phase laterals with a gang-operation feature, enabling three configured TripSaver II reclosers to drop open concurrently when one detects a fault.

Comparing Common Lateral Protection Strategies

Depending on the lateral protection strategy you are using on your system, the impact faults have on your operations, reliability, and end-customers can vary widely. Though some strategies may appear beneficial at face value, it's important to weigh the tradeoffs between each choice. These strategies not only affect your organization's bottom line, but they impact your end-customers' daily lives as they experience the frustrating downsides first hand. Here is a comparison of how common lateral protective strategies respond to both temporary and permanent faults beyond the lateral protection device:

	LATERAL RECLOSING STRATEGY			
	FUSE-BLOWING (Lateral fuses operate to clear any fault, temporary or permanent)	**FUSE-SAVING** (Relies on upstream protective devices to clear temporary faults that occur beyond the fuse location)	**SECTIONALIZING LINKS** (Drop-open device isolates segments on a circuit and relies on upstream reclosing to clear temporary faults that occur beyond the device)	**LATERAL RECLOSING** (Moves reclosing closer to the fault location, conducting several testing operations to clear temporary faults)
TEMPORARY FAULTS ON THE LATERAL				
Momentary Interruption?	● No	▲ Yes—All customers connected to main feeder	▲ Yes—All customers connected to main feeder	◆ Yes—Only among customers on affected lateral
Sustained Outage?	▲ Yes—All customers on affected lateral	● No	● No	● No
Truck Roll?	▲ Yes	● No	● No	● No
Reliability Impact	◆ High SAIDI and SAIFI	◆ High MAIFI	◆ High MAIFI	● Low MAIFI, SAIDI, and SAIFI
Customer Impact	▲ High—all customers on affected lateral experience sustained outage even though the fault was temporary	◆ Moderate—All customers connected to main feeder experience momentary outages for a fault on any lateral	◆ Moderate—All customers connected to main feeder experience momentary outages for a fault on any lateral	● Low—Only customers on affected lateral experience momentary outage
PERMANENT FAULTS ON THE LATERAL				
Momentary Interruption?	● No	▲ Yes—All customers connected to main feeder	▲ Yes—All customers connected to main feeder	● No
Sustained Outage?	▲ Yes—All customers on affected lateral	▲ Yes—All customers on affected lateral	▲ Yes—All customers on affected lateral	▲ Yes—All customers on affected lateral
Truck Roll?	▲ Yes	▲ Yes	▲ Yes	▲ Yes
Reliability Impact	◆ High SAIDI and SAIFI	▲ High MAIFI, SAIDI and SAIFI	▲ High MAIFI, SAIDI and SAIFI	◆ High SAIDI and SAIFI
Customer Impact	◆ Moderate—All customers on affected lateral experience sustained outage	▲ High—All customers connected to main feeder experience momentary outage; all customers on affected lateral have sustained outage	▲ High—All customers on feeder have momentary interruption; all customers on affected lateral have sustained outage	◆ Moderate—Only customers on affected lateral experience sustained outage

KEY ▲ poor ◆ moderate ● excellent

PRO TIP: At face value, you might think investing in a change on your system is too costly. However, sticking with the status quo can impede grid-modernization goals, cause mounting O&M expenses over time, and may ultimately hurt your end-customer satisfaction.
Will inaction cost you more than making a change in the long-run?

5 Lateral Recloser Device Evaluation

Lateral reclosing is the winning strategy for reducing the impact on end-customers in the event of both temporary and permanent faults. However, there are key differences among different lateral recloser devices. Compare the pros and cons of common lateral protection devices:

		LATERAL RECLOSING DEVICES		
EVALUATION CATEGORY	**EVALUATION CRITERIA**	**Hydraulic Reclosers**	**Single-Phase Microprocessor Reclosers**	**TripSaver II Cutout-Mounted Reclosers**
FINANCIAL (How much do devices cost your organization initially and over time?)	Upfront Cost	● Moderate	◆ Higher	◆ Higher
	O&M Expense	▲ High—Tedious, costly servicing must be conducted every 3-5 years.	◆ Moderate—Some require periodic battery replacement.	● Low—Product has no user-serviceable or replacement parts
SYSTEM COMPATIBILITY (How will devices fit into your system's existing operational processes and requirements?)	Coordination	▲ Limited—Inflexible protection curves limit the number of TCC curves available.	◆ Moderate—Some flexibility with a handful of curves available.	● Wide variety—Easily integrates into existing schemes with over 300 curves to choose from
	Accuracy	▲ Low—Variable, inconsistent responses to fault currents and TCC curve drift because of oil viscosity.	● High—Predictable and precise response characteristics to fault currents	● High—Predictable and precise response characteristics to fault currents
	Lateral Segmentation	▲ Low—Fewer devices can be placed in series.	◆ Moderate—Multiple ratings with sequence coordination available	● High—Range of ratings from 40 A, 100 A, 200 A for 15 kV & 25 kV with sequence coordination available
ENVIRONMENTAL (What impact could devices have on local ecosystems?)	Pollution Risk	▲ High—Oil-filled device	◆ Moderate—Uses vacuum interrupter but battery requires disposal at end of life	● Low—Uses vacuum interrupter
	Spark Risk	▲ High—Oil presents combustion risk	● Low—No oil and no external sparks at device location	● Low—No oil and no external sparks at device location
INSTALLATION (Will the time it takes your crews to get devices up and running considerably boost labor expenses?)	Programming flexibility	▲ Limited—When programmed, devices are very difficult to change because protection parameters are built-in under oil inside the tank.	● Yes—User-programmable smart device	● Yes—User-programmable smart device
	Installation Time	▲ Longer—Heavy devices are slow to install.	◆ Moderate—Requires extra equipment and control power, as well as cumbersome line or pole mounting of heavy device	● Short—Simple deployment process with easy cutout mounting
UPKEEP (When the devices are installed on the line, how must your crews interact with them?)	Inventory	▲ High—Requires large number of bulky devices to have on-hand for replacement	◆ Moderate—Devices require extra hardware and/or are heavier.	● Low—Reduced inventory with 1-2 standardized base catalog numbers across your system and smaller device size
	Power Source	● Battery-free—Self-powered by line current	▲ Battery-dependent—Requires replacement	● Battery-free—Self-powered by line current
	Event Log	▲ No—Analog device	◆ Yes—However, often no on-device display	● Yes—On-device LCD screen. Also available remotely with Remote Communication option

KEY ▲ poor ◆ moderate ● excellent

End-to-End Lateral Protection

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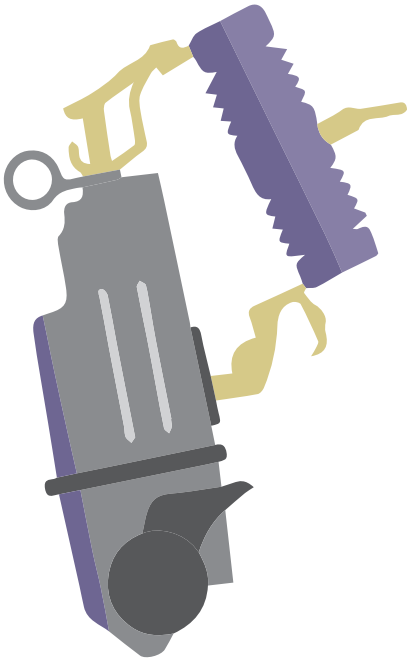
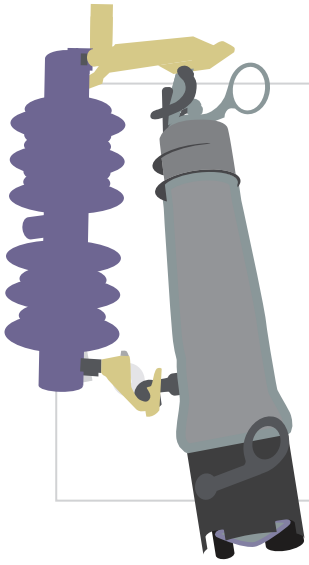
Segmenting lateral lines with multiple fault-testing devices in series provides end-to-end protection and, for the first time, enables a *smart grid* in the truest sense—self-healing technology from the head of the feeder to the very edge of the grid. Configurable, flexible protection settings allows lateral segmentation, which curbs the number of customers affected by outages, increasing reliability and customer satisfaction. Lateral segmentation also reduces the number of customers affected by momentary outages by blinking only the affected lateral segment.



200-A TripSaver II Recloser:	Replacement for **HYDRAULIC RECLOSERS** on laterals, **CLOSEST TO THE FEEDER** • Vastly reduces inventory and eliminates costly maintenance schedules • Simple deployment and installs in half the time
100-A TripSaver II Recloser:	Replacement for **FUSES** on laterals, **FURTHER FROM THE FEEDER** • Prevents unnecessary momentary outages resulting from fuse-saving • Prevents unnecessary sustained outages caused by temporary faults resulting from fuse-blowing • Reduces O&M costs by avoiding truck rolls
40-A TripSaver II Recloser:	Alternative to **LOW-AMPERE SOLUTIONS** on laterals, **CLOSER TO THE END OF THE LATERAL** • Keeps faults toward the end of the lateral from affecting most customers upstream on the same lateral • Local data visibility and communications requires less than 1 A of load current



Accompanying the wide range of lateral protection offered by TripSaver II recloser, the VacuFuse II Self-Resetting Interrupter provides grid-edge protection for customers in the most vulnerable locations on your system.

VacuFuse® II
Self-Resetting Interrupter:

Alternative to **OVERHEAD DISTRIBUTION TRANSFORMER FUSES** at the **GRID-EDGE**

- Avoids unnecessary sustained outages, which equal 70% of wasted O&M costs from re-fusing these areas
- Targets grid problem areas with repeat outages and low customer satisfaction, automatically restoring power when temporary faults occur

7 Common Misconceptions

You may hold some preconceptions when considering TripSaver II reclosers, but here are a few facts to dispel them:

MISCONCEPTION:
TRUCK ROLLS ARE NOT THAT EXPENSIVE.

Truck rolls are much more than the cost of your crew's labor. Additionally, there is still a significant opportunity cost of responding to outages caused by temporary faults, which could be otherwise avoided, taking your crews away from important grid modernization tasks.

MISCONCEPTION:
TRIPSAVER II RECLOSERS HURT LINE CREW INCOME.

Your crews may believe TripSaver II reclosers will cut into their overtime pay, which commonly occurs during a storm response and contributes meaningfully to their overall income. However, the device allows line crews to be available for other, higher value-added services on your system, such as grid modernization or responding to major events such as storms.

MISCONCEPTION:
THIS DEVICE ISN'T COMPATIBLE WITH MY SYSTEM.

The TripSaver II Cutout-Mounted Recloser offers more than 300 Time-Current Characteristic (TCC) curves from which to choose that align with existing hydraulic, fuse, and microprocessor curves on your system. Other devices may not be one-to-one replacements for existing equipment because non-standard TCC curves require increased coordination study efforts.

MISCONCEPTION:
UNFAMILIAR DEVICES WILL INTRODUCE DIFFICULTY IN DETERMINING WHETHER THE DEVICE HAS OPERATED.

When a permanent fault occurs, TripSaver II reclosers swing to a visible Open position, providing an easy and unmistakable visual identification. Crews then visually inspect the line, repair the issue, and manually restore power.

MISCONCEPTION:
THIS DEVICE MAY NOT COMPLY WITH MY ORGANIZATION'S ENVIRONMENTAL OBJECTIVES.

Every truck roll avoided with the TripSaver II recloser saves emissions. Also, unlike fuses, TripSaver II reclosers do not expel debris, which reduces sparks. And Non-Reclose mode allows operators to disable reclosing, if needed.

MISCONCEPTION:
I'LL HEAD DOWN THE PATH OF PILOTING TRIPSAVER II RECLOSERS, BUT I CAN WAIT TO RALLY MY TEAM.

Before proceeding with a new device on your system, it is critical to gain buy-in from key groups or individuals at your utility. Operations, engineers, and line crews will need to familiarize themselves with the new solution. Convincing key stakeholders early-on will smooth the path forward from pilot to deployment.

8 Next Steps

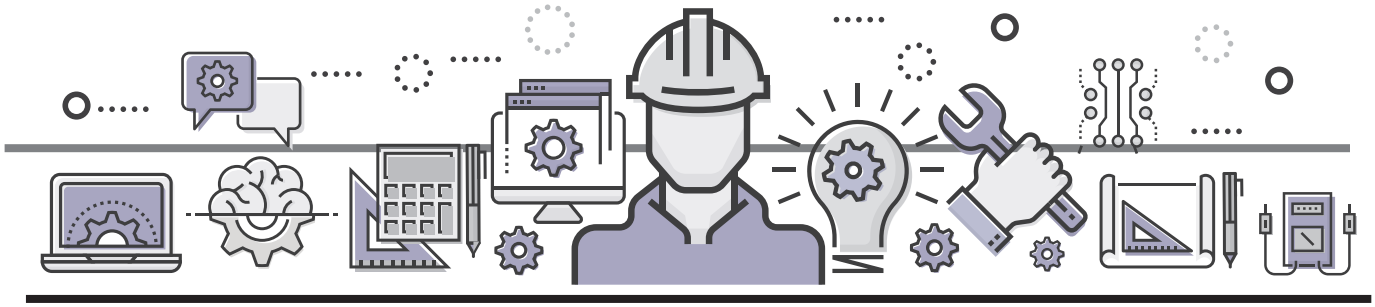
Now that you are equipped with the information you need to carefully evaluate your present lateral protection strategy, it is important to keep next phases in mind.

A shift in strategy will require you to convince others in your organization that change is good—particularly those most affected by using a new device. You'll also need to consider how existing standards and processes will be affected by a change.

Running a pilot will help calculate the long-term benefits of installing TripSaver II reclosers on your system, especially how different your reliability and bottom line could be if you install the reclosers across your system. A targeted pilot will prevent outages from temporary faults, reduce momentary outages, and eliminate O&M costs from unnecessary truck rolls, allowing your crews to focus on other, value-added services. Preventing temporary outages will improve the overall reliability of your system, improving SAIDI, SAIFI, and MAIFI scores as well as customer satisfaction.

If you aren't sure where to start in explaining the value of a pilot project or mapping out a path forward, S&C is here as a resource to help prepare a case for you and develop a plan to present to key decision-makers.

And we'll guide you through each step of the pilot phase.



Rethink Your Lateral Protection Strategy at **sandc.com/tripsaver**

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