



A Comprehensive Commitment Challenges Power Reliability's Status Quo

S&C Featured Solutions: IntelliRupter® PulseCloser® Fault Interrupters, TripSaver® II Cutout-Mounted Reclosers, IntelliTeam® SG Automatic Restoration System, and VacuFuse® Self-Resetting Interrupters

Location: Florida

Customer Challenge

Florida Power & Light Company's (FPL) unique service territory wraps around the state's peninsula, outlined by 530 miles of coastline. This geography presents continual operational challenges for the investor-owned utility: salt spray produces a corrosive environment, a year-round growing climate promotes one of the fastest growth rates in the U.S., and lightning strikes at the highest rate in North America—and second only to the DR Congo in the world. Furthermore, torrential tropical storms and the risk of hurricanes can cause destruction and widespread power outages.

Of the utility's nearly 5 million customers, the majority live within 20 miles of the coast, making them particularly prone to long-lasting outages from storms arriving from any of the three exposed sides of Florida's peninsula. In addition to the coastline, tropical weather and lush landscape are signature to Florida, and many residents resist tree trimming for the aesthetic effects on the scenery. Because of this, customers experience momentary and permanent outages caused by overgrown foliage brushing against lines. In an increasingly digital world, FPL has experienced the rising power-reliability expectations of its customers.

Driven by its ongoing dedication to continuous improvement, FPL committed to addressing all outages—from the quick blips in power to severe storm restoration—when the most active hurricane seasons in recorded history hit the utility with seven storms in 15 months. In the aftermath, FPL reassessed its strategies and questioned whether there were better ways to restore power faster or avoid outages altogether.

FPL determined inherent conditions, such as weather or foliage, should not dictate its ability to provide quality service to its customers. The company assessed the issues accounting for the inevitabilities of the environment, strategizing an integrated solution that would tackle outages of any length.



FPL team restores power after the hurricane.

Integrated Solutions

FPL's first step was to aim for industry-leading reliability and to tackle the more straightforward, grid-hardening solutions. The company's Storm Secure Program redefined system performance on major event days, such as severe storms. The utility adopted extreme wind loading standards so the system could handle hurricane-force winds of 145 mph, mitigating damage from major storms and enabling faster repairs.

FPL refused to let inherent regional conditions dictate its ability to provide reliable power and implemented a comprehensive system-improvement plan.

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The second strategic step involved smartening the grid by investing in industry-leading distribution automation technologies. Having worked with S&C Electric Company for years, FPL knew of S&C's recent smart-grid innovations. To upgrade its feeders, FPL decided to install more than 4,000 IntelliRupter PulseCloser Fault Interrupters, with plans to eventually increase the total to 6,000. These automatic feeder switches leverage PulseClosing® Technology, which uses 95 percent less energy to test for faults than conventional reclosers. If a fault is temporary—common with high winds and palm trees brushing up against lines—the devices gently test the line with a pulse of current and restore power, saving the system from unnecessary stress and eliminating the voltage sags on adjacent feeders, characteristic of conventional reclosing.

The IntelliRupter® fault interrupters' sensing accuracy also means better coordination so more devices can be placed in series on feeders, enabling FPL to further segment lines and reduce the number of customers affected. If a fault is permanent, the devices isolate the fault to one small section and keep the lights on around it. With resolving even seconds-long outages a priority for FPL, it set the IntelliRupter fault interrupters to trip on an individual phase basis if a fault is temporary and then lock out all three phases only when a fault is permanent—a change from circuit breakers in substations that blink everyone on the feeder on all three phases. Using IntelliRupter fault interrupters further downstream on a feeder and homing in on the faulted phase localizes fault-testing

and isolation so only customers close to the fault and fed from the faulted phase see a quick blink, saving other customers from seeing these outages.

FPL also applied advanced technology to its laterals. The company chose to install 80,000 TripSaver II Cutout-Mounted Reclosers, a fundamental change from its fuse-saving protection strategy. These automatic lateral switches replace fuses and test whether faults are temporary or permanent downstream from them. With 46 percent of lateral outages requiring replacement of the fuse, the TripSaver II reclosers save customers unnecessary or extended outages caused by temporary faults and FPL the operational costs to replace them. Working with S&C's engineering teams, FPL determined it only needed two curve settings for most of the devices and arranged for S&C's teams to preconfigure them during production, making installation faster and reducing inventory of spare devices.

When FPL upgraded its baseline protection strategy with advanced smart-grid devices, it set out to shorten the restoration process after a fault was isolated. It deployed S&C's IntelliTeam SG Automatic Restoration System, which has the unique capability of locally assessing the situation within a subsection of the grid and reconfiguring it to restore as many customers as possible. On looped circuits, FPL could connect customers to another source, safely speeding up restoration without depending on central control systems and communication networks. The reconfiguration is completed in less than a minute.



An IntelliRupter fault interrupter being installed.



FPL team installs TripSaver II reclosers.

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The third step in FPL's integrated solution strategy was to improve the availability of smart-grid devices after a major event. FPL developed a smart-grid assessment team to perform restoration replacement approaches immediately following a storm. FPL teamed up with S&C on these assessments to evaluate damage to equipment and recommend solutions to place the devices back in service—a collaboration especially important after major storms.

Results

Grid hardening, coupled with S&C's smart-grid devices, enabled FPL to drive an overall reduction in SAIDI of 15 minutes since the beginning of its reliability-improvement program. FPL estimates S&C's IntelliRupter fault interrupters avoided 4.2 million customer interruptions within their first six years of installation and 1 million customer interruptions in 2017 alone, excluding major events. S&C's TripSaver II reclosers avoided 8,500 interruptions within their first four years, saving operational expenses. Overall, on blue-sky days, FPL found that hardened feeders performed up to 46 percent better than nonhardened feeders.

FPL Grid Improvements

Project installations	Percentage of System Coverage	
	2005	2017
IntelliRupter fault interrupters	10%	72%
TripSaver II reclosers	0%	75%
Hardened distribution feeders	0%	26%
Underground feeders	13%	15%

S&C's IntelliTeam SG system, paired with smart-grid devices, performed so predictably and reliably that they won FPL's confidence to keep the automation and reconfiguration logic up and running during storms with less than 75-mph winds—something few utilities feel comfortable doing because less advanced distribution-automation systems typically can't handle multiple fault contingencies during storms.

Although day-to-day operations have shown significant improvements, comparing storms before and after FPL's grid modernization highlight the extraordinary difference. Though Hurricane Irma (after integrated solutions had begun) affected more of FPL's service territory and was a stronger storm than Hurricane Wilma 12 years earlier (before integrated solutions improvements), FPL was able to restore power to more customers faster after Hurricane Irma. In fact, 50 percent of customers had their power back within one day. In total, FPL shaved off eight days for complete restoration, resulting in a GDP contribution of \$8 billion back into Florida's economy within its 35-county service territory.

Hurricane Restoration Improvements

	Hurricane Wilma (2005)	Hurricane Irma (2017)
Saffir-Simpson Scale	Category 3	Category 4
Maximum sustained wind (mph)	120	130
Customers affected (millions)	2.1	4.4
% of FPL customers affected	75	90
50% customers restored (days)	5	1
75% customers restored (days)	8	3
95% customers restored (days)	15	7
100% customers restored (days)	18	10

Not only did FPL notice these changes and improvements, so did its customers. During an 11-year period, FPL customers experienced a 71 percent reduction in momentary interruptions. This contributed to a 93 percent reduction in customer complaints, even while new customer connections increased by 36 percent over the same period. Even with intelligent device upgrades, the cost of electricity for customers remains affordable, with rates 30 percent below the national average.



These improvements have also earned FPL recognition as an industry leader. In PA Consulting's suite of ReliabilityOne™ awards, FPL received the Outstanding Reliability Performance in the southeast region for five consecutive years, the Outstanding Technology & Innovation for three out of five consecutive years, and Outstanding Response to a Major Outage Event award for two consecutive years. Reaching ultimate acclaim, FPL has won the National ReliabilityOne™ Excellence Award for outstanding reliability in three out of four consecutive years. Davies Consulting also recognized FPL with both its Communications Excellence and Most Innovative Practice awards for leadership and emergency response, including its innovative policies and tools used during post-storm restoration efforts.

Such accolades, as well as drastic reliability improvement, inspired FPL to reach out to S&C to innovate a new smart-grid solution to eliminate nuisance fuse operations above overhead distribution transformers. FPL noticed that after having solved a number of its reliability and resiliency challenges, these transformer locations were its next focus for grid advancement. A significant amount of outages on overhead transformers only required a fuse replacement, indicating the causes of these faults were likely temporary. Collaborating with S&C, the teams invented the VacuFuse Self-Resetting Interrupter, which tests faults on overhead distribution transformers, improves the customer experience, and avoids operational costs. FPL deployed 1,000 devices on 50-75 kVA overhead distribution transformers and, after initial positive results, plans to deploy 50,000 across its system.

FPL's future-thinking mindset and investments in smart-grid technology prove that a dedicated, comprehensive, and integrated solution can set the bar for power reliability, even with some of the nation's most aggressive weather.



Wooden poles are replaced with concrete poles.

"When building a reliability-improvement program, it's not simply one solution but several solutions that come together to make significant change. Extraordinary results come from a larger, multiple-item strategy."

*—Ron Critelli
Senior Director of Power Delivery Engineering
& Technical Services, Florida Power & Light
Company*

