GE’s PowerOn Fusion advanced switching applications provide distribution utilities with state-of-the-art tools to improve the quality of their supply. These tools include:

- Automated Power Restoration System (APRS), providing Fault Detection, Isolation and Restoration (FDIR) functionality
- Switching Advisor, providing tools to assess restoration options

These applications enable control engineers to effectively manage planned or fault-based outages affecting the distribution network. Switching applications provide network reconfiguration strategies ensuring customers are isolated and restored in a fast and safe manner.

Electricity is a vital service for modern life. Regulatory bodies ensure that residential, commercial and industrial consumers receive a reliable service by monitoring the frequency and duration of network outages. Some even provide incentives for, or impose penalties on those distribution utilities exceeding or failing to meet their targets.

Faults on the distribution network can trip out circuit breakers and result in all customers on a feeder losing power. After the protection device has operated, APRS uses telemetry data from circuit breakers and fault detectors to identify the location of a fault. It will then recommend or automatically send a sequence of switching actions to isolate the fault and restore power to the rest of the network. Switching Advisor helps Control Engineers assess further restoration using devices operated by field crews. The proposed restoration strategy ensures that equipment will not be overloaded.

Benefits

Restoring customers quicker
APRS and Switching Advisor reduce the time that customers are without power. These applications ensure that network sections with the highest number of customers, especially if they include sensitive or priority customers, are among the first to be restored.

Preventing damage to assets
APRS takes into account the load on a faulted circuit and the spare capacity of neighboring circuits before deciding the best way to isolate a fault and restore the rest of the circuit. Additionally with DPF, the power analysis module within PowerOn Fusion system can also check for potential voltage violations.

Improving quality of supply
Restorations by APRS typically occur within a minute or less, depending on communications infrastructure. This ensures any outages that do occur fall within typical short interruption thresholds. This has a potential to improve power quality indices (e.g., SAIDI) and reduce the likelihood of regulatory penalties for distribution utilities.

Low system maintenance
APRS is easy to set up and apply on a circuit by circuit basis. It always considers the current network topology and status of equipment and doesn’t require specific scripting for each circuit. It can be disabled on an individual circuit or system basis.

Effective use of field crews
Switching instructions created using Switching Advisor can be quickly relayed to field crews using voice communications or using PowerOn Fusion Mobile Switching for immediate operation.
Features

Automated Power Restoration System

APRS is a new feature of the automation programs in PowerOn Fusion. It allows radial and lightly meshed circuits with different feeder topologies to be automatically and optimally restored when a fault is detected. It can operate in control or advisory mode. When a fault occurs on the network, APRS:

- Uses telemetered fault detection/location devices to locate network section containing the fault;
- Analyses the faulted circuit and its neighboring circuits to determine the size of the outage and spare capacity on potential donor circuits;
- Records switching noting impact on loads and customers;
- Isolates the faulted section; and
- Restores supply upstream and downstream of the isolated section.

If utilities don’t have customer information, then the number of load points or connected kVA is used to determine the restoration order of downstream outages.

Intelligent Downstream Restoration

APRS attempts full downstream restoration from a single donor circuit. If no single donor has the spare capacity required to pick up the outage, APRS can be configured to use other techniques to fully restore the outage:

- **Outage splitting:** APRS may seek to split the downstream outage with the aim of fully restoring the outage from multiple donors. Where more than one donor or split option is available, APRS works out the best switching option based on optimized load spreading following switching.
- **Load transfer:** If an immediate neighbor circuit doesn’t have enough spare capacity to fully restore a downstream outage, APRS can identify second tier (adjacent+1) circuits suitable for offloading, to allow full downstream restoration.

Integration with Up-to-Date Operational Model

APRS checks for devices with control inhibits, recent switching, live line work, and other network conditions which would affect safe execution of automation programs.

Switching Advisor in Planned and Fault Scenarios

Control Engineers interact with Switching Advisor to create switch plans for planned work and fault conditions. Switch plans are easy to create by selecting a device on the network diagram and choosing whether future (planned) or current (fault) switching advice is required. Switching Advisor presents a list of available switching options to ensure customers are kept on supply or restored while minimizing the impact on adjacent circuits. The switch plan is prepared in seconds after selecting an appropriate option.

Switching Advisor Options

Switching Advisor can also be used following the execution of an automation program. Once the fault location is confirmed by field staff, Switching Advisor can subsequently minimize the scope of the faulted section by using manual switches to further “squeeze” the outage, while ensuring spare capacity or other limits are not violated.

Squeezing Outages

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Supporting Components

APRS and Switching Advisor are optional modules within the PowerOn Fusion product range. They require the following core modules as standard:

- **PowerOn Fusion NMS:** For planned and fault switching
- **PowerOn Fusion SCADA:** For communications, telecontrol switching and automation programs

In addition the following elements complement their use:

- **PowerOn Fusion DPF:** APRS or Switching Advisor can additionally check for voltage drop off on potential donor circuits by rejecting any operations that would violate voltage limits.
- **PowerOn Fusion Load Forecast:** Provides Switching Advisor or APRS with the ability to consider future loads when making recommendations.
- **PowerOn Fusion Mobile Switching:** To send recommended switching steps from Switching Advisor directly to field crews.

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