

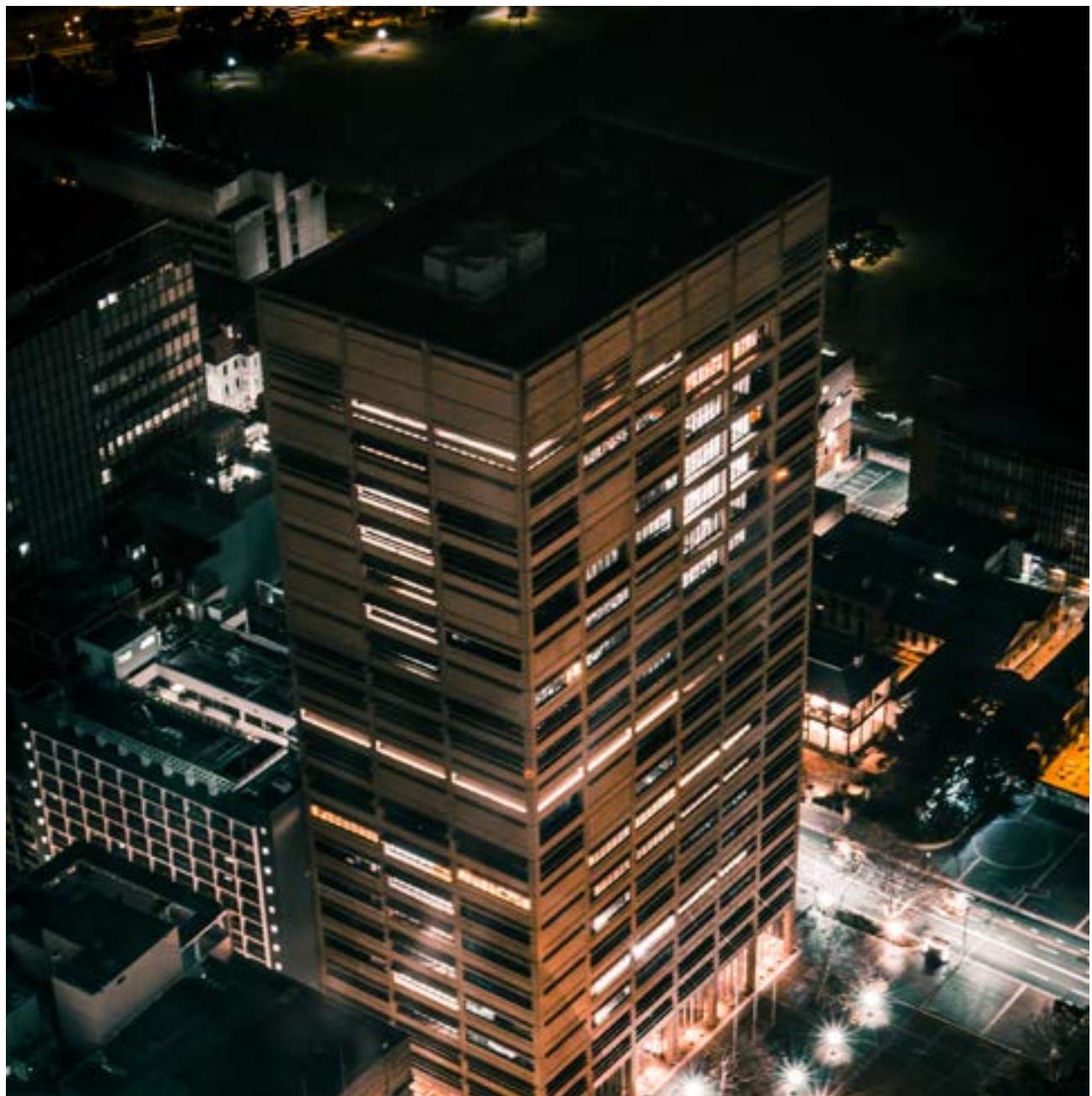
WHITE PAPER

FROM BLACKOUTS TO LIGHTS BACK: A BRIEF
ACCOUNT ON FAULT LOCATION, ISOLATION, AND
SERVICE RESTORATION.

**KEEP THE
CITY BRIGHT**

FLISR

Spin Engenharia | Sinapsis Inovação em Energia | October 2018





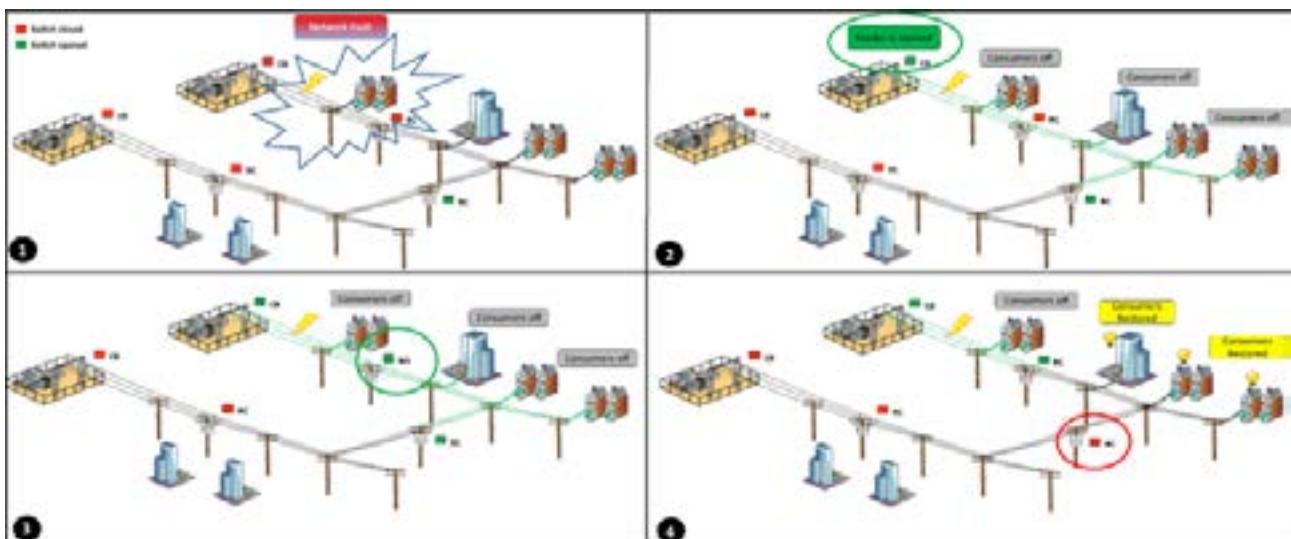
WHERE WE BEGIN

Identification and location of network faults, isolation of the fault in the smallest possible area and automatic reconfiguration of the electric grid in order to minimize the duration and extent of power outages: that is fault location, isolation, and service restoration (FLISR).

A detected fault is restrained by the FLISR system immediately within the smallest possible area. Then nearby feeders/power sources are called to reenergize the surrounding sections. The grid level of redundancy and the ability of neighboring feeders to handle the additional load determine the process used in each portion of a network.

THE BELOW FIGURE IS A GOOD EXAMPLE OF A “SELF-HEALING” ALGORITHM WORKING. THE FOUR SNAP SHOTS SHOW:

- (1) There is a fault near the circuit breaker (CB);
- (2) The feeder is opened and provided energy for several consumers until the normally open recloser (RC) became without energy;
- (3) The green highlighted recloser is opened, isolating the fault;
- (4) The red highlighted recloser is closed, restoring the energy for most consumers.

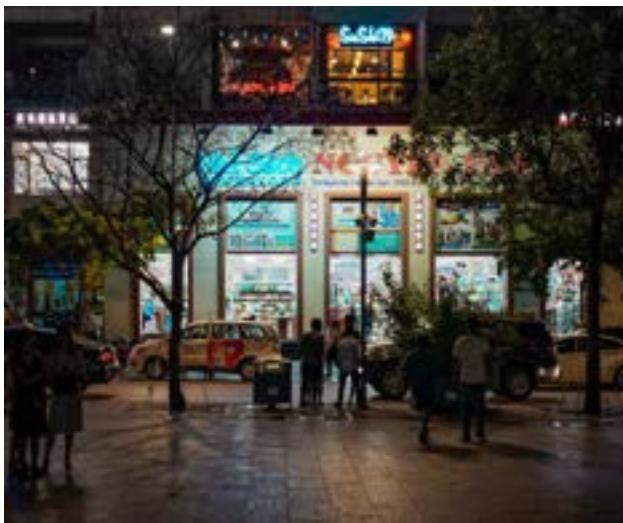


GET READY TO IMPLEMENT

The expression “centralized FLISR” means to deploy a software solution, independent of switches and feeders manufacturers. It can be implemented in the utility’s Operation Center, in a regional center or even a group of substations that controls dozens of distribution circuits.

If, for example, the utility already has a SCADA system, the solution can be coupled to this SCADA, executing only the FLISR algorithm and sending the utility’s SCADA orders to isolate the fault and restore the system.

As a prerequisite for the implementation of the FLISR system, it is important to carry out a study of the allocation of pole switches in strategic locations that optimize the load relocation maneuvers in case of faults, just as it is important to have a high-availability telecommunications system integrated with all switches used by the FLISR function.



GET YOUR ROI GOING

When meters are not turning, revenue is not flowing. By keeping the power on to more customers for more hours of the year, FLISR reduces the amount of unserved electricity – also known as the expected energy not supplied (EENS) – and thus maximizes revenue.

FLISR is also a proven way of boosting key performance metrics and adding value for customers, so it can help utilities justify rate increases.



More reliable

With FLISR, when a fault occurs it is possible to reduce the number of customers with sustained outage. It is also possible to reduce the amount of time for service to be restored.

This improves reliability KPIs such as customer minutes of interruption (CMI), System Average Interruption Duration Index (SAIDI), and System Average Interruption Frequency Index (SAIFI), which are used to assess the quality of an electric grid with respect to internal performance targets, regulatory standards, and customer commitments.



C&I Customers deserve better

Companies that depend on power to produce count on the electric grid. Even short power outages can mean loss of revenue. With a FLISR system, the situation is different.

What FLISR demands

A centralized FLISR system demands utilities to be prepared to make a range of new infrastructure investments, which can generally be classified as field equipment, communication devices, or software control systems.

At the Field

There is a series of remotely controlled equipment that must be deployed before the FLISR system can be brought online. They are the telemetered devices operating in the field that detect faults and reconfigure the electric grid like fault indicators, tie switches, line switches, breakers, reclosers, etc.

Happier customers

Commercial and industrial customers can only benefit from a system that enables utilities to restore customer service faster than old methods.



HOLD THAT OPEX

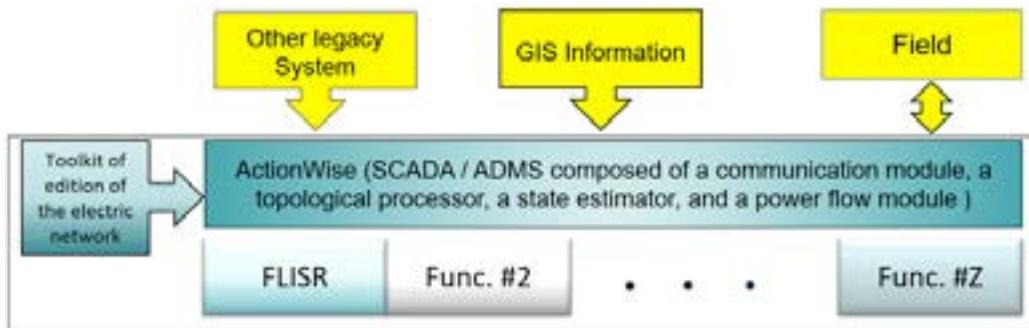
Operating costs go down automatically with the restoration of power after temporary faults. In addition, your field team will thank you for that because they can work knowing that as many customers as possible have their power restored. And the area in need of restoration is reduced to a minimum. Without too much labor and other resources, costs the field crews can focus on planned tasks.



Control

To efficiently reconfigure the grid ActionWise FLISR solution requires an accurate network connectivity model that defines the position and state of grid elements in a proper way. The basic model will need to be augmented with additional information, such as cable type, network topology, load description, etc. These data can be found in the utility GIS and will facilitate load transfer calculations.

The ActionWise FLISR solution (figure below) already is a SCADA/ADMS composed of a communication module with the field or utility's SCADA, a topological processor, a state estimator, a power flow module and a modified genetic algorithm used for the FLISR. In the future, other functions can be added to the solution.



SMART GRID TECHNOLOGY SUPPORTED BY INFRASTRUCTURE/A FLISR system implementation liberates utilities to have more field equipment available for other distributed automation applications.

COMMUNICATIONS/A FLISR system must be able to communicate with field devices correctly in order to act properly. A robust communication network helps with the challenge of maintaining communication during extreme weather conditions.

This solution communicates directly with the field or to the utility's SCADA. In the second option, the SCADA performs the field communication and sends the information to the algorithm that sends orders to execute the maneuvers.

FLISR: HOW

FLISR reduces the impact for the customer of a fault by reconfiguring the network with telemetered switches and relays. After a fault occurs, the system uses data to orient the opening and closing of switches until it isolates the fault within the smallest possible section of the network ([see demonstration in YouTube](#)).

Basic steps of the solution running in automatic mode:

- Fault occur;
- Identify the fault;
- FLISR algorithm runs and defines the maneuvers to isolate the problem and restore the service for most consumers considering, line attributes, number of commands, load in the next hours, and quality KPIs.
- At this point, only 20–30 seconds have elapsed (based on the communication network) but the FLISR system has already completed its task.
- The utility must now dispatch a field crew to repair the damage and restore service to the remaining customers.

Attention: the FLISR algorithm just consider devices that are communicating (no communication error) and are not blocked for any reason (device error or operation intervention).



FLISR: WHAT

The ActionWise FLISR solution operates in four different ways:

- **Simulation mode:** ActionWise assumes the default setting of all breaks and switches (normally closed and normally open switches), with an average load. The user can simulate faults and the system will perform the maneuvers in the same way as when installed. The simulated mode allows you to test the entire system before installing it in the definitive environment.
- **Listening mode:** the software is connected to the field (directly or through the utility's SCADA) and in this mode performs all functions except that it does not execute commands for the field. Thus, in this mode, all communication with the field is tested, as well as the actions that would be performed.
- **Semi-automatic or manual mode:** the software generates the maneuvering planning sequence, but does not execute them automatically, waiting for the operator's authorization to send the commands to the field.
- **Automatic mode:** the software generates the maneuvering planning sequence and immediately execute them.

When implementing a FLISR system consider

1) Number of reclosers/As many reclosers are installed, more maneuvers are at the system disposal and that means less customers without energy. A careful analysis of the network can result in a reasonable balance between cost and performance.

2) Miscoordinations/The extent to which a network can be sectionalized is connected to device coordination. Miscoordination occurs when different protective devices are simultaneously tripped by the same fault, or a device removed from a fault reacts to clear it before the nearest device can perform the same function. To prevent this and calibrate the network for optimal device timing, and then ensure that new protection settings are used when the network changes.

3) Compatibility with equipment/Before implementing FLISR it is important to check if existing field devices are compatible with the new system.

4) Communication Network Upgrade/Check your communication network for resiliency, security, suitability,

and upgraded or replaced. Remember to secure the entire communication network against outside threats.

5) Maintenance/FLISR operations depend on the communication network. Utilities should plan for more communication maintenance as well as FLISR and its components (even equipment). The operative repositioning of the switches changes, since now, whenever a switch is modified, it is necessary to change the localization of it in a topological database.

6. Training/All team dealing with FLISR must be trained on equipment, software, and processes. Remember to include new or modified safety procedures. The ActionWise simulation environment is ideal to based training programs.

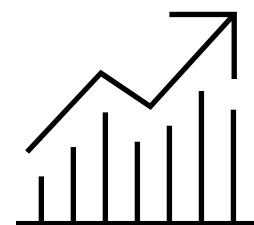
7. Management Support/Implementing a FLISR system involves cost, planning, personnel, and time. It may change the way utilities works. Managers must keep an eye on the company culture evolution.

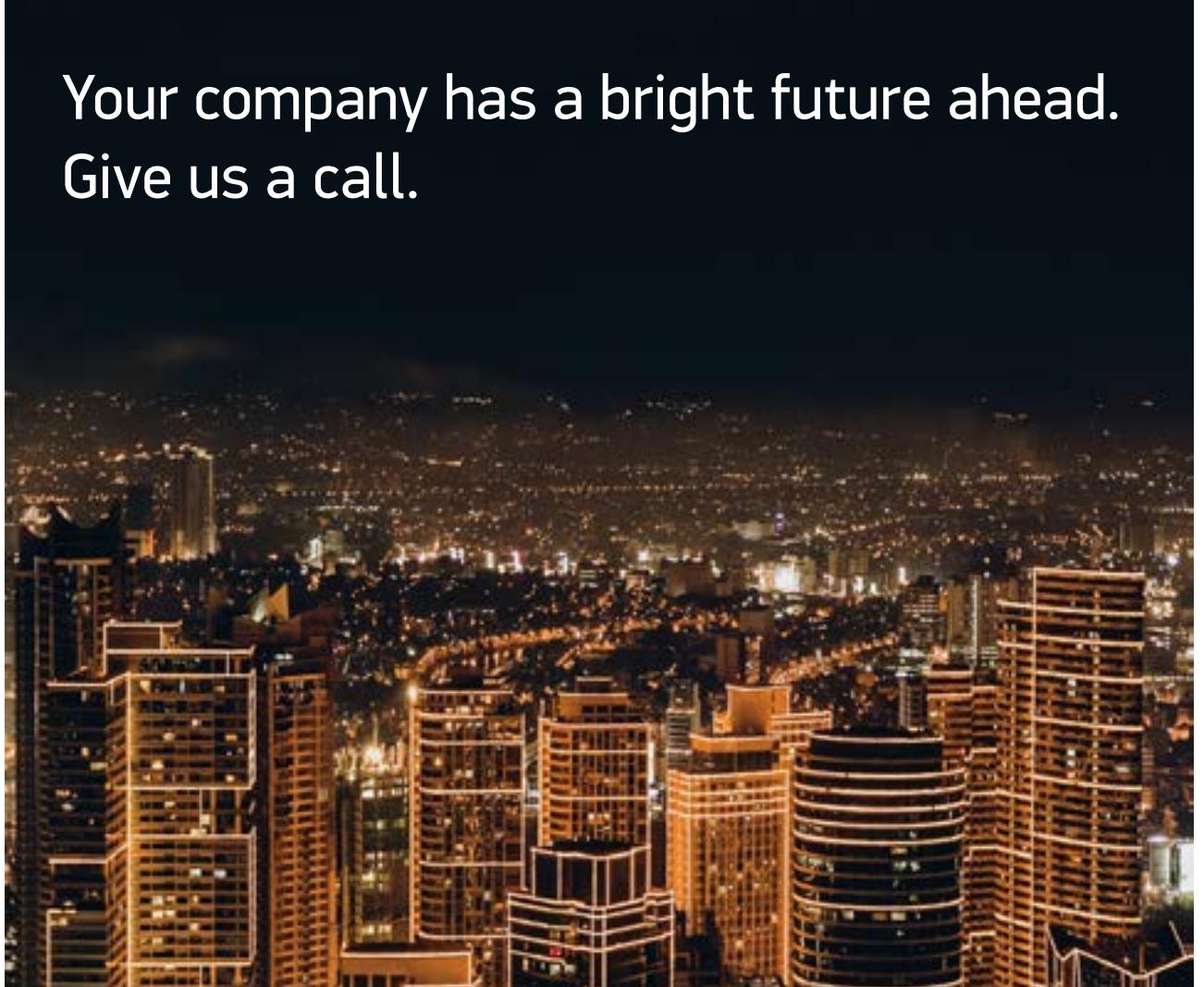
FLISR is a system that changes the way utilities operate. With it comes new equipment, new software and new systems to maintain. It also demands new ways to execute familiar tasks. It is important to anticipate such changes during the planning stage of a FLISR project, including finances.

Minimize outage impact & duration with ActionWise

ActionWise's FLISR solution uses telemetry from field devices or utility's SCADA to rapidly identify faults, isolate them, and then automatically resupply as many customers as possible.

- Software FLISR decision can run in one group of substations, one regional center or in the utility's center of control. It can be integrated with the field or can be connected with utility's SCADA;
- Ability to enable/disable the application on a per feeder basis or globally. If any recloser/feeder is out of control, it is automatically removed from the algorithm;
- Listening, semi-automatic and automatic modes of operation;
- Vendor agnostic for field devices;
- Sophisticated fault location algorithm;
- Powerful simulator environment;
- Comprehensive FLISR operations log as shown in the figures below.
- Easy deployment;
- Easy understanding of the ties through schematic diagrams presenting all devices involved.





Your company has a bright future ahead.
Give us a call.



EXPERTISE AND TRADITION ARE THE BASIS
OF GOOD TECHNICAL SOLUTIONS

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October 2018

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