A substation's approach to self-healing grids
COM600 grid automation controller

Today's utility challenges

Reduced grid reliability due to unscheduled outages is one of the top challenges in the electrical industry today. Loss of revenues due to the inability to quickly restore power after an unplanned event represents a direct hit to the utility's bottom line and, in many cases, affects reliability indices and public image. Above all this, optimization of crews and their safety is a priority that must drive every effort to improve the utility's bottom line.

The implementation of a comprehensive plan to improve reliability includes traditional measures that historically have been effective such as tree trimming; however, while these measures are still required and bring great value, only the implementation of self-healing capabilities in the grid will maximize the utility's reliability.

There are several types of self-healing solutions: 1) peer-to-peer, 2) decentralized or station level, and 3) centralized. There is no one type that fits all possible situations. Therefore, a careful analysis should be carried out to determine which option offers the best solution.

Implementation of a station-level self-healing strategy can help solve many of today's utility challenges. Deployment of centralized, self-healing capabilities to maximize distribution circuits' reliability requires automation of switching points as well as a communications platform such as fiber optic or wireless radios. The best solutions are those that allow the user to cost-effectively automate existing switches or install new reclosers that communicate using open protocols, avoiding proprietary protocols that force the user to adopt a single-supplier solution.

The right station level self-healing solution is the one that brings real savings to the bottom line and accounts for future changes to the grid such as addition of feeders or reconfiguration of circuits. One way to achieve real savings by choosing the right solution is to minimize the time required to rearrange a self-healing configuration from days to hours.

Fault Detection, Isolation, and load Restoration (FDIR)

FDIR enables the utility to quickly identify the location of a fault, isolate it, and restore power during an unplanned outage by rerouting the flow of power on the distribution grid through unaffected areas. FDIR has two main goals:

1. To limit the size of impacted areas
2. To safely speed restoration of power

What are the benefits of FDIR?

Customers can benefit from FDIR by minimizing outage time and the areas without power after a fault.

Some of the potential benefits are:
- Improved personnel safety
- Improved customer service
- Increased revenues
- Lower operations cost
- Reduced risk of fines and lawsuits
- Improve CAIDI and SAIDI metrics by up to 33%
- Significant reduction in restoration time
- Reduce the cost of restoration
- Prevent lost revenues
- Boost the utility's reputation with customers, stockholders and regulators

How Fault Detection Isolation and Restoration works at the station level

When there is a fault in a distribution network, ABB's COM600 grid automation controller receives a lockout status via open protocols and then activates the FDIR algorithm.

Once the isolation is completed, the load restoration starts from the downstream node of the isolation switches. The COM600's algorithm searches all possible neighboring sources for restoration and determines single or multiple paths for restoration. The COM600 takes into consideration the source(s) and switch capacities to determine the FDIR sequence. If loads and capacities are not appropriate to do restoration, the fault will be isolated but not restored.

The FDIR feature in the COM600 can be set to do the isolation and restoration steps either in "Auto" or "Manual" mode. When in manual, after a fault is detected the user will receive a message through the HMI that a fault has occurred and a suggestion of what switch/recloser to operate in order to isolate the fault will be presented; it is up to the user to decide whether the suggested operation should take place or not. A similar process takes place for the restoration of a fault. "Return to Normal" is always a manual procedure – a suggestion on what device should be operated to do the "roll back" (to let the system return to its normal process) is presented to the user after the isolation has been done. To comply with safety requirements, the FDIR sequence of the COM600 can be blocked when hot line tag is applied.

For added convenience, increased flexibility, and quicker implementation, an offline mode is also provided to simulate scenarios without operating any apparatus.

1 COM600 | 2 The fault was detected between Breaker_1 and the Recloser_1A | 3 FDIR feature is enabled and in Auto mode | 4 COM600 recommendation to perform fault isolation in Manual mode | 5 COM600 recommendation to perform load restoration in Manual mode | 6 The healthy portion of the network will have power: Circuit-2 and Circuit_3

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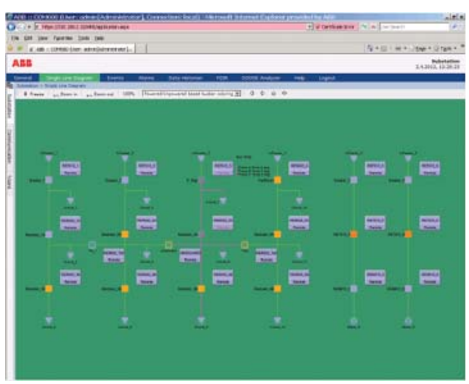

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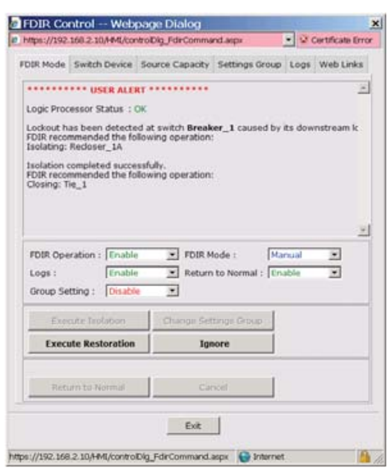

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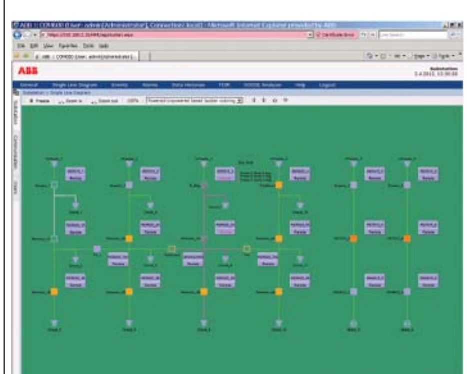


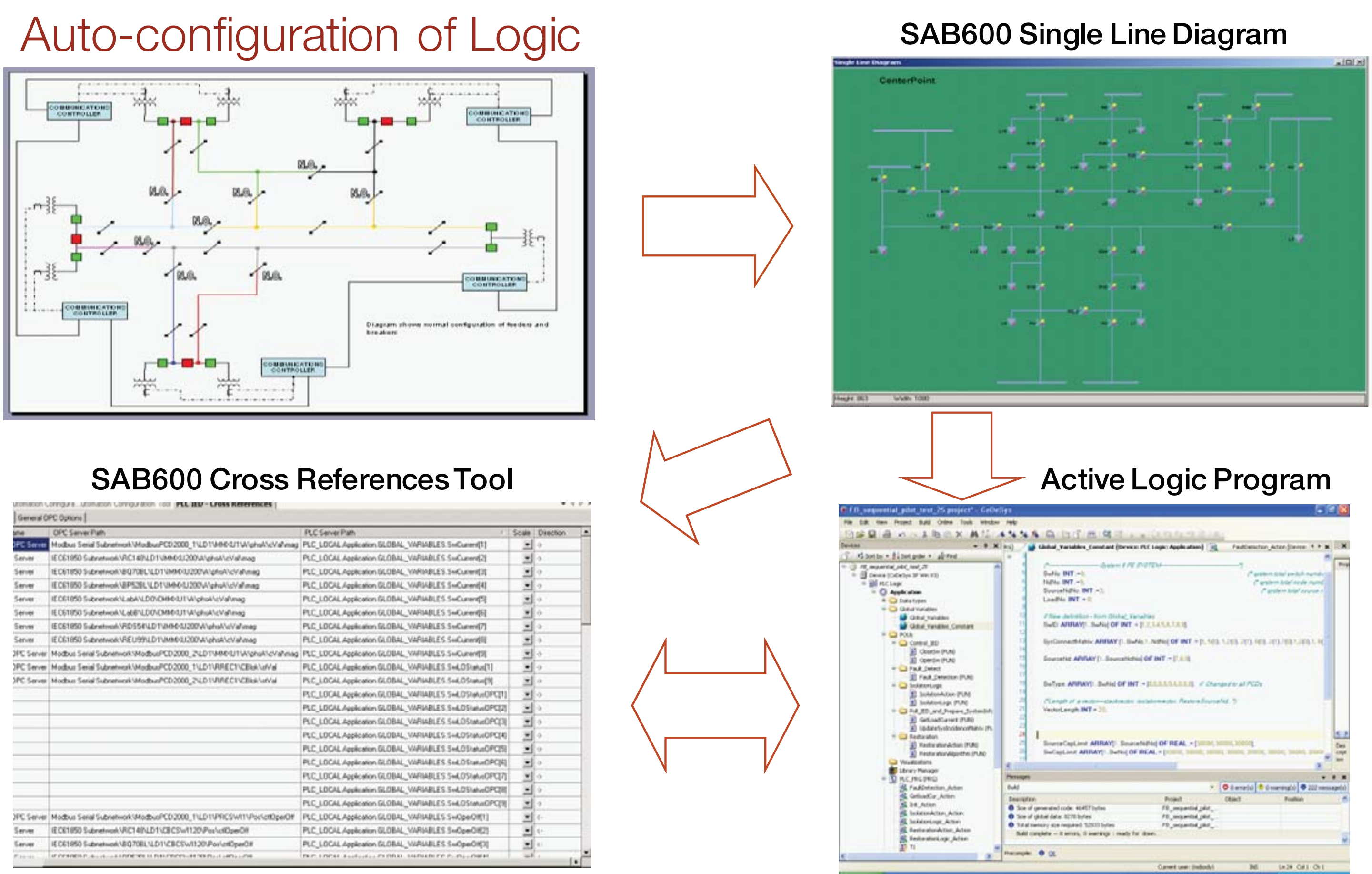
Time-saving configuration

Using SAB600 (Substation Automation Builder), the logic for the fault isolation and load restoration can be dynamically generated – this means that configuring and modifying a project can be done in a matter of hours without writing any code at all. SAB600 does all the work of creating the FDIR logic at the station level.

The following steps need to be done in order to configure FDIR with the COM600:

1. Build communications structure. This is the step where the user indicates how many IED's are in the scheme and each IED's communication characteristics.
2. Build single line diagram using the object-oriented tool.
3. Set device usage, load limits, and priorities using FDIR configuration tool.
4. The software will automatically generate the FDIR project and cross reference tables.

The following diagram displays 1) system topology transferred to single line diagram of COM600 config tool (SAB600), 2) Connectivity & IED data points/commands (cross references) automatically configured in Active Logic program using Feeder Automation Configuration Tool, and 3) Isolation and restoration logic automatically configured based on connectivity and device statuses



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