



SIEMENS



Systems and Services

Siemens Distribution Feeder Automation System (SDFA)

Scalable high-speed feeder automation solution

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SDFA restores service to unfaulted sections of distribution feeder lines — with or without operator intervention.

Siemens distribution feeder automation system

The Siemens Distribution Feeder Automation System (SDFA) automates the fault location, isolation and service restoration (FLISR) tasks and automatically restores service to viable sections of line, thus minimizing outage time and dispatch expenses.

The SDFA-FLISR functions by segmenting distribution feeders into manageable line sections. Line sections are typically separated by primary switches, such as reclosers, load break switches and substation circuit breakers. Each line section is provided with a possible alternative power source which typically supplies residential or commercial consumers with power. In some instances, a line section can provide power to a critical facility like a hospital, prison or emergency services. The SDFA system provides a new, innovative approach for locating and isolating power system faults on line sections. After isolating a faulted line section, SDFA connects un-faulted line sections to alternate power sources, thereby restoring power to line sections that were unaffected by the fault. This process is commonly known as FLISR (Fault locate, isolation and service restoration). The SDFA-FLISR system operates in a blink of an eye, making it very difficult for a consumer to detect that the electrical system was reconfigured and connected to an alternate power source.

Features

- Rapid FLISR for minimal outage time
- Rapid Automatic Prioritized Source Transfer
- Inter-operable with conventional protection systems
- Innovative, patented jDiff™ protection feature
- Load balancing and load monitoring
- GPS time synchronized event data
- Communication link monitoring
- Simulation mode for offline SCADA testing
- Sequential logic for precise operation
- Scalable, decentralized architecture
- Simple Graphical Sequence Programming software (FASE)
- Each system thoroughly tested and “Ready to Install”
- Communication over fiber, Wi-Fi, WiMAX and cellular
- Requires minimal IP-based communication bandwidth
- Turnkey solution from primary switch to automation
- Integration kits available for various types of primary switches



How it works

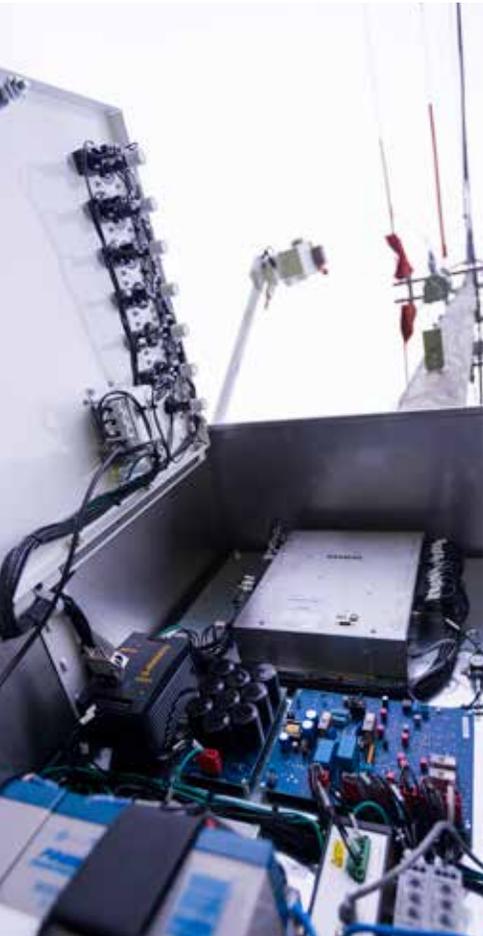
In the traditional approach, a utility must have a protection system that will detect and isolate power system faults. If the protection system detects a fault, it will do its best to isolate the faulted line section including all downstream line sections through coordinated protection tripping. In the process, the protection system will test to see if the fault was temporary in nature, such as during a storm, when a tree branch makes intermittent contact with a power line. We have all experienced these situations in our homes during a storm; Our lights go out, and then come back on. A temporary fault was the cause. If the lights go on and off a few times and finally stay out, the fault must have been permanent in nature and the protection system isolated the faulted line section as well as all downstream line sections. Line crews are then dispatched to manually isolate the faulted line section and repair the line. Perhaps, having to remove a tree that has fallen on the line. The line crews will go to the affected feeder, or if available, a SCADA operator will reconfigure the feeder remotely to supply power to as many line sections as possible. This process could take minutes to hours before power can be restored to all consumers.

SDFA-FLISR isolates faulted line sections, reconfigures feeder to supply power to all unaffected consumers in a blink of an eye. The SDFA-FLISR system accomplishes this by employing a new innovative protection technique called "jDiffTM". The jDiffTM function will detect a power system fault on a feeder line section in a fraction of a second. The system immediately isolates the fault by opening the upstream primary switch and then closing the switch back to provide power. This is a test action to see if the fault was temporary

in nature. If the fault is again detected when the primary switch is closed, the system would immediately isolate the faulted line section, then reconfigures the feeder to provide unaffected line sections with power from alternate sources. The isolated faulted line section will again be tested by the protection function by providing power to the, now isolated, faulted line section. If the fault is temporary in nature, SDFA would immediately restore power to the line section. If the fault is permanent in nature (a fallen tree for example), the section would remain isolated and a message is sent to the Outage Management System to dispatch line crews to remove the fallen tree and perform any required line repair work.



JDIFF™ is the difference. Patented technology allowing restoration in the blink of an eye.



To accomplish the task, pole-mounted, intelligent substation-hardened 7SC80 devices control automated sectionalizing switches, circuit breakers and reclosers located along the feeder. Each line section contains two 7SC80 devices with powerful programmable logic controllers (PLCs) that can be easily configured by the utility to operate the primary switching devices in response to local or network conditions. The 7SC80 devices communicate with each other in a peer-to-peer fashion, operating autonomously with no need for a master controller. The 7SC80 contains on-board GPS time synchronization, making it ideal for wireless communication networks, and thereby providing synchronized operational and non-operational data to the utility enterprise. The 7SC80 can simultaneously communicate to 5 DNP masters, making the device information accessible to multiple enterprise services and or applications. During a power system fault or event, all 7SC80 devices will capture fault recordings that can be automatically retrieved. With GPS-synchronized data, fault recordings from numerous field devices can be compared using the SIGRA analysis software thereby making system wide fault analysis a breeze.

Rapid fault detection (jDiff™)

Fault detection is accomplished using the jDiff™ high-speed line differential function residing in each 7SC80 device. Each sectionalizing switch or recloser contains current sensors that continuously supply line current measurements to each adjacent device in the feeder section. When a fault current spike or “jump” occurs along the feeder, controllers in the affected section receive information about the dynamic current jump and compares it with the dynamic current conditions at adjacent controllers. If a comparison yields a dynamic current differential exceeding utility defined parameters, the affected devices issue a line section fault notification to all other devices in the

system. Fault detection occurs in as little as 1/16 of a second, or one power cycle.

A complete FLISR sequence (i.e., Open Recloser 1, Open Recloser 2 then close Recloser 3) is typically completed in less than a 1/3 of a second when deployed using Fiber Optic communication and fast acting reclosers or circuit breakers. On wireless systems, SDFA-FLISR reconfiguration will be completed in less than 1/2 a second.

To compare that speed, on average, a human eye takes between 300 and 400 milliseconds to complete a single blink. That’s roughly between three-tenths and four-tenths of a second.

Fault isolation and service restoration

The system provides two distinctly different operating sequence options. The first is a conventional approach where the SDFA system will wait for the protection system to issue a final trip or lockout before starting an automatic reconfiguration sequence. The system can thus, be easily integrated into existing switchgear and protection systems. Siemens can provide various SDFA Integration Kits for reclosers, switches and circuit breakers.

The second option is a new and innovative approach. This functionality was developed for a local US utility to achieve the shortest possible outage time at critical loads in their system. The patented, jDiff™ is used as a protection function to immediately locate faults and isolate faulted line sections. It then provides alternative power to all line sections through the reconfiguration of the feeders by switching the primary switches in proper sequences. The system will then go back to test the faulted line section for temporary faults. This is done by reclosing a power source onto the

SDFA can locate, isolate and restore power in less than one-half of a second.

faulted line section. If the fault was permanent in nature, the SDFA system will disconnect the power source and attempt this action a set number of times per normal protection system practices. One of the advantages to this approach is that line sections feeding consumers that are not affected by the fault are not subjected to 3, 5 or even 10 second interruptions that conventional protection systems will cause. For large commercial loads or critical facilities like hospitals, these unnecessary interruptions cause problems and negative publicity. Another major advantage is that the Siemens solution dramatically simplifies the conventional coordinated protection tripping schemes. When



automating a feeder system with multiple sources that are feeding an ever-changing, mesh-connected topology, the protection system can become overly complicated and costly to implement. SDFA's jDiff™ differential protection approach provides a simple, completely selective, and dependable protection solution.

Simple switching logic

The fault isolation and service restoration tasks are performed using simple sequential switching logic that are programmed into the 7SC80 controllers. Each controller contains a powerful PLC and uses multiple AND gates to perform switching steps, which when combined, create logical sequences that control the isolation and restoration processes. Sequences for source transfer, load balancing and single command topology changes can also be programmed. Thus, the system has complete flexibility to execute desired sequences based on operating mode, fault information, and system status as combined simply at a single AND gate.

FASE configuration software

The FASE configuration software included, is the graphical tool used to easily program the SDFA system. System programming is accomplished using a drag-and-drop, point-and-click graphical user interface. FASE software requires the user to first build a topology through a simple drag-and-drop, point-and-click method to define the network topology of primary switches, sources and interconnecting lines. The user then defines the normal power system operating state by changing the open and close position of the primary switches by changing device colors between green and red. In the second step, the user enters all required protection and communication

settings for the entire feeder system in a single table with easy-to-use, drag and copy features. There is no need to open individual devices to apply settings. In the third step, the user has the option to program all operational sequences, following a simple straight forward sequence, or have the system generate all sequences automatically. Finally, FASE automatically generates control device files that get downloaded to each 7SC80 field control device. It's really that simple!

Simulation mode

The SDFA system provides a device-based simulation and test mode. In this mode, the system can simulate all operating sequences, fault sequences and control functions. In the simulation mode, the control device will not operate the actual primary switchgear but internally simulate the primary switchgear. The controllers will provide feedback to the SCADA system making it very easy to test SCADA integration without having to send a field crew out to bypass and operate the switchgear. The system also provides a live test of the communication system whereby all sequences can be initiated at all controllers to ensure that communication links are able to support the application.

Find out more today

To discover how the Siemens Distribution Feeder Automation System can save you time and money, please contact your nearest Siemens representative. We'll be pleased to discuss your specific needs and offer a solution that maximizes customer satisfaction while reducing service expenses.

SDFFA minimizes feeder down time by quickly and automatically restoring operation to serviceable feeder sections, while isolating those requiring repair. This results in minimal outage, fewer service calls, and reduced monitoring and management demands.

SDFFA makes the grid more reliable.

- Rapid FLISR for minimal outage time
- Scalable for maximum cost effectiveness
- Decentralized peer-to-peer architecture, no master required
- Easily integrates into SCADA networks
- Standardized IEC 61850 & DNP3 protocols
- Multiple control points
- Advanced monitoring functions
- Load balancing and monitoring
- Critical-load transfer schemes
- Failsafe remote and manual operation
- Simulation mode for offline testing and configuration
- Sequential logic programming for precise operation
- One software package programs logic
- Turnkey solution from primary switch to automation
- Each system thoroughly tested before shipping



Features and benefits of SDFA include:

1. Flexible configuration

- On location
- Control Center
- Integrated with SICAM

2. Quick, automated restoration

3. Multiple communication options

- Direct fiber
- Ethernet over Fiber
- Copper
- WiMAX

4. Use of any standard recloser

- Siemens or other brand

5. Small footprint

- Pole-mounted control box rather than pad-mounted
- Built-in automation controller
- Protective Relays

6. Integrated 7SC80 automation controller for local control

- Optional HMI
- Provides operational status
- Access non-operational data

7. Protects critical loads

- Hospitals
- Prisons
- Emergency services
- Industrial facilities

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Subject to change without prior notice.
Order No: E50001-E720-A156-X-4AUS
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