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USE CASE 10 – SYSTEM OPERATOR IDENTIFIES, LOCATES, ISOLATES AND RESTORES SERVICE AFTER A FAULT

Use Case Title

System Operator identifies, locates, isolates and restores service after a fault

Use Case Summary

Utilities that operate in congested metropolitan areas have a need for rapid information gathering, and analysis of switching options to restore service when a substation or substation transformer is lost. Without this capability, it makes 8 hours or more to restore power should an inner city substation be lost. This application runs at a control centre level, with data collected from the substation and feeder levels.

Use Case Detailed Narrative

Utilities have a need for rapid information gathering, and analysis of switching options to restore service when a substation or substation transformer is lost. In congested metropolitan areas, without this capability, it could take eight hours or more to restore power should an inner city substation be lost. The Fault Identification, Location, Isolation and Service Restoration ("**FILISR**") application runs at a control center level, with data collected from the substation and feeder levels.

The following steps describe how the application works:

Step 1: Using IEC 61850 the status of the power delivery system is constantly monitored.

Step 2: When a fault occurs on the power grid…say a tree falls on a power line, remote IEDs communicate using IEC 61850 to provide the change in status of the utility grid. This identifies the line segments that are currently de-energized due to the fault.

Step 3: When the change in system status indicates that a fault Using has occurred, the FILISR application uses the electrical network configuration in CIM, along with the Field IED information provided via IEC 61850 to determine which two opening points the fault is located.

Step 4: Next the FILISR application uses the Switching application to determine the valid switching options and notifies the System Operator of the various switching options via the Control Center.

Step 5: Next the System Operator selects the best switching option and uses the FILISR application to execute the switching procedure to open the switches on each side of the fault location to "Isolate" the fault.

Step 6: Next the FILISR application closes the switches feeding the non-faulted de-energized feeder segments, "Restoring" service to the non-faulted sections.

Step 7: Once the crews have repaired the fault the FILISR application reverses the switching process to "Restore" service to all sections.

Business Rules and Assumptions

More Utility Commissions are starting to implement performance based rates (PBR). PBR essentially penalizes utilities for performance based on service unavailability. Before PBR utility engineers had a difficult time in building a business case for automated switching. The costs for automating switches made their application valid only for extreme operating cases, or when a customer paid the additional cost for automating the switches. The penalties can typically pay for the implementation of an automated FILISR system.

The rules for PBR will vary from State to State, however most include the performance measures of SAIDI (System Average Interruption Duration Index, SAIFI (System Average Interruption Frequency Index, and often system average interruptions per mile of line.

ACTORS

Actor Name	Actor Type (person, device, system etc.)	Actor Description
Field Device Communication Interface	System	Generic architectural component that communicates with substation and field devices using IEC 61850. This system can translate IEC 61850 services to GID services.
System Operator	Person	Monitors network and identifies the need for and performs required switching using the Switching Application.
Fault Identification, Location, Isolation and Service Restoration Application (FILISR)	System	System that uses automation to aid and increase speed of recovery of fault events. Involved during entire fault process from identification to system restoration.
Management	Person	Collects outage data for reporting to Utility Commissions.
CIM Model Server	System	
Service Crew	Person	
Field Devices		

STEP BY STEP ANALYSIS OF EACH SCENARIO

Scenario Description

Triggering Event	*Primary Actor*	*Pre-Condition*	*Post-Condition*
(Identify the name of the event that start the scenario)	*(Identify the actor whose point-of-view is primarily used to describe the steps)*	*(Identify any pre-conditions or actor states necessary for the scenario to start)*	*(Identify the post-conditions or significant results required to consider the scenario complete)*
Fault occurs on system	FILISR	Power distribution system is continuously monitored.	

Steps for this scenario

Step #	*Actor*	*Description of the Step*	*Additional Notes*
#	*What actor, either primary or secondary is responsible for the activity in this step?*	*Describe the actions that take place in this step including the information to be exchanged. The step should be described in active, present tense.*	*Elaborate on any additional description or value of the step to help support the descriptions. Short notes on architecture challenges, etc. may also be noted in this column.*
1	Field Device	Field Device reports fault condition to FILISR	Multiple Field Devices may be reporting their knowledge of the fault condition.
2	Protection Devices	Protection Devices de-energize some segments of the power distribution system.	
3	FILISR	FILISR uses Field Device fault reports and CIM system model to determine fault location	
4	FILISR	FILISR notifies System Operator of various valid switching options and their impact on the system	
5	System Operator	System Operator selects desired switching operation to best isolate the fault	
6	FILISR	FILISR transmits switching commands to Field Devices	
7	Field Devices	Field Devices confirm switching operations to FILISR	
8	FILISR	FILISR updates system model and line status information	
9	Service Crew	Service Crew downloads line status information	
10	Service Crew	Service Crew repairs fault	
11	Service Crew	Service Crew notifies System Operator of fault repair	Outage Management System notifies System Operator
12	System Operator	System Operator uses FILISR to restore service to faulted line segments	

Step #	Actor	Description of the Step	Additional Notes
13	FILISR	FILISR transmits switching commands to Field Devices	
14	Field Devices	Field Devices confirm switching operations to FILISR	

REQUIREMENTS

Functional Requirements

Functional Requirements	Associated Scenario # (if applicable)	Associated Step # (if applicable)
Control the operating indexes for the utility grid.		

Non-functional Requirements

Non-Functional Requirements	Associated Scenario # (if applicable)	Associated Step # (if applicable)