Automatic Source Transfer

Charlene Ericson

May 10th 2023

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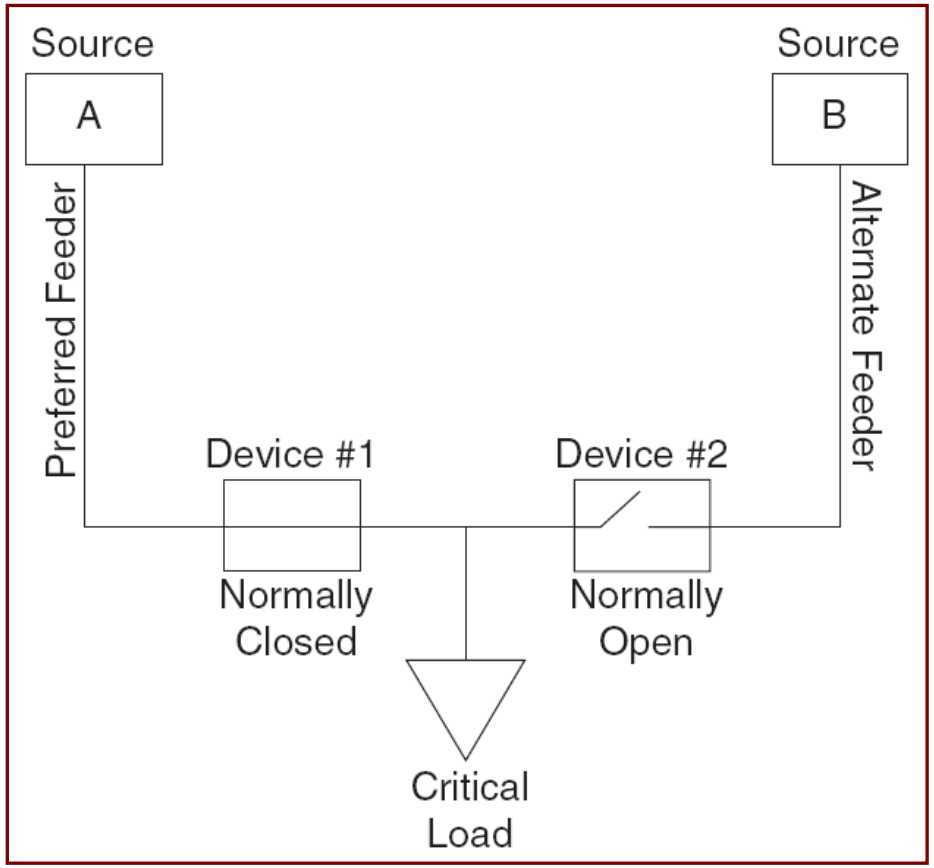
Objective

Transfer to an alternate source for a voltage event on the preferred source



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Technology and Equipment

- Form 6 control
- ProView™ and PeerComm™ software
- Flexible communications
- NOVA™, NXT, VSA ,or VWE 3-phase reclosers, or NOVA-TS or NOVA STS triple-single reclosers
- Internal voltage sensors

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Example applications

- Single critical load
  - Controls back-to-back on a pole
    - Twisted pair RS-485
  - One or two pole spans apart
    - Fiber optic cable

- Group of critical loads
  - Controls located up to miles apart
    - Radios and antennas

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Theory of operation

- AST monitors voltage on the source side of both reclosers
- Two reclosers maintain constant communication with each other via the PeerComm™ protocol
- When AST is in the Ready state
  - If the voltage of the closed recloser falls below a preset limit, the AST system starts timing
  - Upon completion of the timer, the closed recloser will open and the open recloser will close restoring service to the critical load.
- The AST will remain in this active state
- Restoring the load back the preferred source depends upon the restoration mode selected

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Overcurrent protection

- AST is additional functionality
- Controls retain all overcurrent protection capability
- Faults between the AST reclosers will be isolated without “Testing the Line”

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What Triggers AST?

- Undervoltage (Extremely common)
  - Voltage goes below a user-defined threshold
- Overvoltage (NOT commonly used)
  - Voltage goes above a user-defined threshold
- Voltage Unbalance (NOT commonly used)
  - Ratio of negative sequence to positive sequence voltage goes above a user-defined threshold

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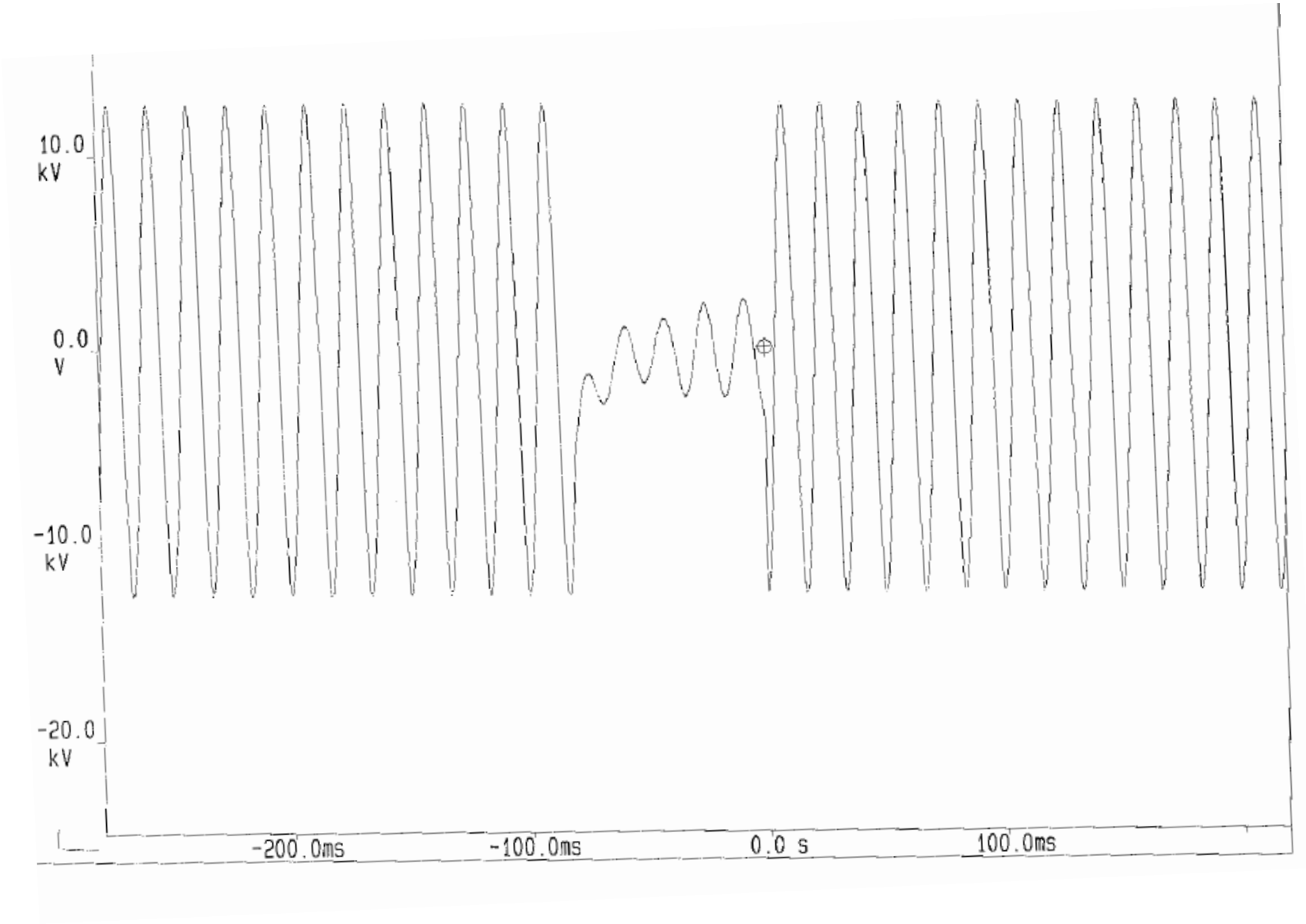
Eaton AST Transfer Times

6 cycles

With 15 kV NOVAs and fiber optic



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Transfer Times

With 15 kV NOVA reclosers and serial fiber optic

Setup	Master	Slave	Fast	Break then Make	Test 1 Open Time (ms)	Test 2 Open Time (ms)	Test 3 Open Time (ms)	Average Open Time (ms)	Restore Open Time 1 (ms)	Restore Open Time 2 (ms)	Restore Open Time 3 (ms)	Average Restor Open Time (ms)
1	Primary	Alternate	Enabled	Enabled	90.62	100.7	84.3	91.9	142.2	142.1	141.6	141.9667
2	Primary	Alternate	Enabled	Disabled	89.76	88.5	83.82	87.4	0	0	0	0
3	Primary	Alternate	Disabled	Enabled	192.01	195	190.8	192.6	150.4	151.3	134.7	145.4667
4	Primary	Alternate	Disabled	Disabled	185	176.6	190.6	184.1	0	0	0	0
5	Alternate	Primary	Enabled	Enabled	241	234.5	223	232.8	141	147.9	142.7	143.8667
6	Alternate	Primary	Enabled	Disabled	240.7	237	237	238.2	0	0	0	0
7	Alternate	Primary	Disabled	Enabled	227	236	223	228.7	146	133	133	137.3333
8	Alternate	Primary	Disabled	Disabled	225	230	240	231.7	0	0	0	0

CAUTION! Performance times are NOT guaranteed

Bidirectional times are not equal, which device is the preferred device does matter.

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Restoration modes

- Parallel or Non-Parallel

- Manual restoration
  - Optional Voltage Seeking
- Automatic restoration
  - Manual initiation
  - Automatic initiation

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Restoration modes: Manual Restoration

- Once the system has transferred the load to the alternate source it will stay in the AST Active state until it is manually restored to the AST ready state
- Exception! Voltage Seeking is selected
  - If voltage seeking is selected AND the control is in the AST Active State AND the voltage on the alternate source is lost AND there is a healthy voltage on the preferred source the AST system will transfer the load back to the preferred source

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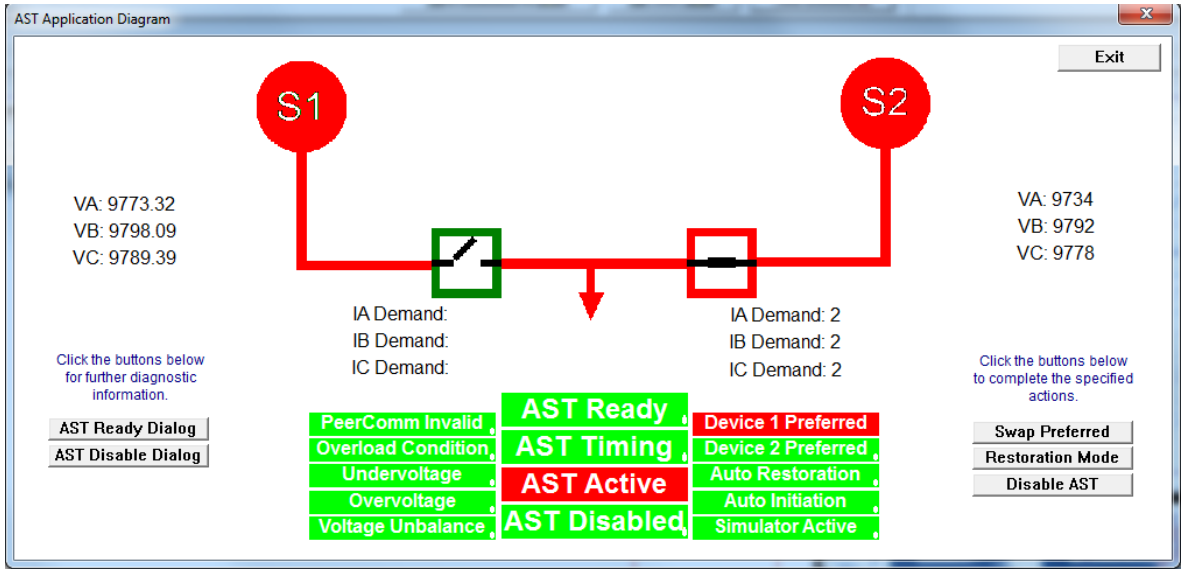
Restoration modes: Auto Restoration

Auto restoration returns the system to AST Ready state given that conditions are such that changing the OPEN/CLOSE state of each recloser will bring the system back to AST Ready



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Auto Restoration with Manual Initiation

- Manual initiation will restore to the AST ready state with the operation of one of the reclosers – either opening the closed recloser or closing the open recloser

- The one method results in a parallel or MBB operation and the other results in a non-parallel or BBM operation
  - MBB (Make Before Break) – synced sources
  - BBM (Break Before Make) – non synced sources

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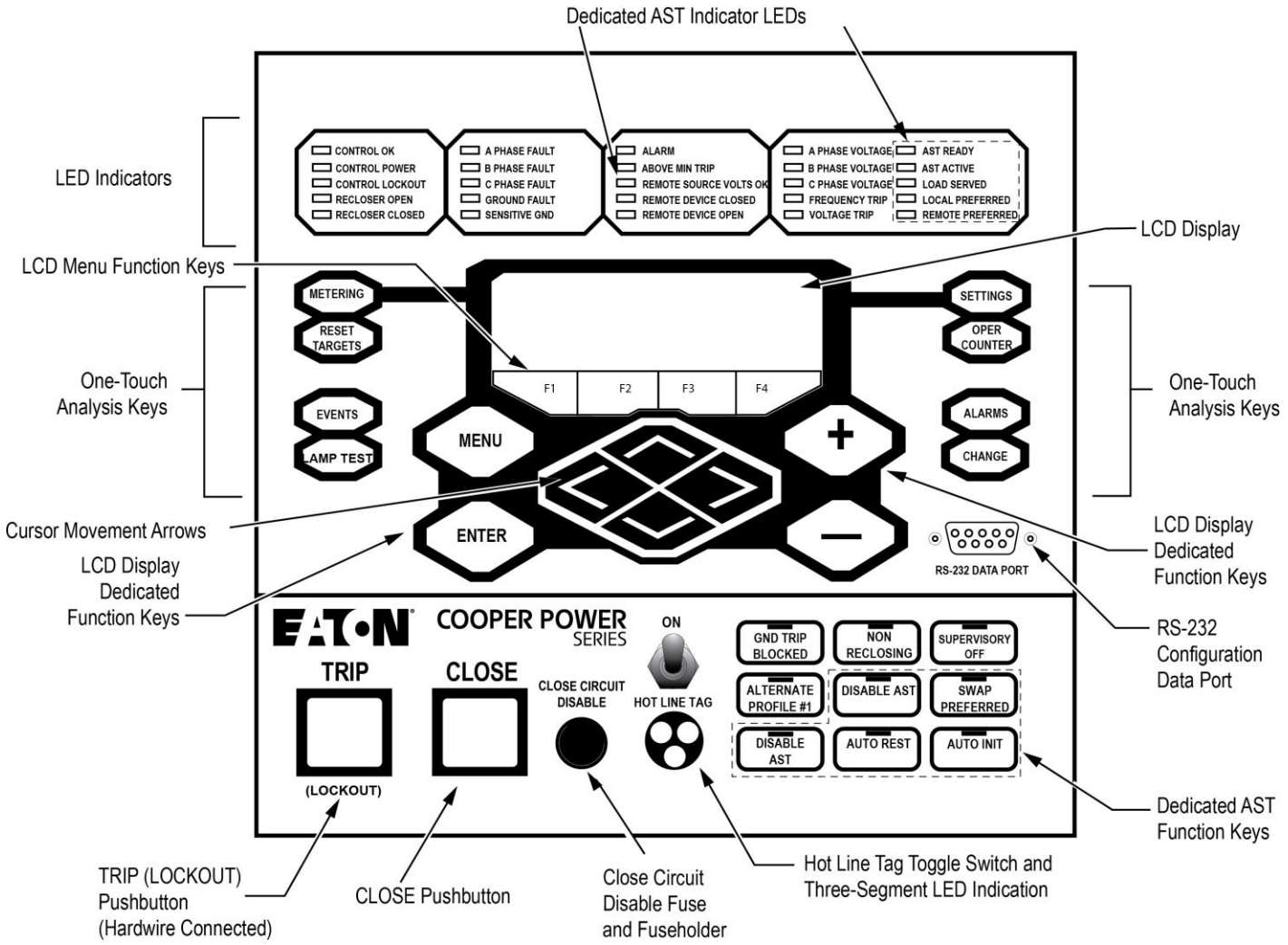
AST Form 6 front panel



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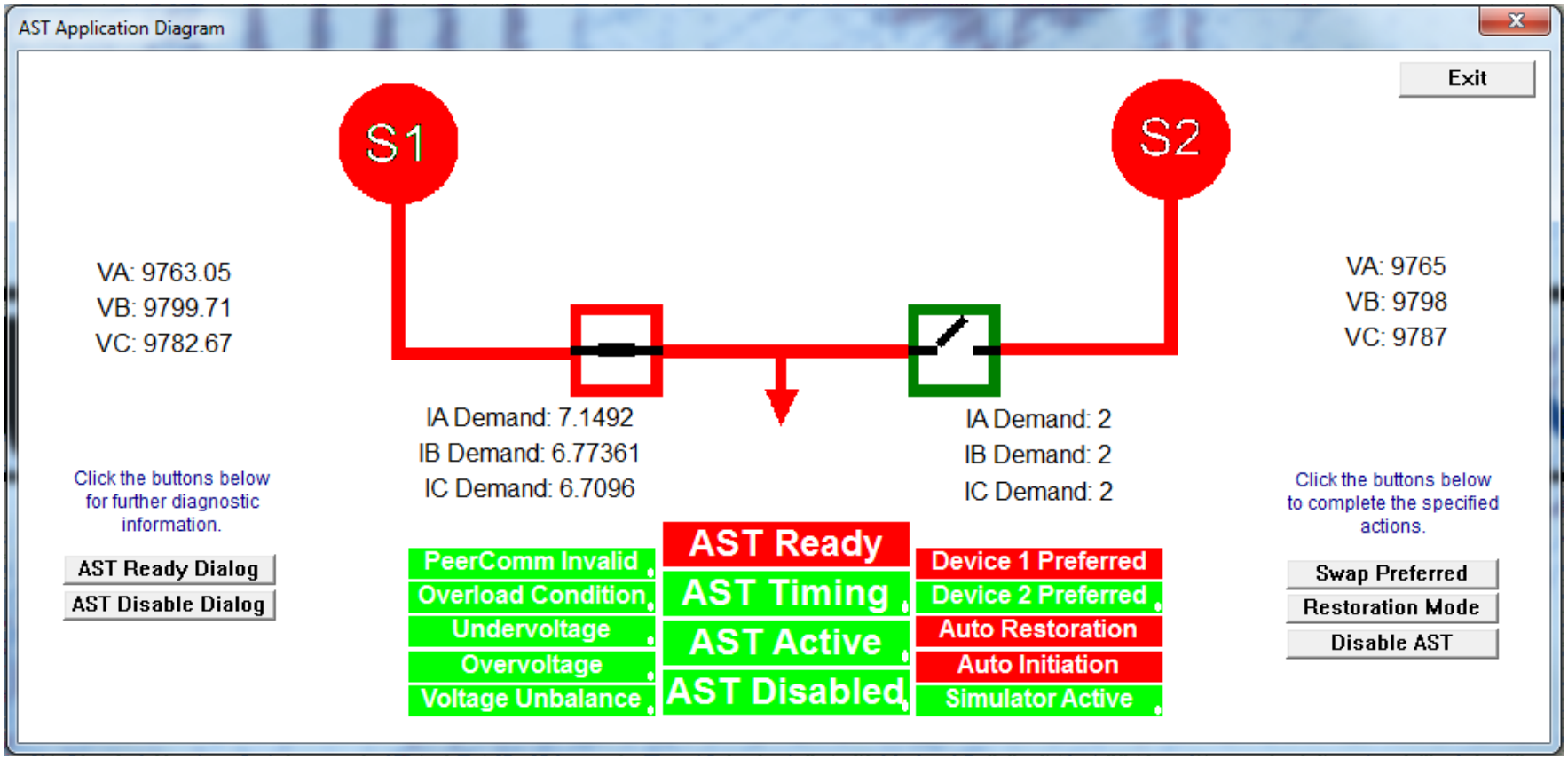
AST Application Diagram



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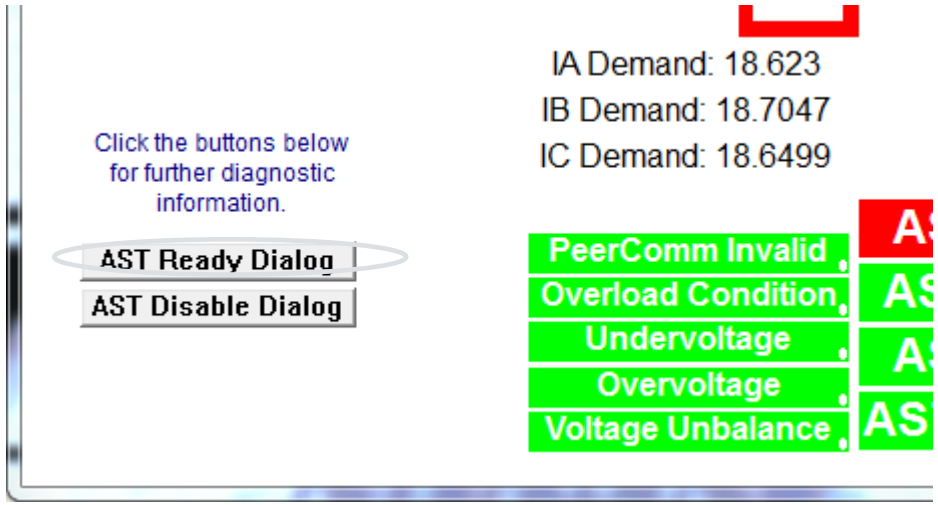
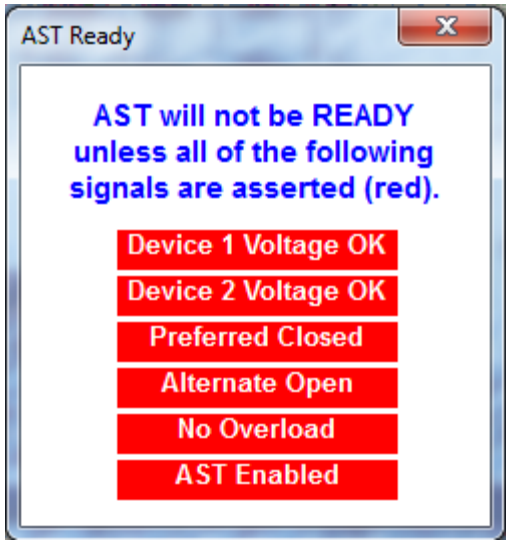
AST Application Diagram

- AST Ready Dialog
  - Great for diagnostics





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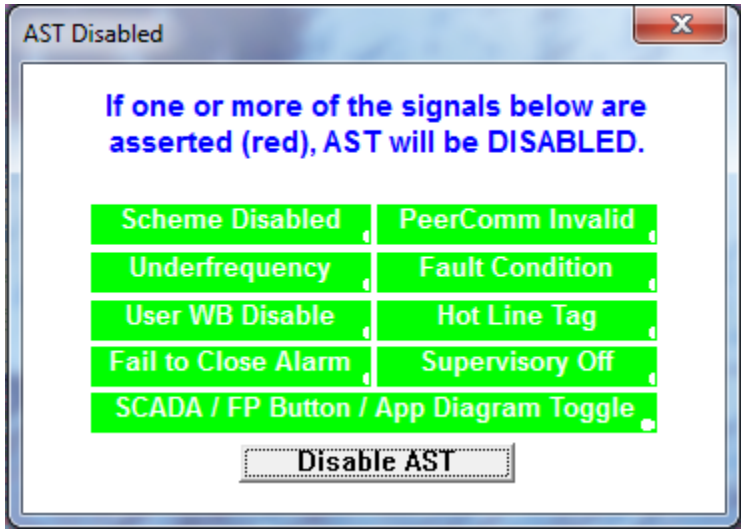
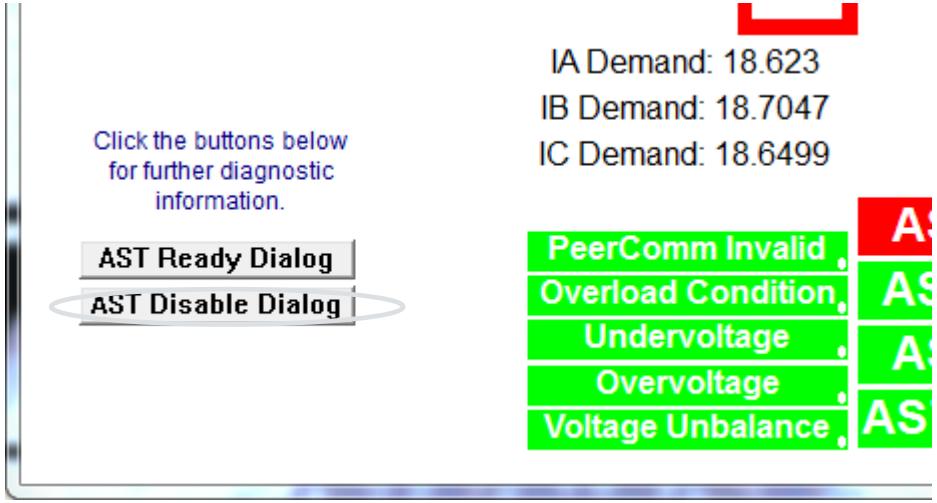
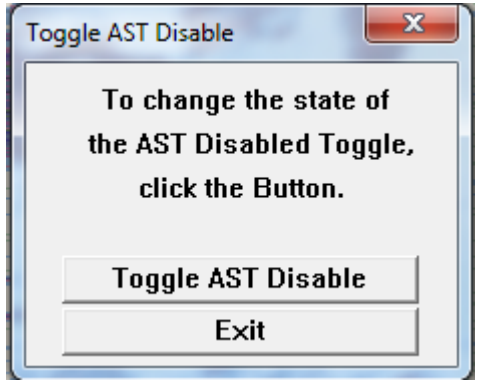
AST Application Diagram

- AST Disabled dialog
  - Good diagnostics tool
  - Can be used to disable the AST from ProView







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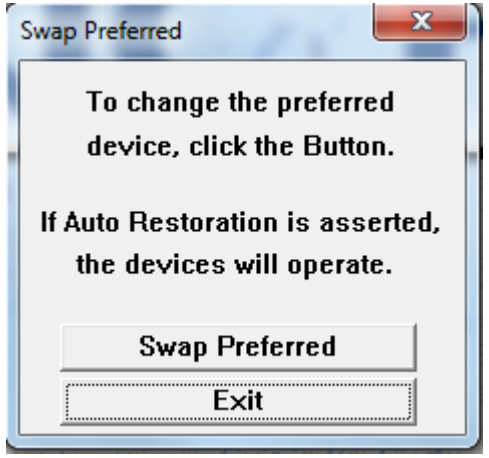
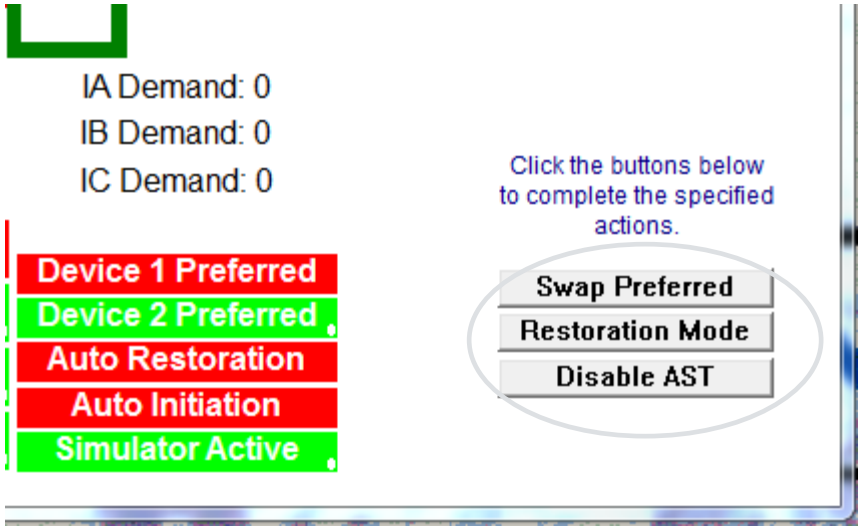
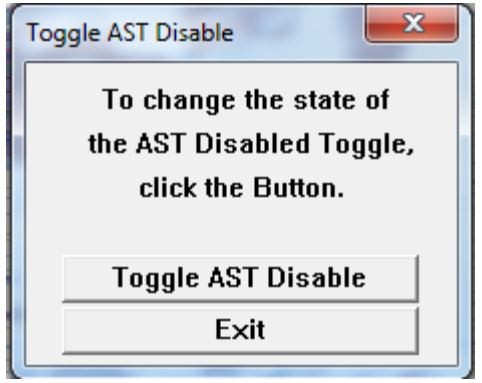
AST Application Diagram

- AST Controls
  - Control States and Modes from ProView







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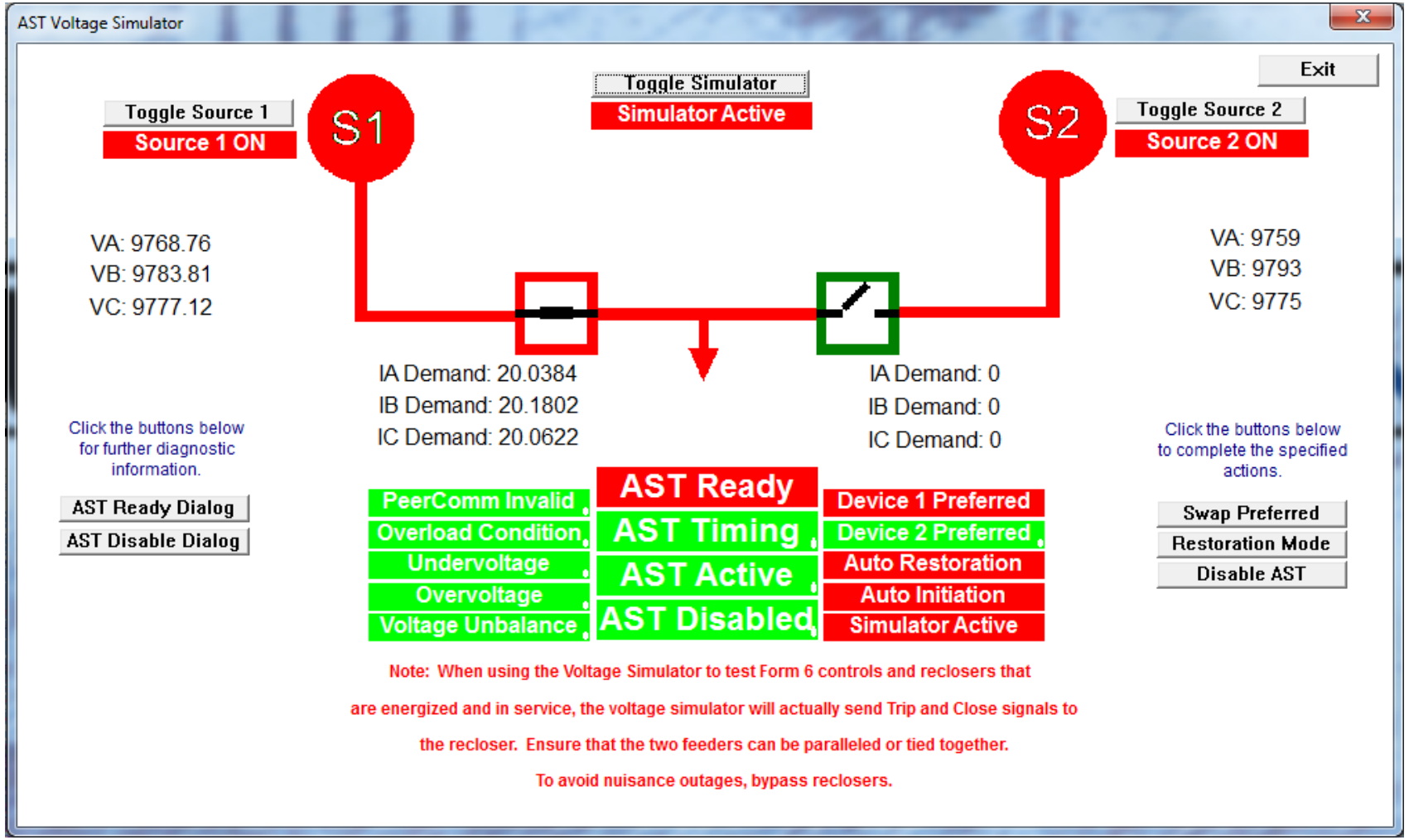
Voltage Simulator



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Voltage Simulator

Great commissioning tool to ensure the system is operating as expected in the field

- Simulates loss of voltage of either source to easily commission and test an AST system
- Resets itself in 5 minutes if not used
- Need actual reclosers or recloser simulators (KMET) to operate correctly
- This simulator will operate the reclosers on the system! Be sure to bypass the reclosers on an actual system before using the voltage simulator!

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Sequence of Events (SOEs)

AST Ready ↔ AST Not Ready

AST Active ↔ AST Not Active

Load Served ↔ Load Not Served

Local Preferred ↔ Remote Preferred

Device 1 Valid ↔ Device 1 Not Valid (Comms)

Device 2 Valid ↔ Device 2 Not Valid (Comms)

AST Enabled ↔ AST Disabled

Auto Rest ↔ Manual Rest Mode

Auto Init ↔ Manual Init Mode

Simulator On ↔ Simulator Off

Overload Condition On ↔ Overload Condition Off

Underfrequency Disable

Manual Disable

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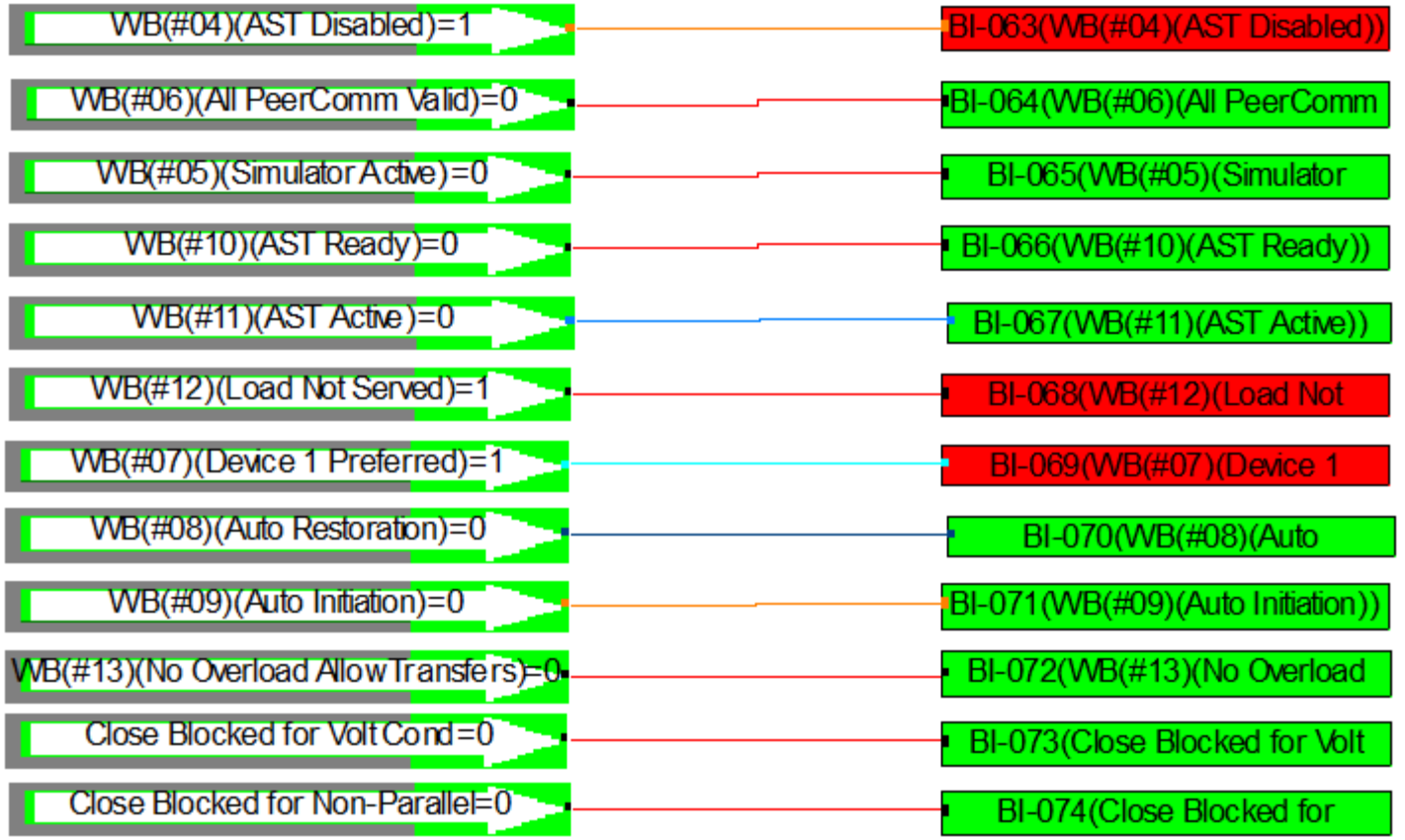
DNP Binary Inputs



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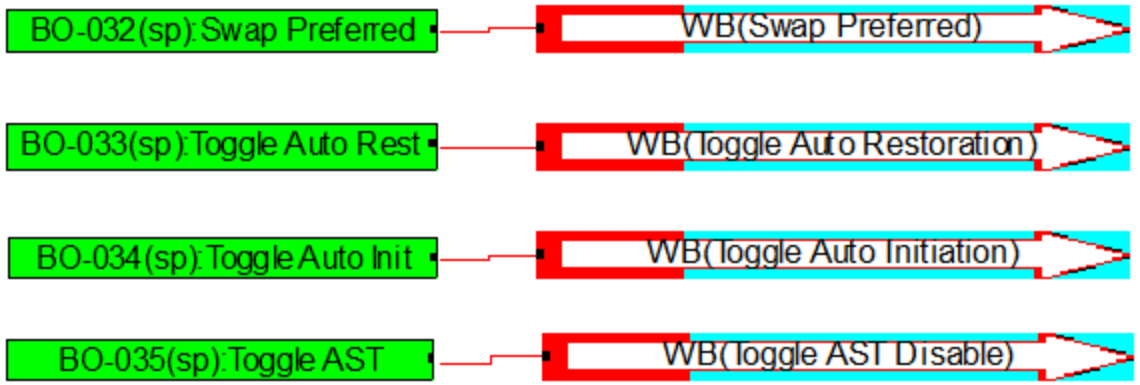
DNP Binary Outputs



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Latest Version

AST jumped from PV 5.1 to PV 5.5

- “Non-parallel restoration” was augmented to “Enforce non-parallel while AST enabled”
- “AST Fast Mode” can only be enabled when configured for “parallel restoration”
- New MMI messages and DNP points to indicate when a device can’t be closed due to Non-parallel restrictions
- New MMI messages to assist use to help identify why AST is disabled
- Additional hardware failures added to the automatic AST disabled logic
- New setting instructs AST to control the GTB when performing a parallel restoration
- PeerComm invalid logic improved to ensure both communications paths are available

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AST with Generator Start-up

Opens device 1, closes a contact to start the generator, closes Device 2 after a delay period and sufficient voltage achieved.

Only available in Ethernet PeerComm version

Only for 3 phase ganged products

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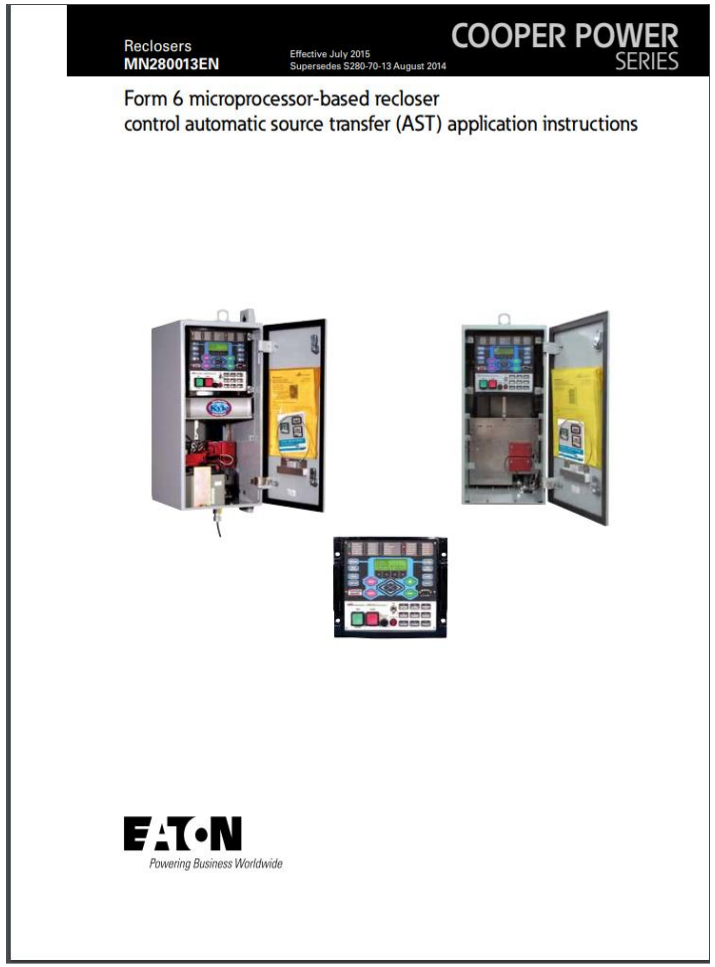
AST Literature



- Refer to instruction document MN280013EN for details
- Complete State Transition tables

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Feeder Automation Solutions

Jasmin Giroux-Maltais

May 10th 2023

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What does Feeder Automation do?

- Improves reliability
- Turns sustained outages into momentary outages
- Drives down SAIDI and SAIFI
  - Common measures of system reliability
- FA can do FLISR
- FA can do Voltage loss management
- FA can do Load management

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What is FLISR?

F ault

L ocation

I solation

S ervice

R estoration

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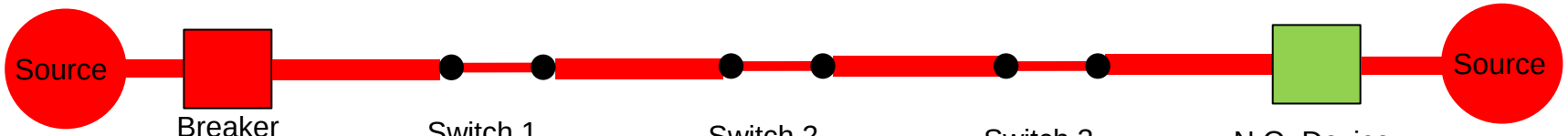
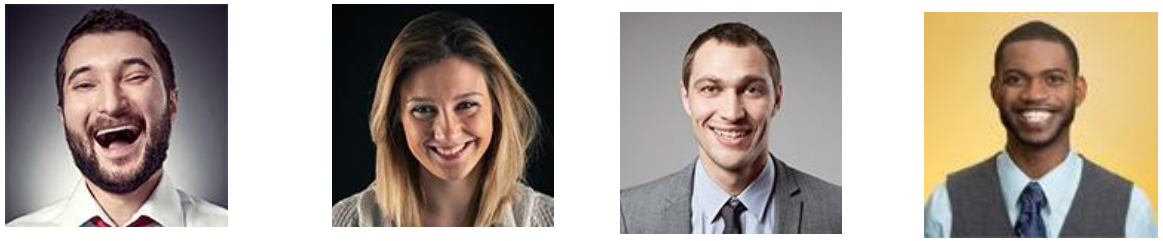
FLISR basics





Zone 1 Customer

Zone 2 Customer

Zone 3 Customer

Zone 4 Customer

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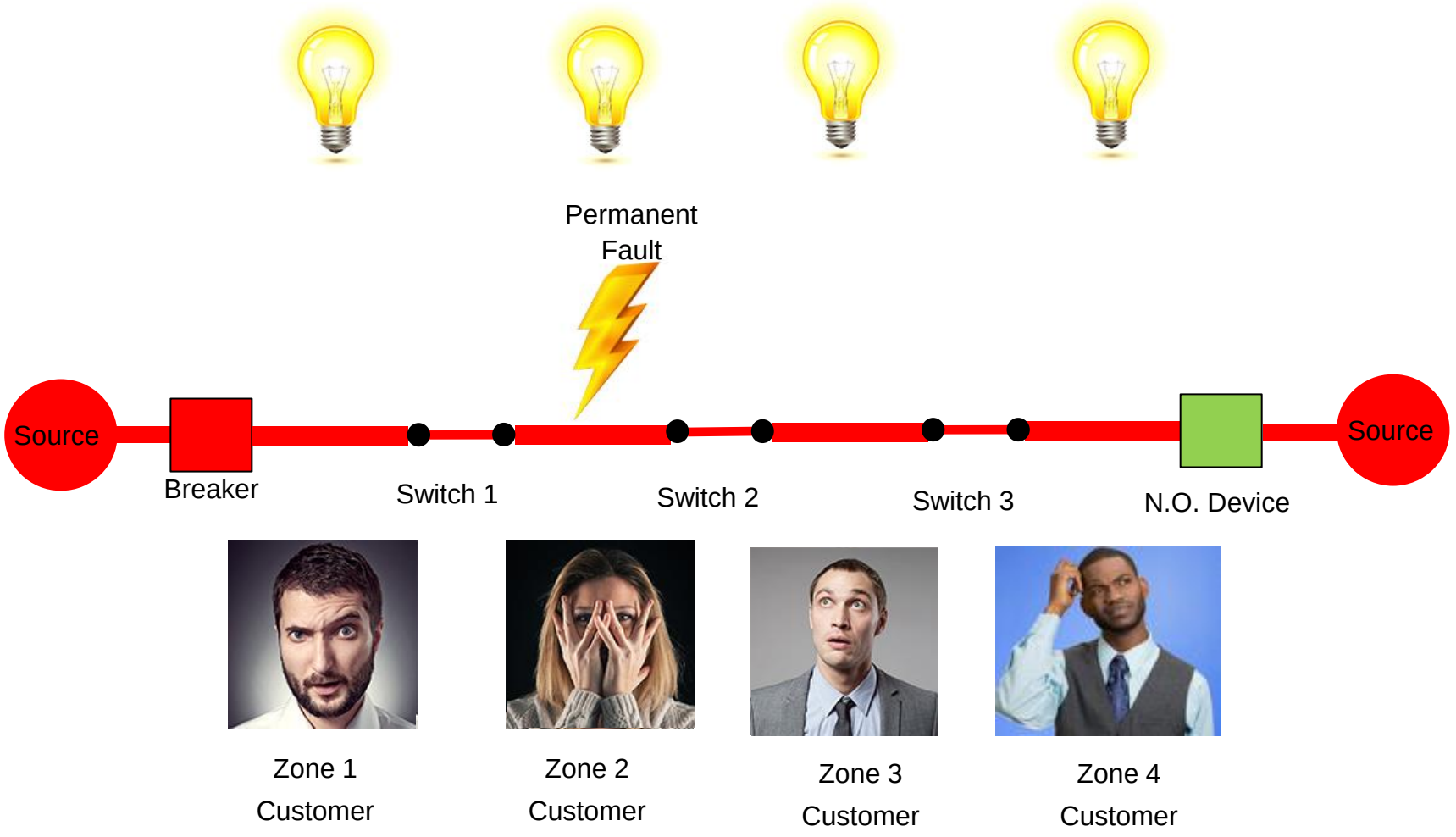
FLISR basics



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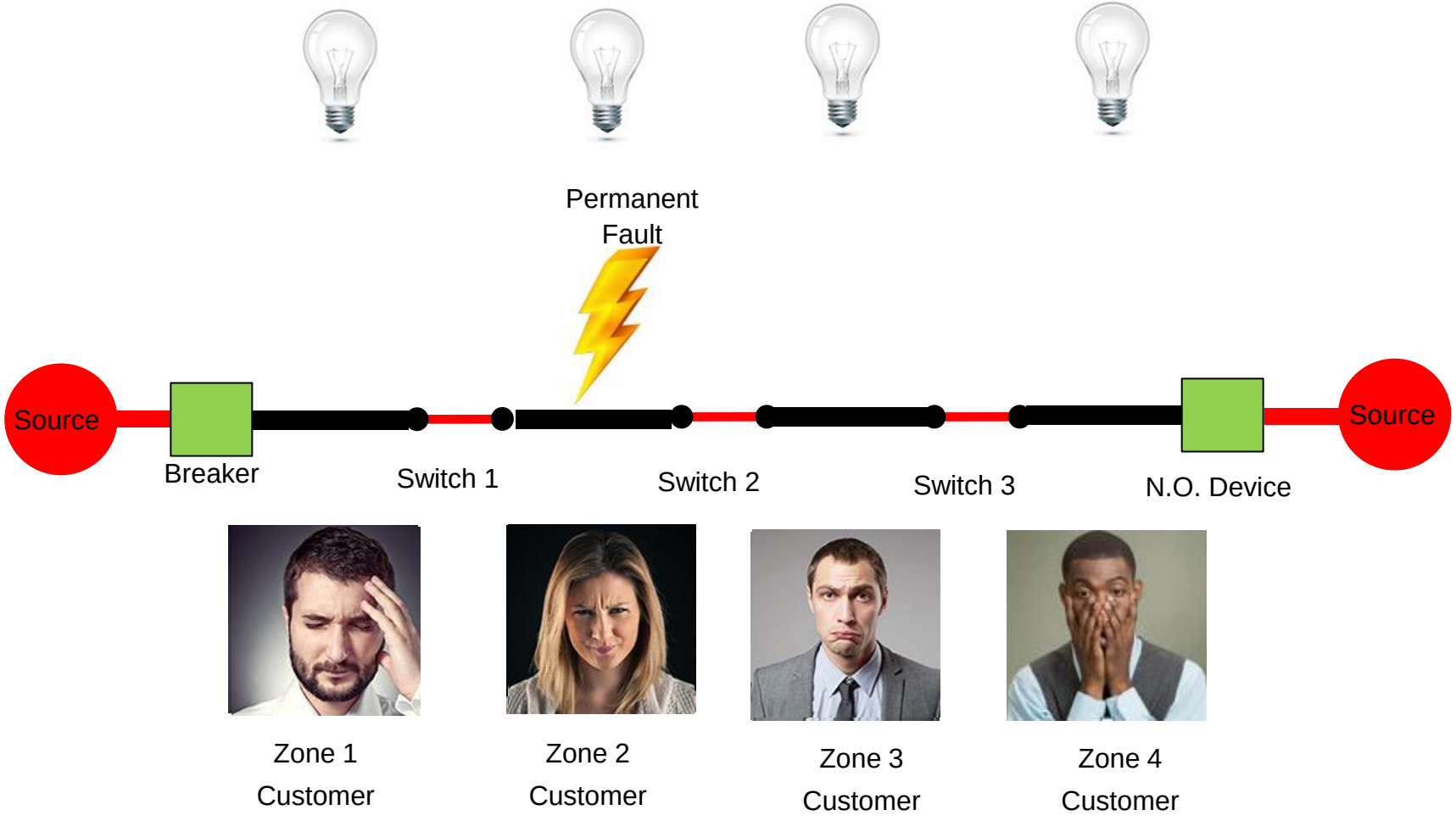
FLISR basics



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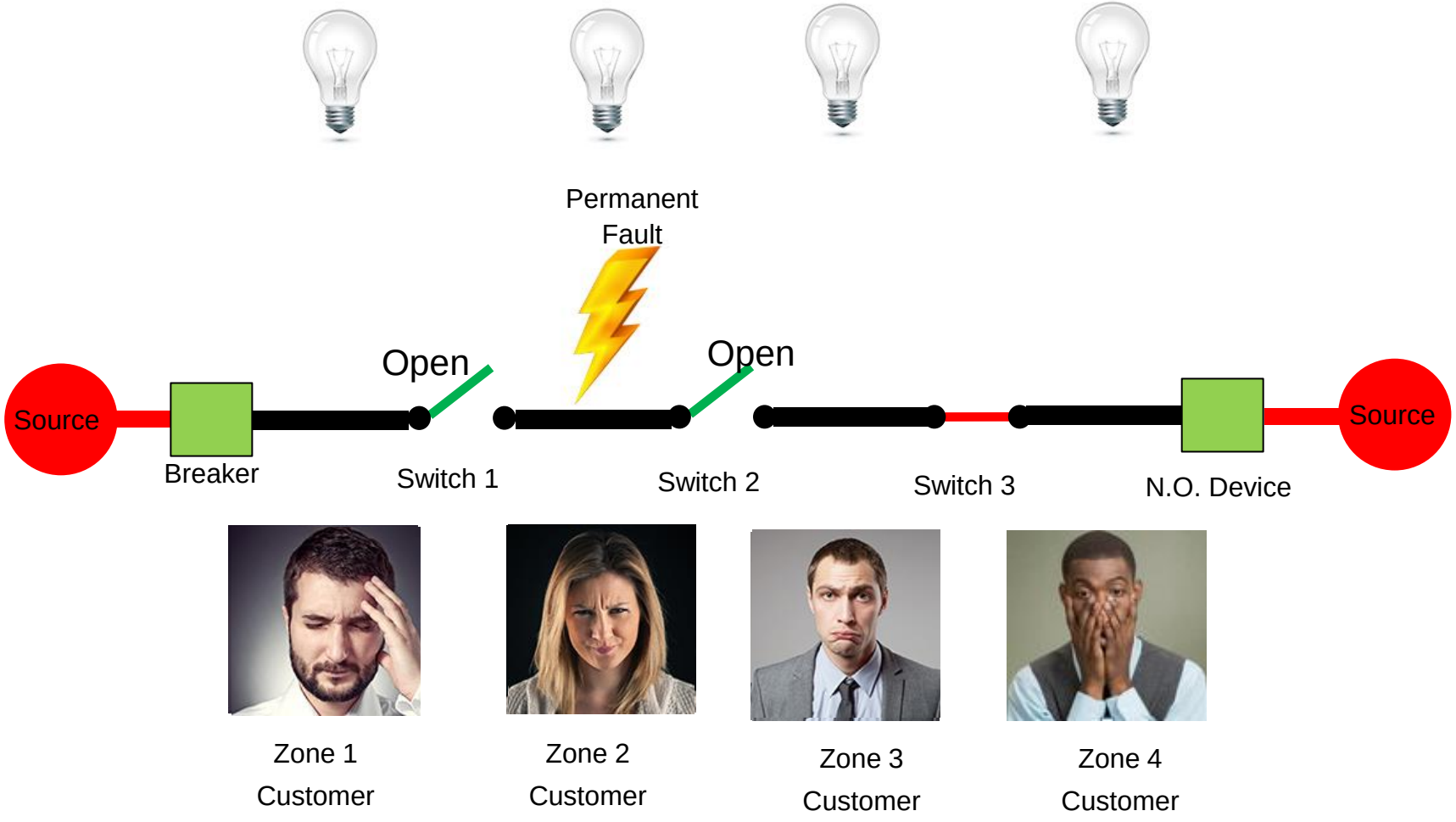
FLISR basics



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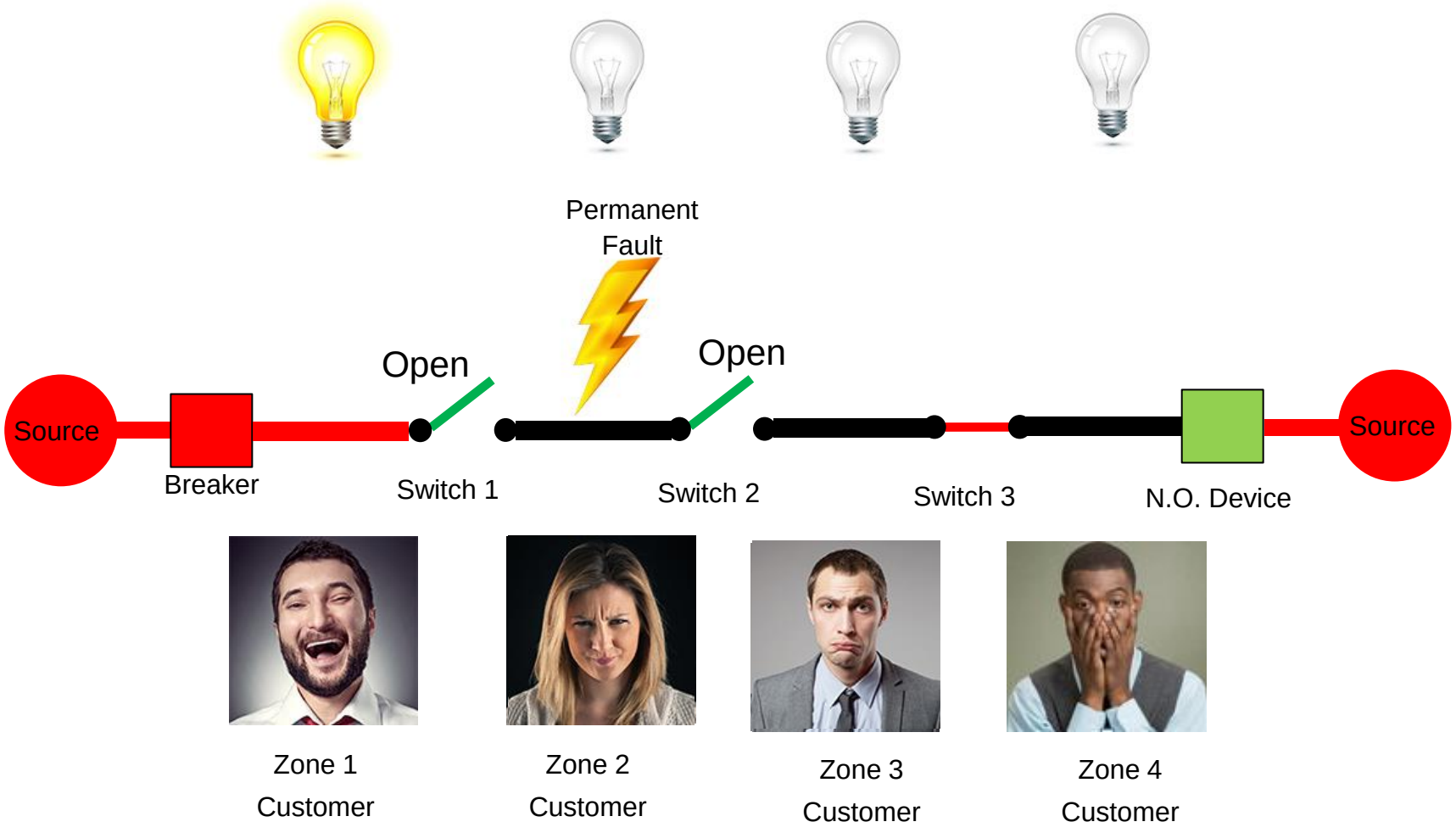
FLISR basics



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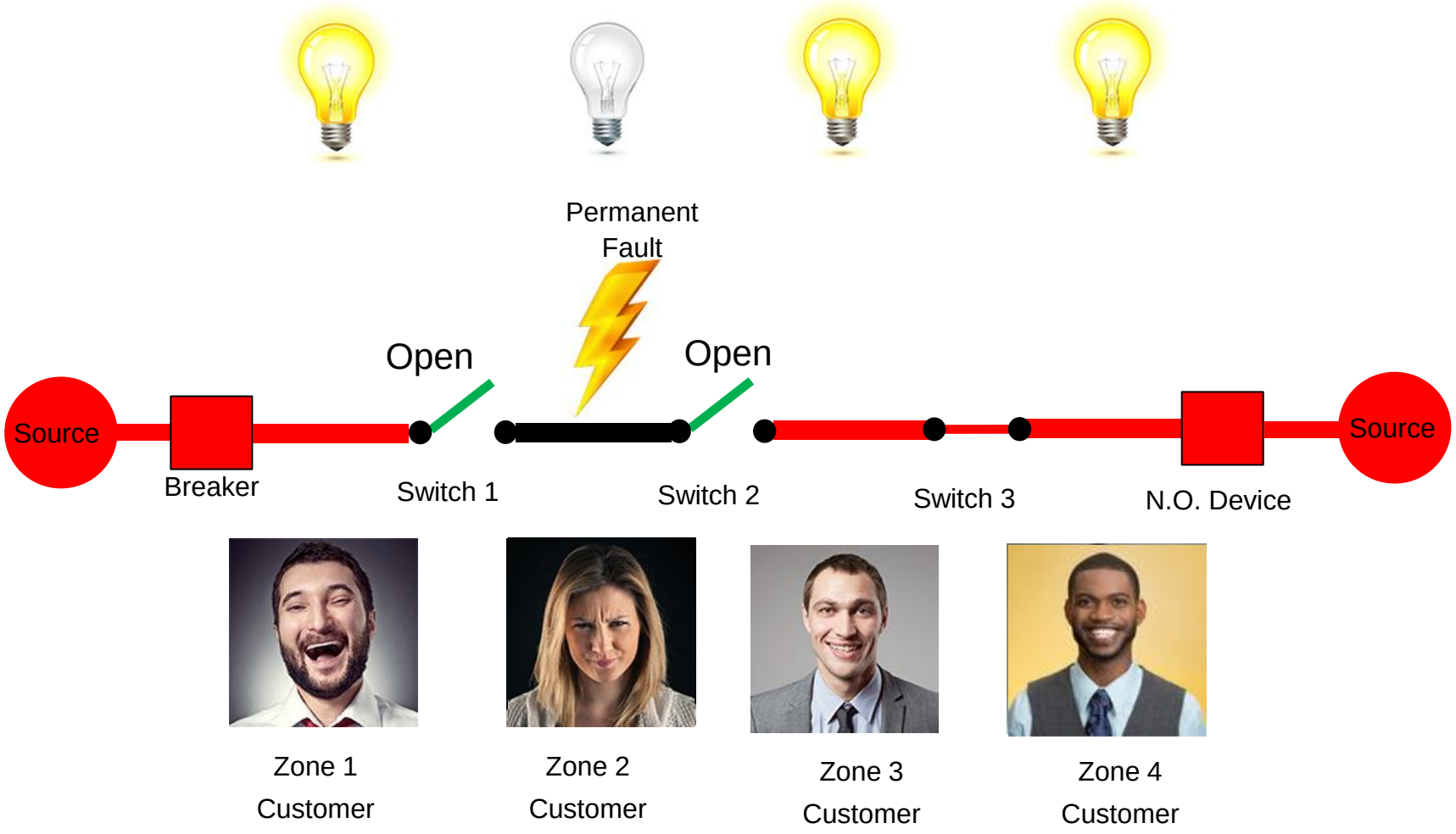
FLISR basics



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What is FA ?

- Server-based application
- Performs FLISR, Voltage Loss and Load Mgmt
- Centralized communication architecture
- Restorations between 30 seconds to 2 minutes
  - Communication dependent

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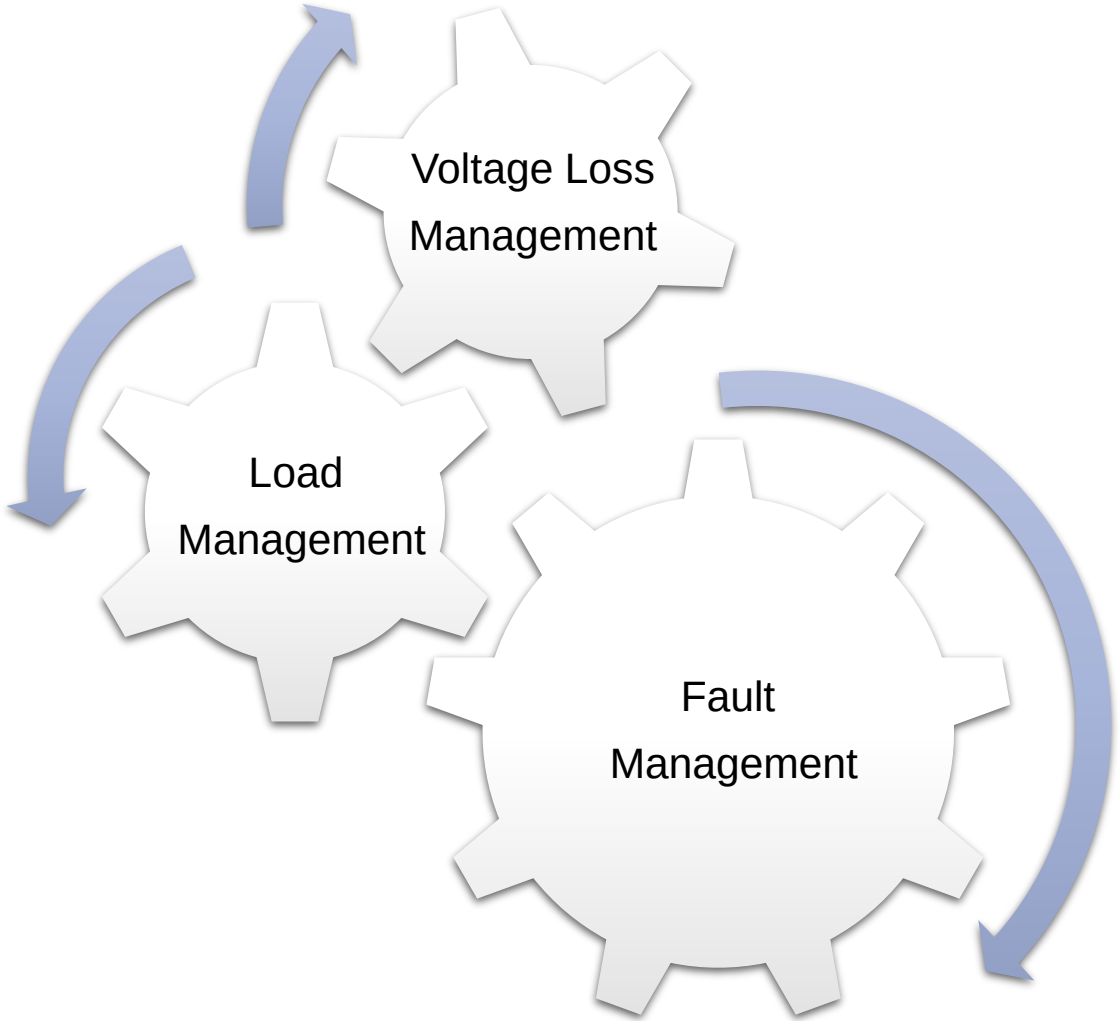
FA Primary Functions



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FA Strengths

- Easy device integration
- Open protocols
- Flexible communications
- Minimal linemen training
- Dynamic
- Simulator
  - Supports desktop and hardware-in-loop (HIL)

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FA Strengths

- Distributed Energy Resource (DER) integration
- Overload protection including substation Xfrm
- Simple configuration
- Scalable
- Automation trace – detailed feedback
- Event/Health report – executive feedback
- Complete system ownership

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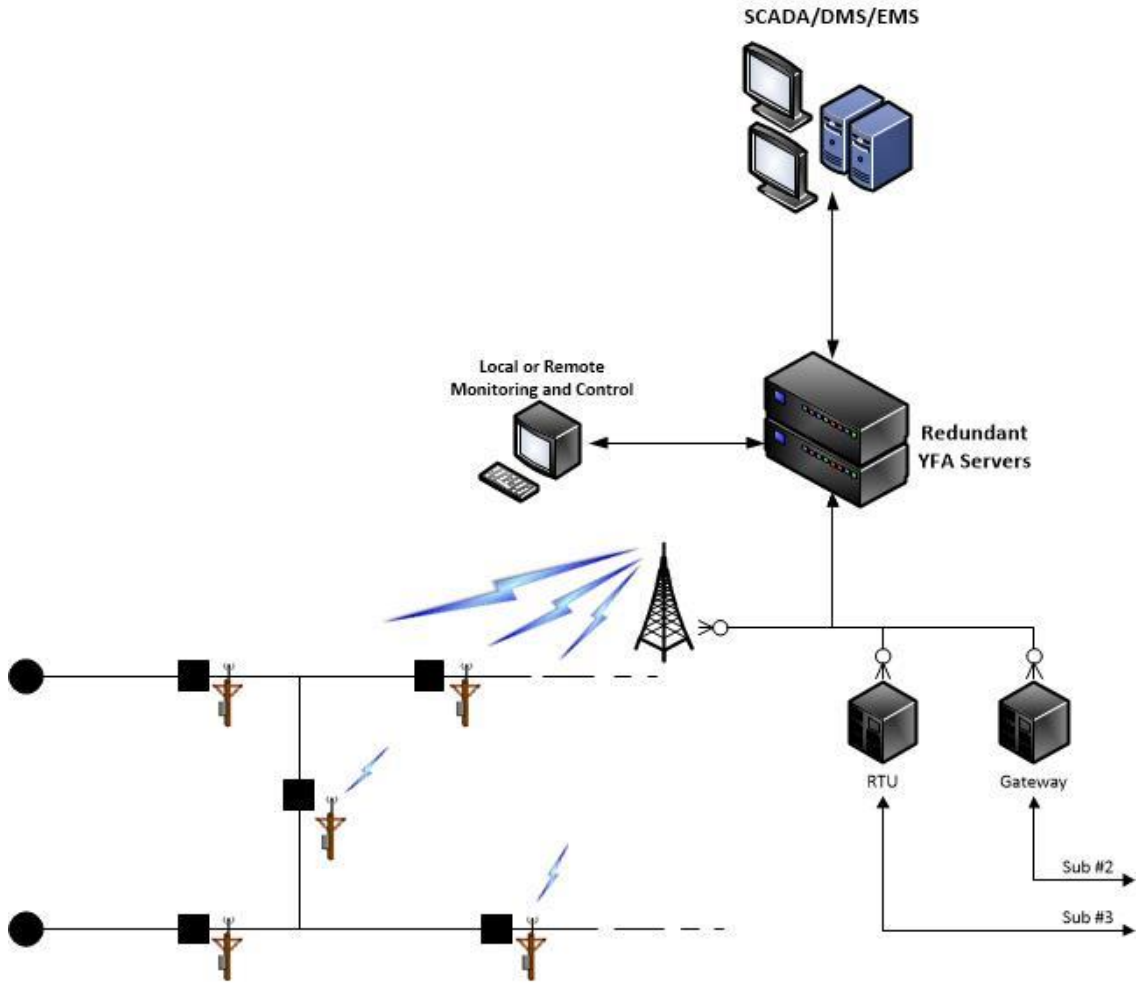
In-Line Network Architecture



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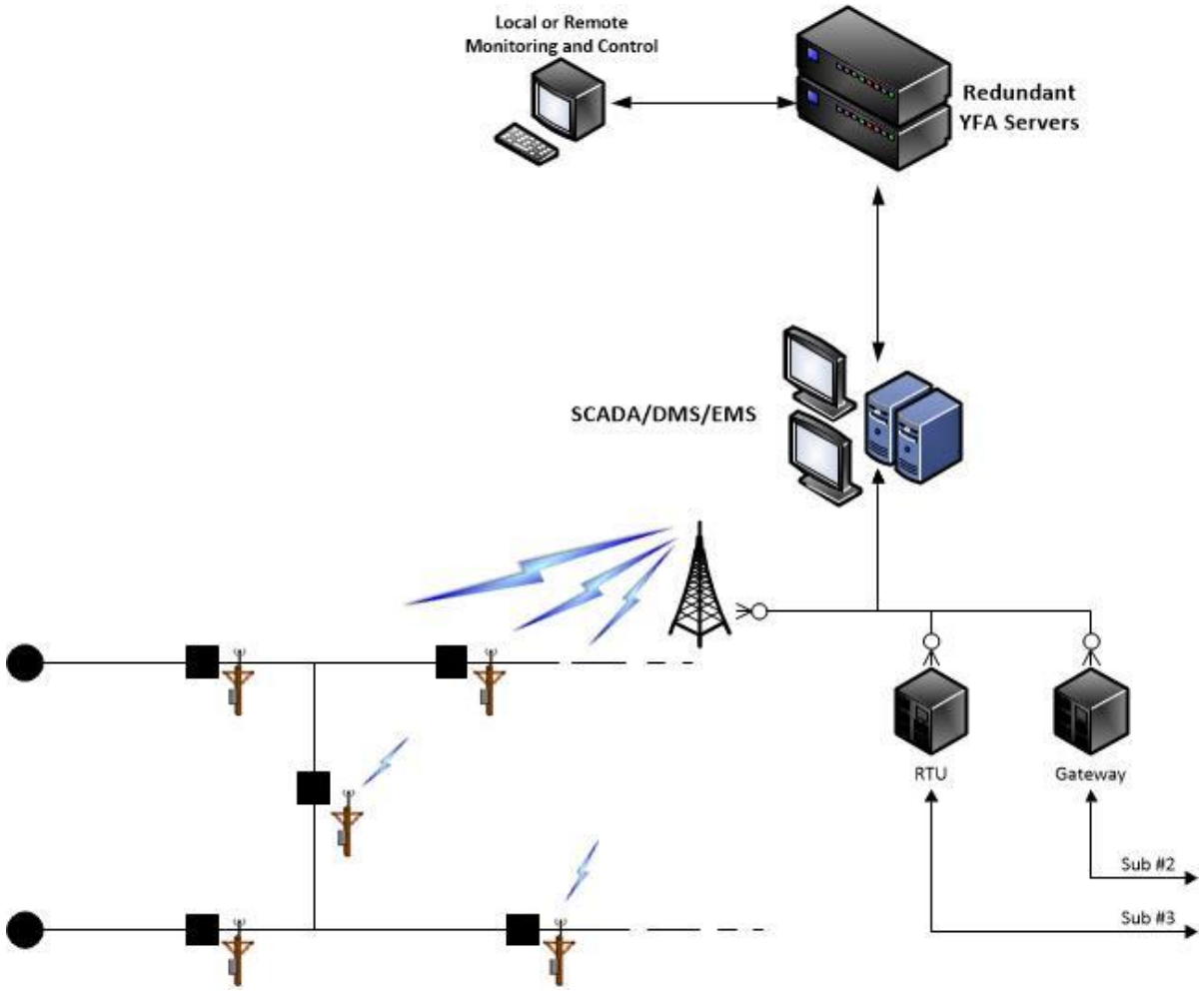
Bolt-On Network Architecture



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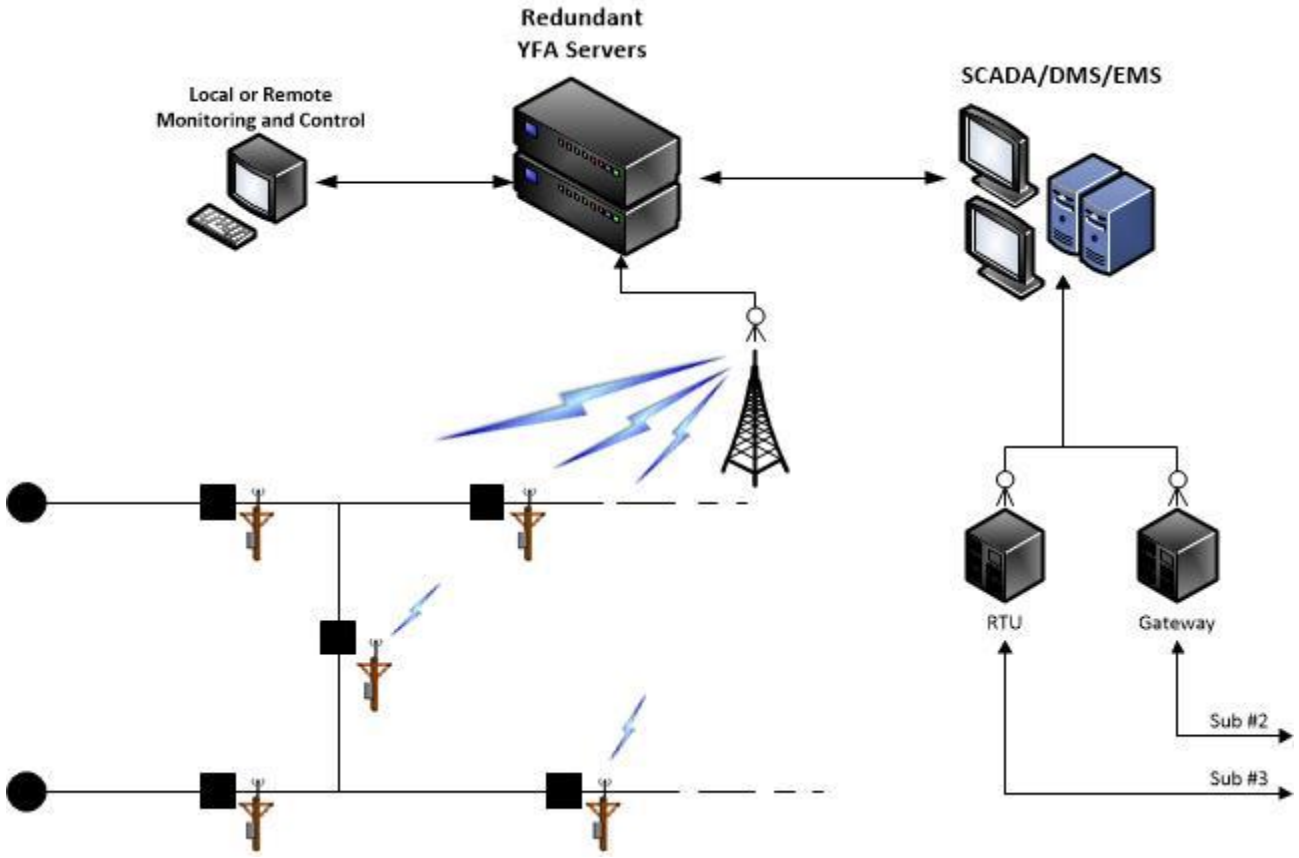
Mixed In-line and Bolt-on Architecture



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FA functionality

Device integration

Integrate nearly any existing control into automation that supports a standard communication protocol without need for additional hardware or protocol converters. Ensure compatibility with next generation of controls.

- Eaton/Cooper – 11 devices
- SEL – 5 device
- S&C – 8 device
- GE – 2 devices
- ABB – 1 device
- Nulec - 1 device
- Noja – 1 device
- Telvent – 1 device

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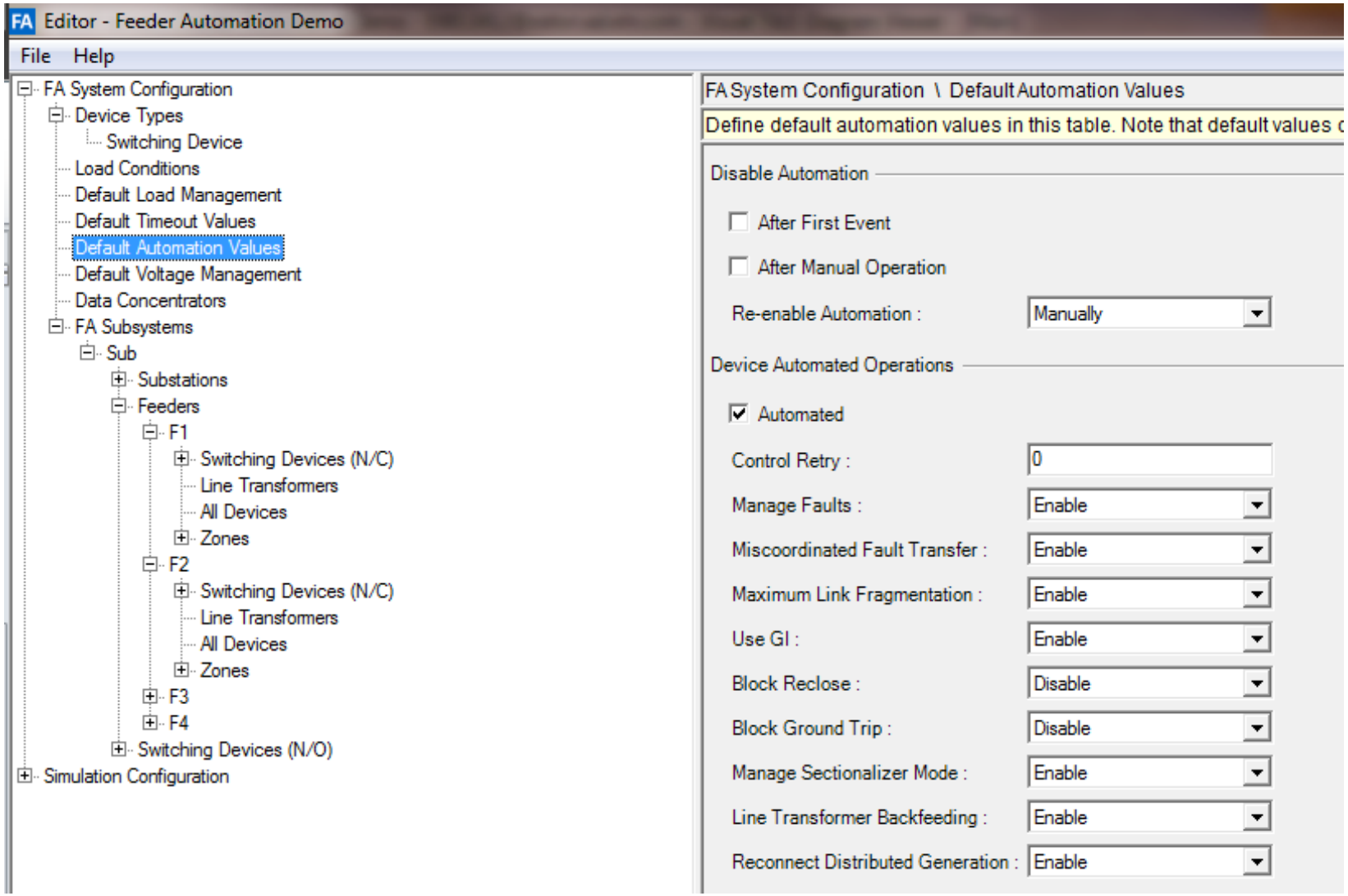
Topology Editor – Configurable control



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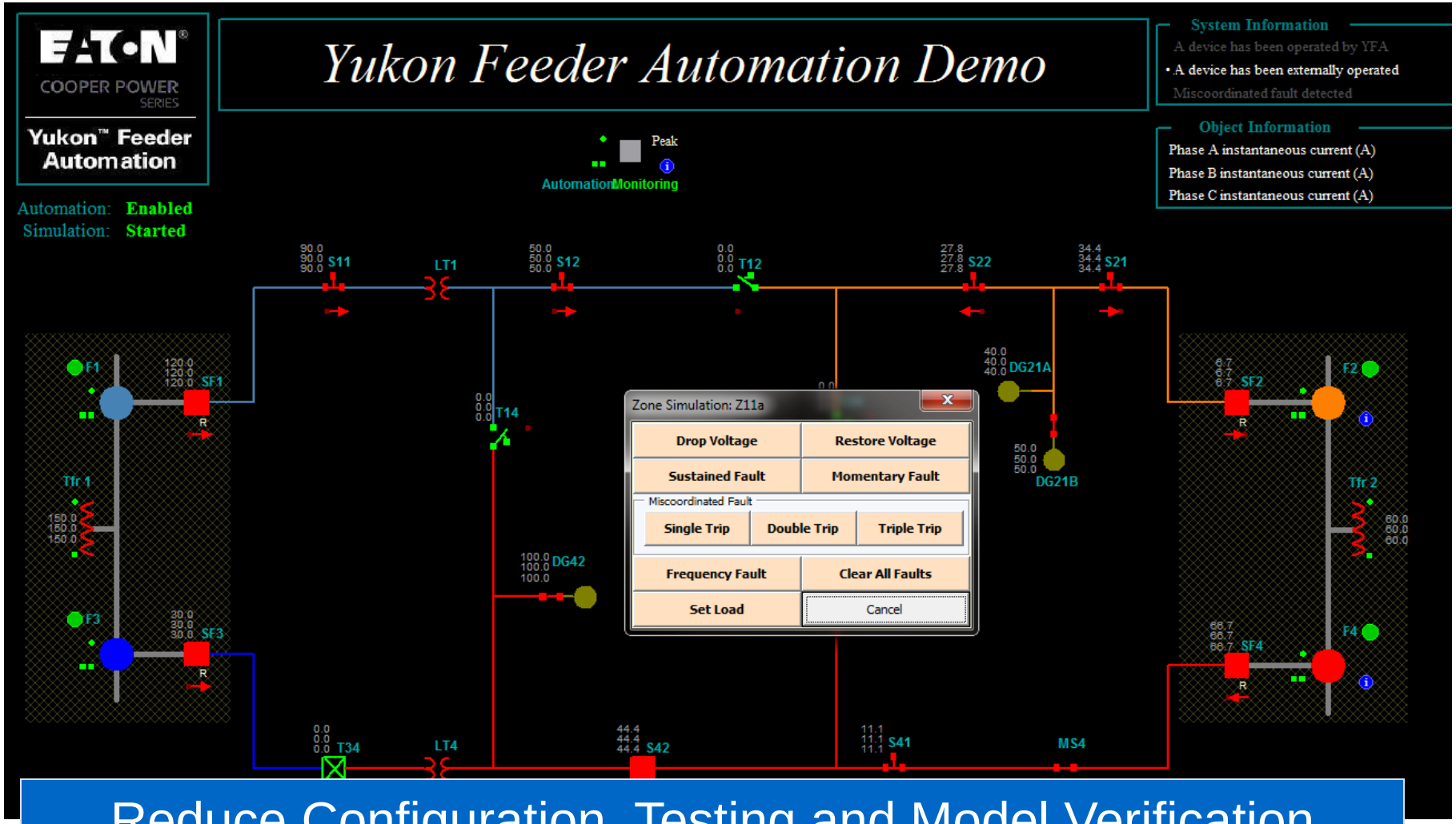
Display and simulation: Validate configurations



Reduce Configuration, Testing and Model Verification

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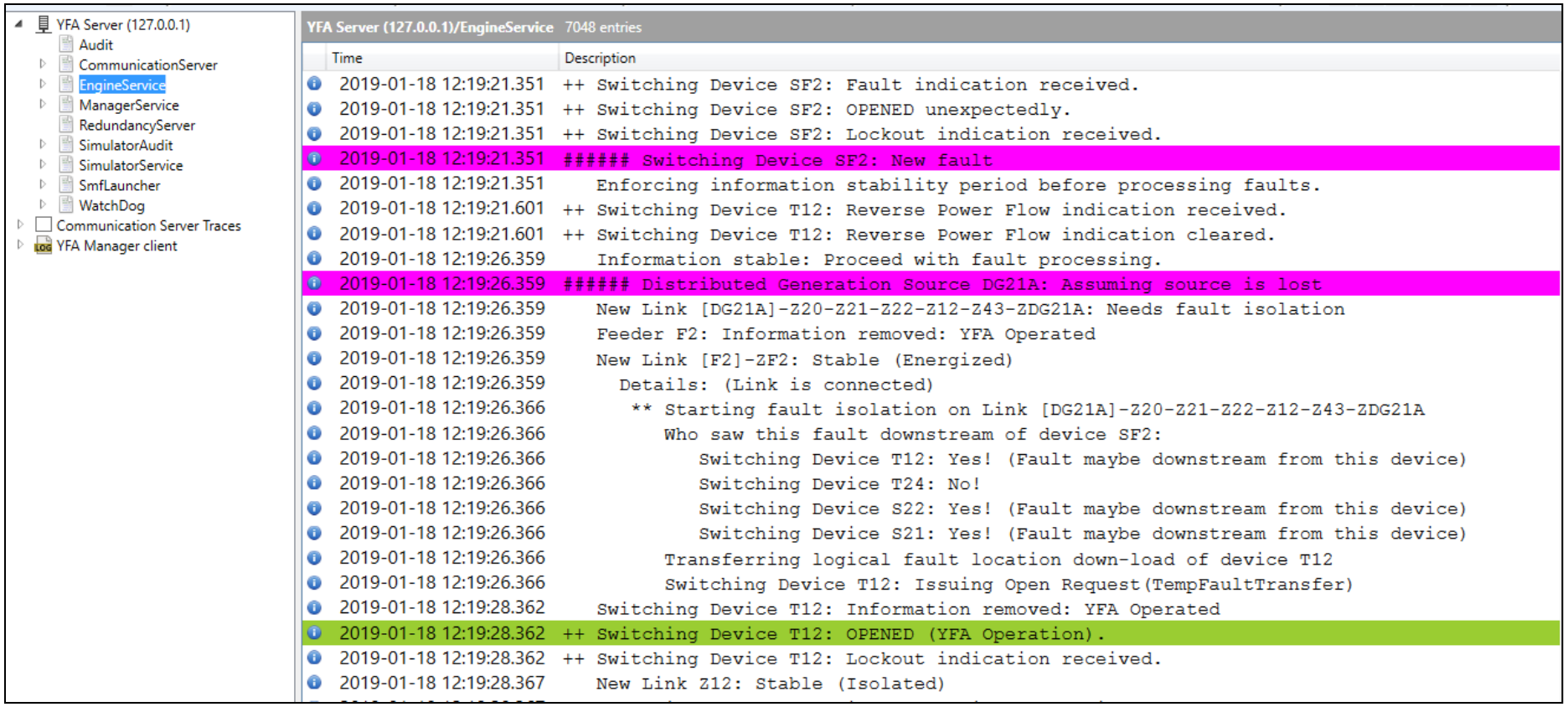
Automation logic trace



- Enables a continuous improvement process around the automation system

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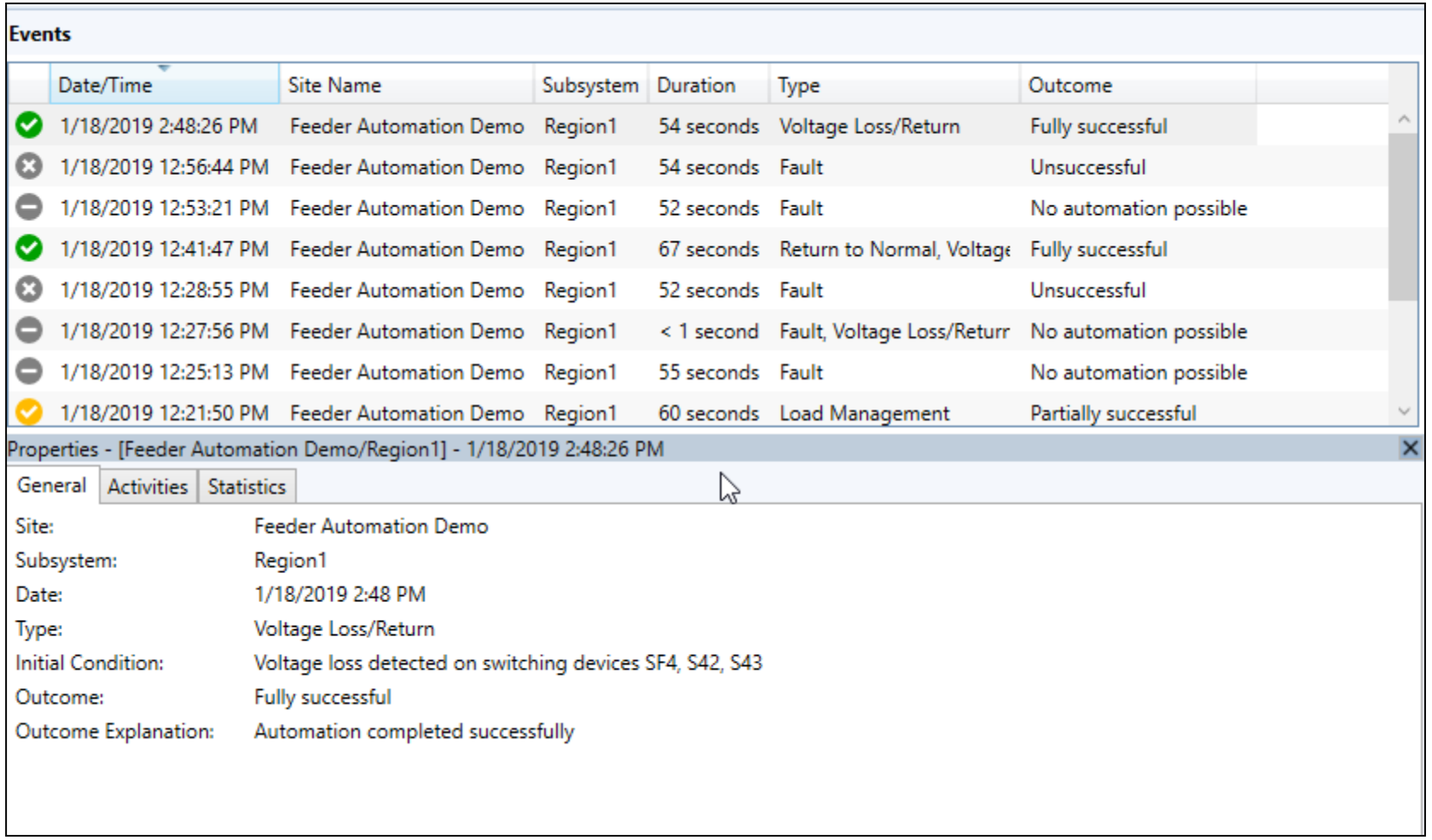
Event reports



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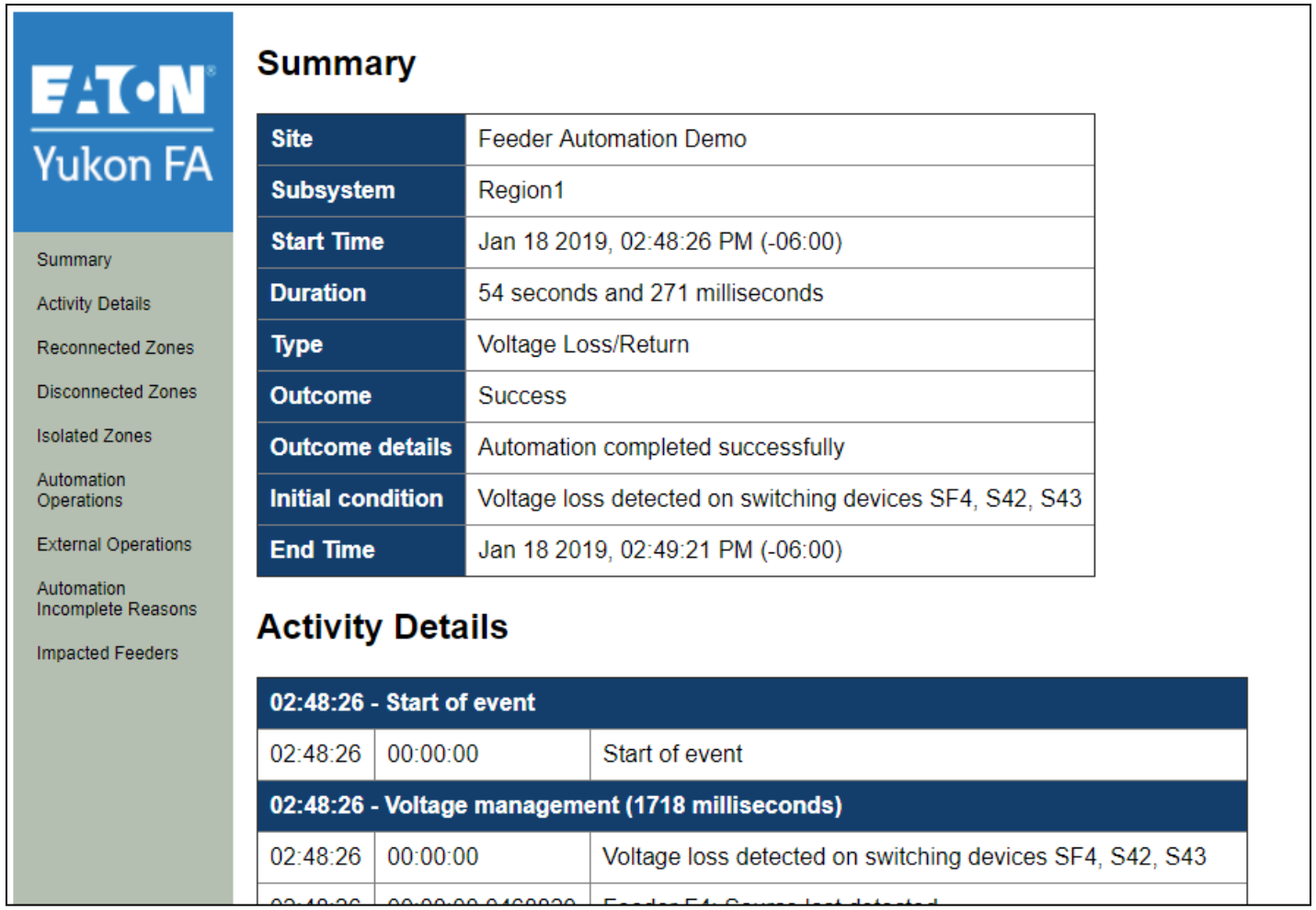
Event reports



Yukon FA

- Summary
- Activity Details
- Reconnected Zones
- Disconnected Zones
- Isolated Zones
- Automation Operations
- External Operations
- Automation Incomplete Reasons
- Impacted Feeders

Summary

Site	Feeder Automation Demo
Subsystem	Region1
Start Time	Jan 18 2019, 02:48:26 PM (-06:00)
Duration	54 seconds and 271 milliseconds
Type	Voltage Loss/Return
Outcome	Success
Outcome details	Automation completed successfully
Initial condition	Voltage loss detected on switching devices SF4, S42, S43
End Time	Jan 18 2019, 02:49:21 PM (-06:00)

Activity Details

02:48:26 - Start of event		
02:48:26	00:00:00	Start of event
02:48:26 - Voltage management (1718 milliseconds)		
02:48:26	00:00:00	Voltage loss detected on switching devices SF4, S42, S43

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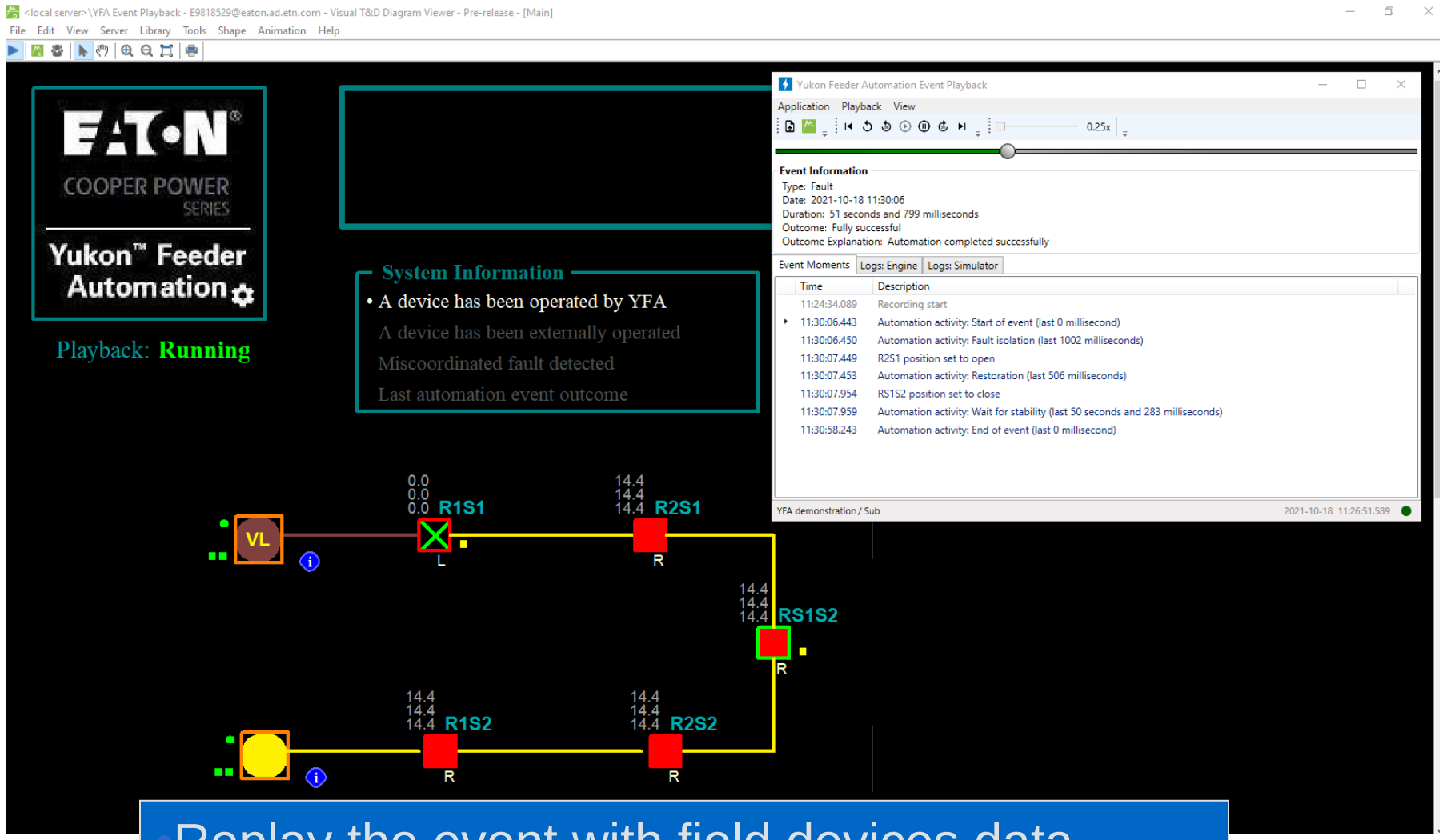
Event Playback



- Replay the event with field devices data

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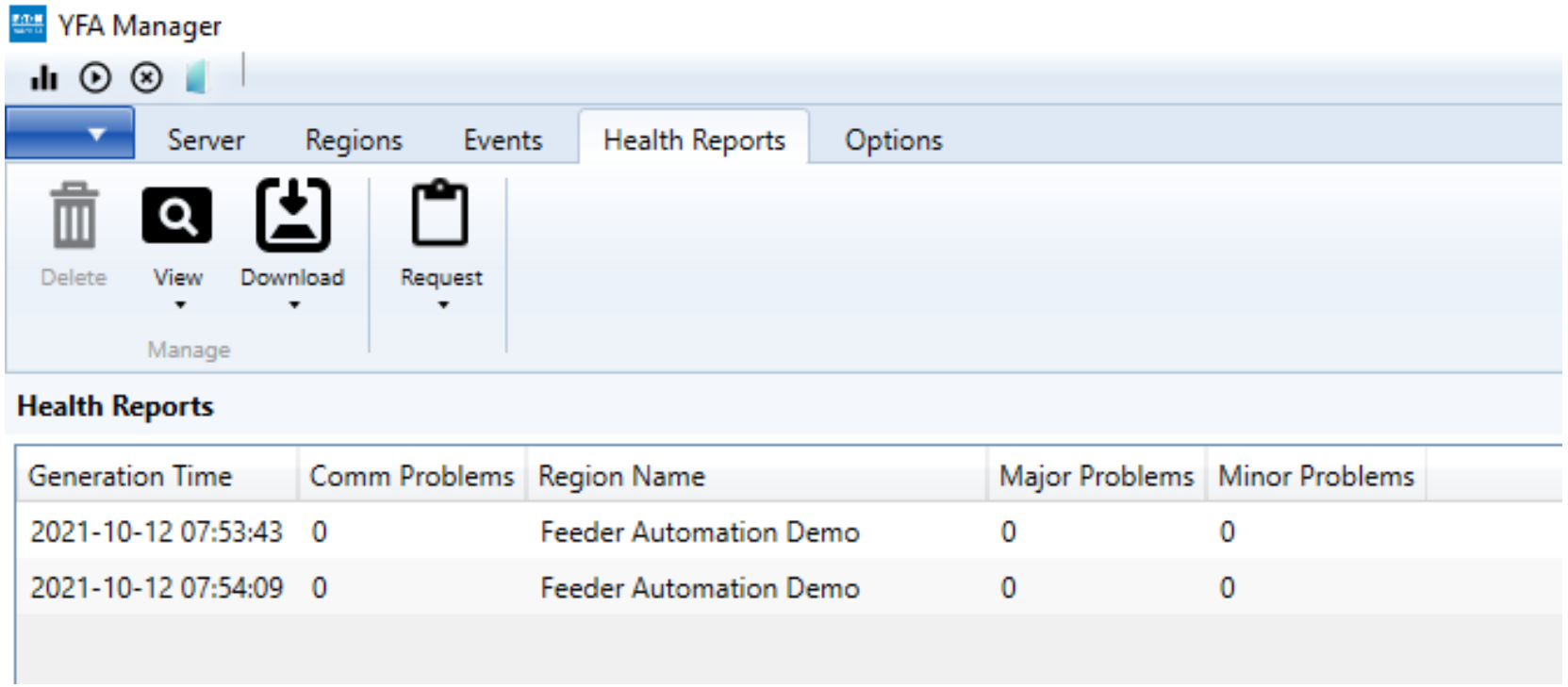
Health reports



- Report any problem that can impact customer restoration

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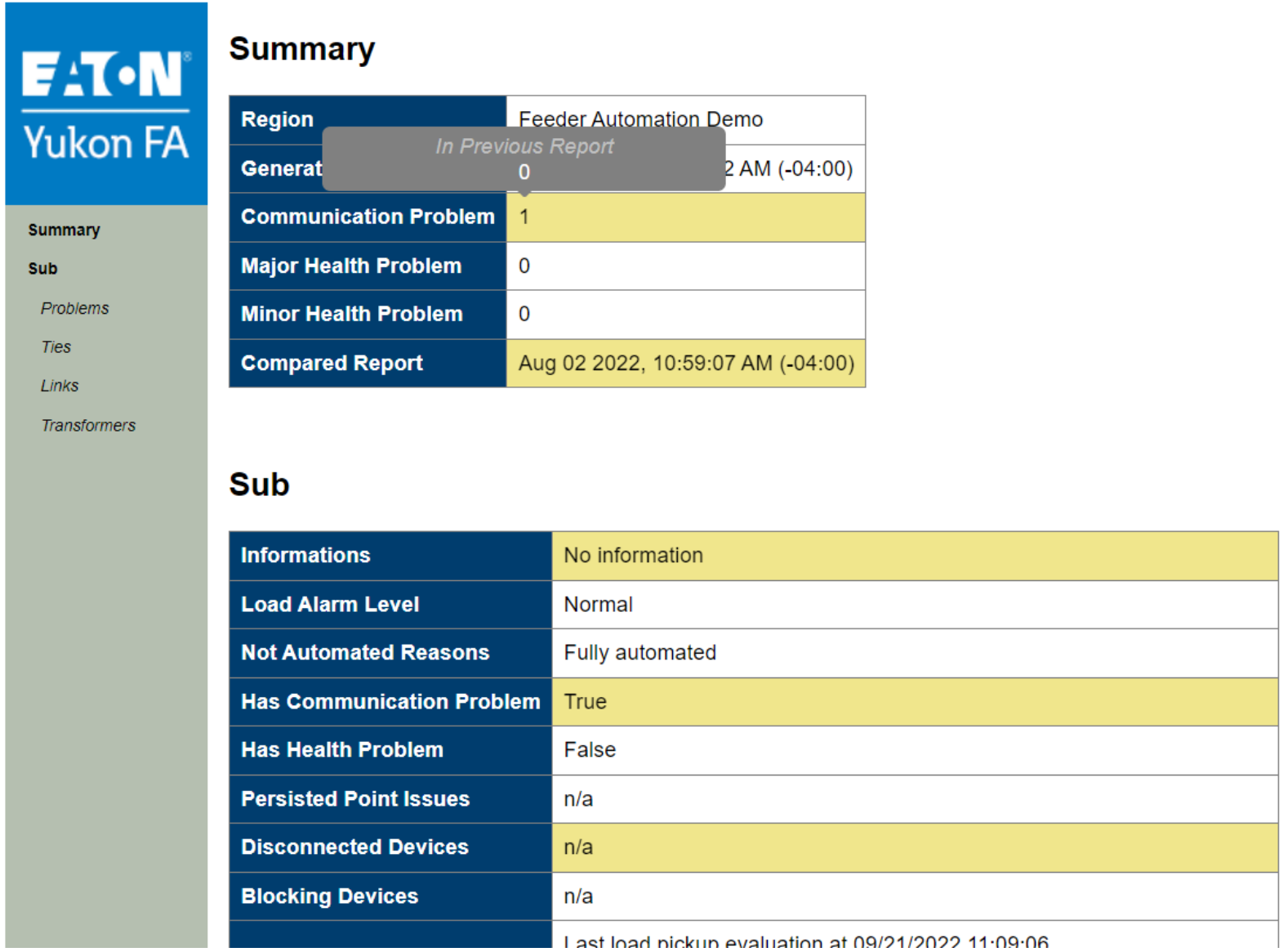
Health reports



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Proven technology

- IOU Customers
  - Pacific Gas & Electric
    - 940 feeders
    - 4400 controlled IEDs
  - Duke Energy
    - 5300 controlled IEDs
  - Exelon - Pepco
    - 6000 controlled IEDs
  - Fortis Alberta
    - 650 Controlled IEDs
- Public Power
  - Delaware Electric
  - Hendricks Power
  - Carroll EMC
  - Owen Electric
  - Adams Columbia
  - CHELCO
  - CBEC

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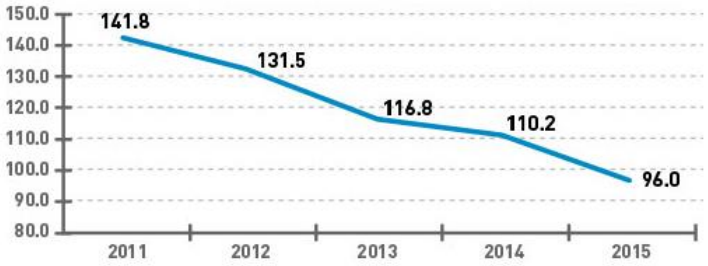
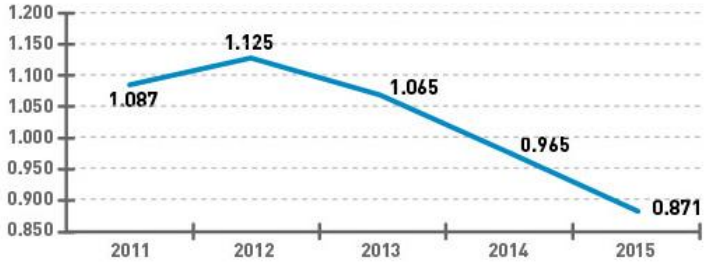
Large West Coast Utility Reliability with FA

SAIDI performance results



32% SAIDI Reduction

SAIFI performance results



20% SAIFI Reduction

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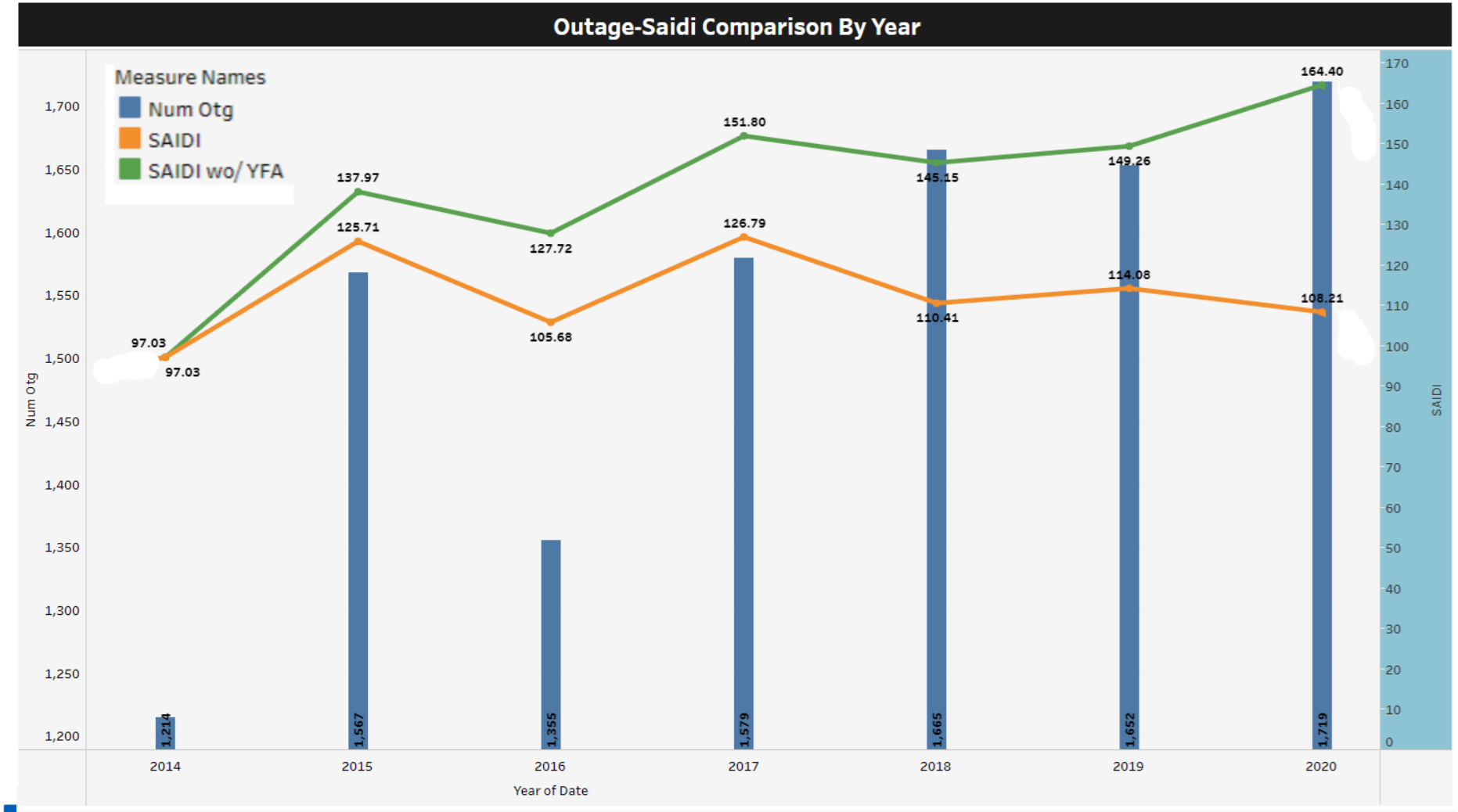
Georgia Utility Reliability with FA



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