Simulate Before Operate (IEC)

Empower Facility Team’s Real-Time Decision-Making with Electrical Digital Twin

EcoStruxure Power Digital Application

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EcoStruxure™ Power

Schneider Electric™

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Table of Contents

Overview

Context of Application

Modern electrical systems are increasingly complex to operate in particular with the advent of renewable power sources.

Facility teams often cannot predict the outcome of switching or maintenance actions, sometimes required following an unintended event. Inexperienced operators' lack of confidence to perform certain operations or procedures, especially when performed in a crisis situation, can result in severe consequences to the system, accounting for a high financial impact to the business.

Problem to Solve

The facility, operations, and maintenance managers need to:

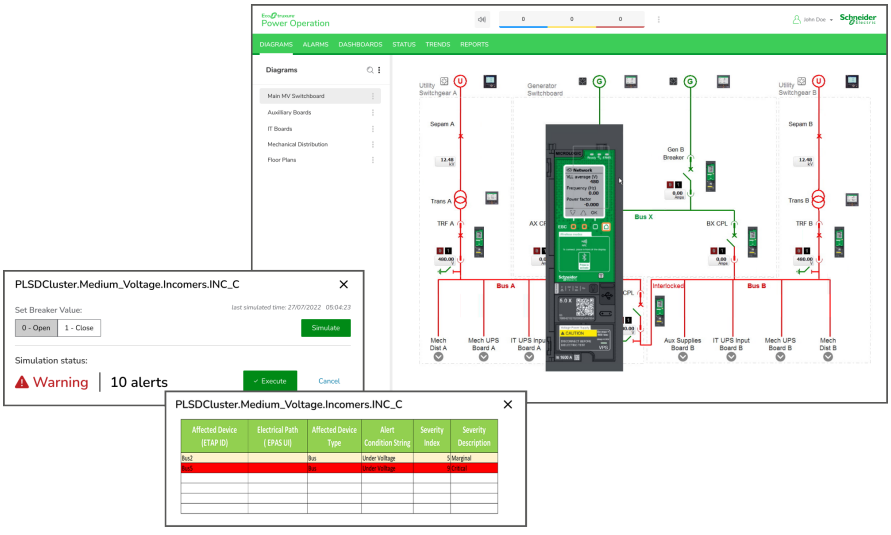
- Help operators avoid missteps that can lead to unplanned outages, equipment overloads, or people safety risk.
- Strengthen operator confidence and efficiency for complex operations (such as breaker operation and motor starting).

Purpose of the Application

Help facility managers and/or operators understand the consequences of an action prior to executing it.

Use a highly-realistic model-driven power system simulator (Digital Twin) to:

- Simulate the consequences of an action and list the potential risks or side effects.
- Enhance familiarity with unusual/new operations.

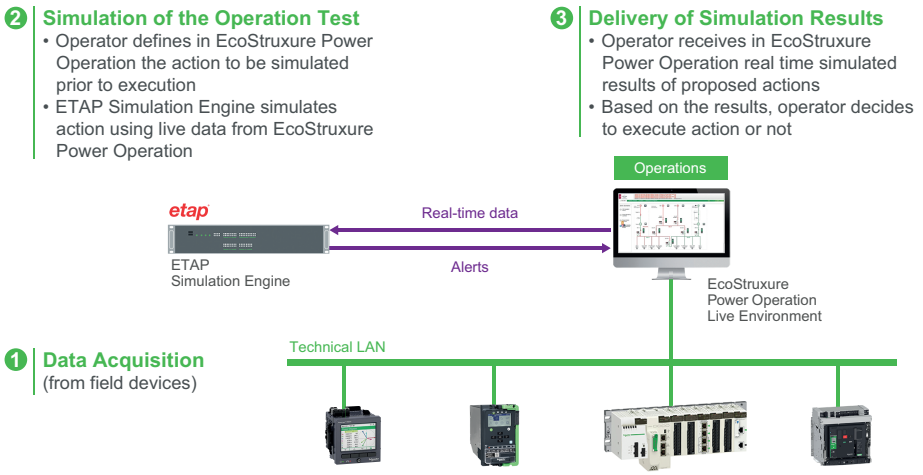


Simulate Before Operate Environment

Application Outcomes

Real-Time Dynamic Simulation

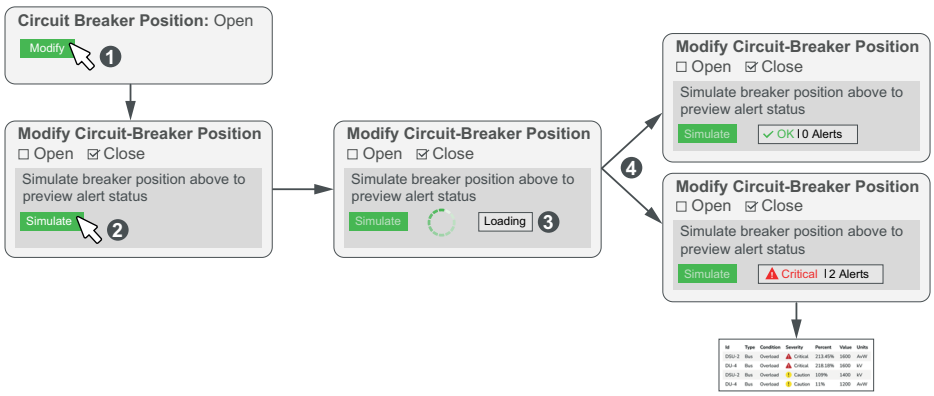
Model-driven real-time simulator using a complete set of actual data of the entire electrical network to simulate the consequences of an action prior to execution



Schematic Diagram for Simulate Before Operate Application

Alerts

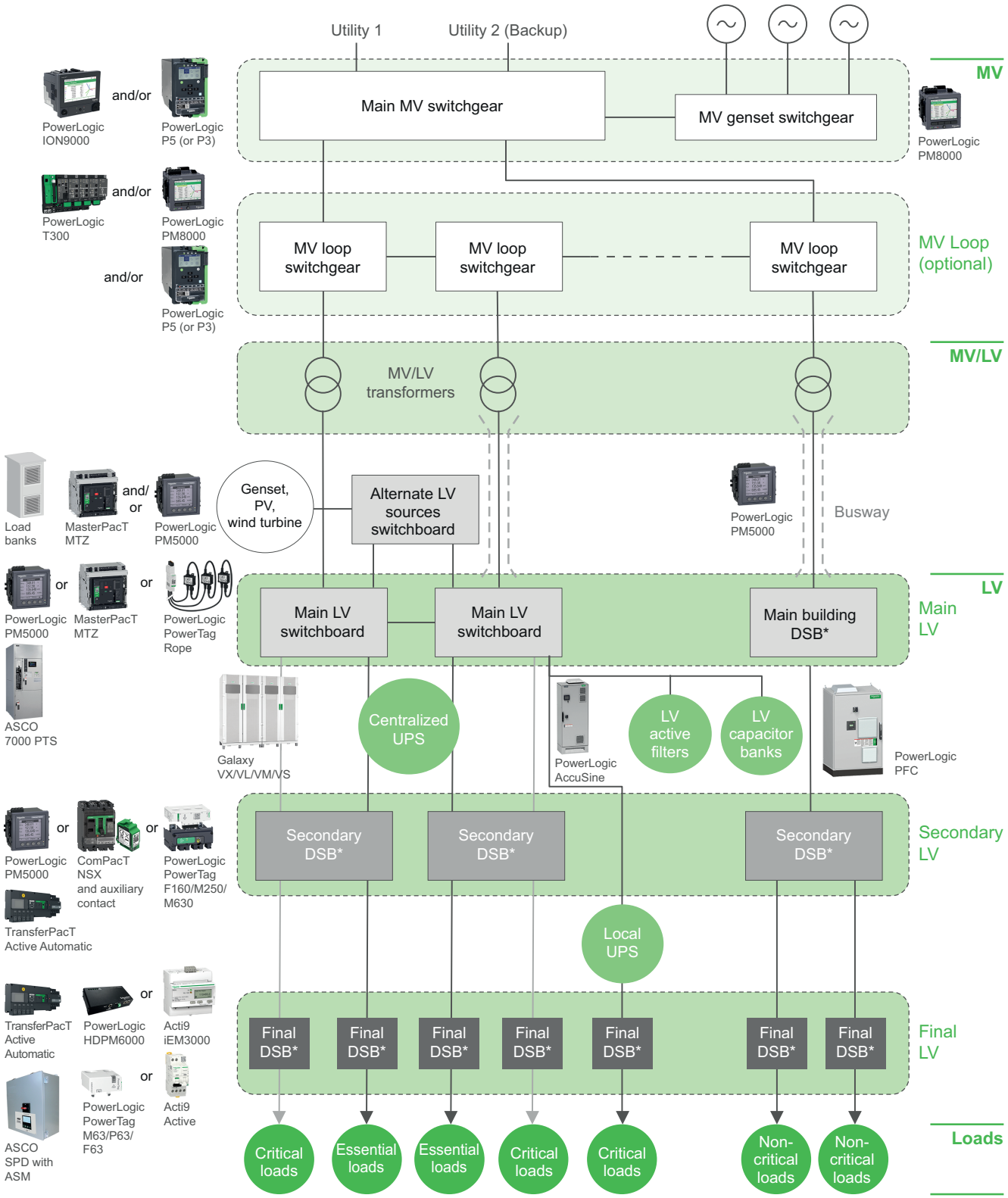
Alerts regarding potential consequences (overloads, over/undervoltage, overexcitation, etc.) if an action is performed



Simulate Before Operate Process Flow to Generate Alerts

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Simulate Before Operate application:

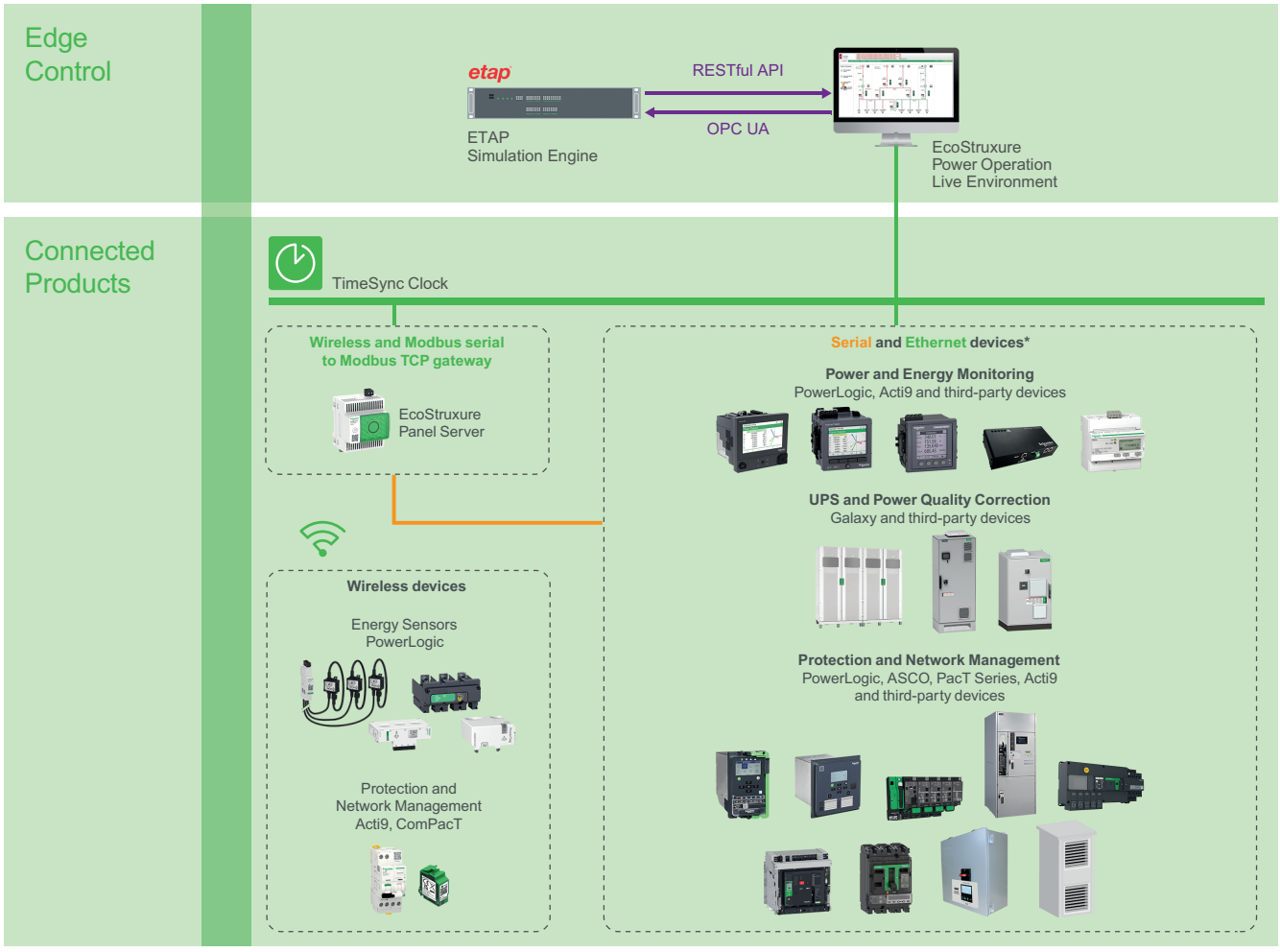


* DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Simulate Before Operate application involves collecting the input data from the different products, either directly over Ethernet or via gateways. This data is then processed by the Edge Control (EcoStruxure Power Operation) and passed on to the ETAP Simulation Engine (using the OPC UA communication protocol) for simulations. The alerts are then displayed in EcoStruxure Power Operation (using the ETAP RESTful API).

The recommended digital architecture for the application is shown below:



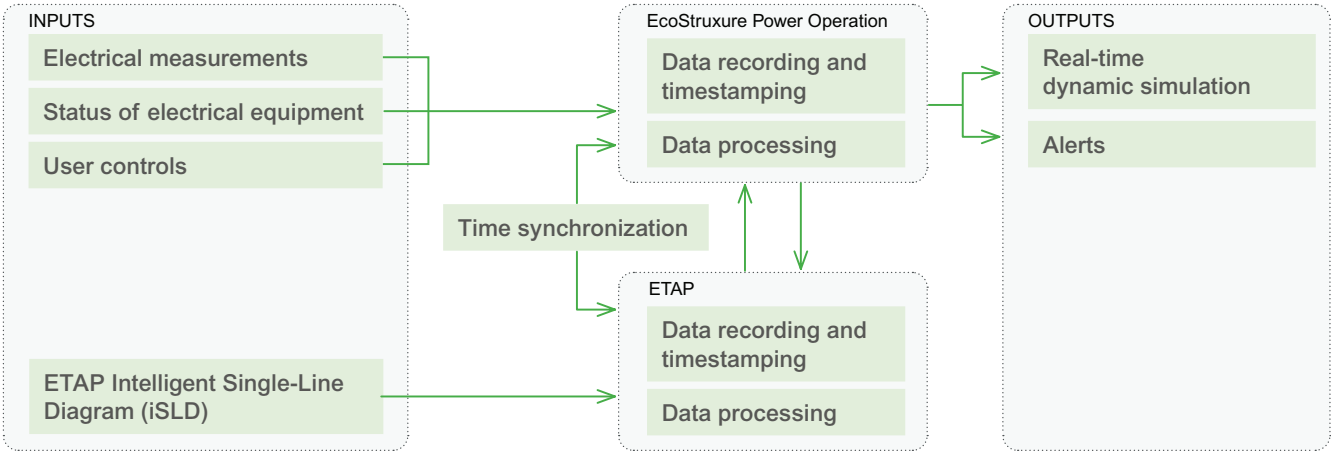
* Depending on the connected device chosen, communication protocols can be Ethernet or Serial

Ethernet - technical LAN
OPC UA / RESTful API
Serial
Wireless - 2.4 GHz

System Description

Data Flow

The Simulate Before Operate application can be broken down as follows:



Inputs

The Simulate Before Operate application collects data in real time from the connected products of the electrical installation to generate a highly realistic model of the electrical system and enable operators to simulate the outcome of an action before executing it.

Electrical measurements and status information can be acquired from a wide range of connected products as well as third-party equipment through open communication protocols. Typical connected products include:

- **Energy/Power meters**, such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, Acti9 iEM3000, PowerTag


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Protection devices**, such as PowerLogic P5/P3, MasterPacT MTZ, ComPacT NSX (including its wireless auxiliary contact), Acti9 Active


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


ComPacT NSX and Auxiliary Contact


Acti9 Active

- **Other equipment**, such as UPS (Galaxy VX/VL/VM/VS), ATS/PTS (ASCO 7000 Series PTS, TransferPacT Active Automatic), ATS controller (PowerLogic T300), protective devices (ASCO SPD with ASM), power correction devices (PowerLogic PFC and AccuSine PCS+/PCSn/EVC/PFV+), Load Banks


Galaxy VX/VL/VM/VS


ASCO 7000 Series PTS


TransferPacT Active Automatic


PowerLogic T300


ASCO SPD with ASM


PowerLogic PFC


PowerLogic AccuSine PCS+/PCSn/ EVC/PFV+


Load Banks

Electrical Measurements

The following electrical measurements are collected from connected products (real-time values, the minimum, maximum, and average values):

- Current and voltage
- Power (Active, Reactive, Apparent)
- Frequency
- Energy
- Harmonic distortion
- Voltage and current unbalance

Status of Electrical Equipment

Information is collected from intelligent electrical devices such as circuit breakers, power quality correction equipment, ATSs, and other electrical distribution equipment:

- Circuit breaker position (open, closed, racked-in, racked-out, etc.)
- Circuit breaker trip status, protection status
- UPS status, motor status
- Other statuses, operating modes, or conditions

User Controls

Control actions are used to determine the response to changes in equipment status, loading, and generation levels such as:

- Breaker operation
- Motor starting
- Load changes

ETAP Intelligent Single-Line Diagram (iSLD)

ETAP's iSLD is a digital representation of the electrical system including all equipment characteristics and system behavior. It is designed to be the model of AC & DC networks based on real-time and estimated data.

Data Recording and Timestamping

For the Simulate Before Operate application:

- User actions are recorded and timestamped by EcoStruxure Power Operation.
- ETAP Simulation Engine predicts system behavior using real-time data.

To reach an optimal chronological correlation, a time accuracy of ±1 millisecond is recommended for both the trainee workstation (EcoStruxure Power Operation) and the ETAP Simulation Engine.

ETAP
Simulation Engine

EcoStruxure
Power Operation

Time Synchronization

To be able to replay or analyze a sequence of operations, time synchronization is required between the EcoStruxure Power Operation computers (server and user HMI) and the ETAP Simulation Engine.

This can be achieved by setting NTP or SNTP synchronization between computers.

TimeSync Clock

Data Processing

Real-time data from the electrical installation is provided by EcoStruxure Power Operation Edge Control using the OPC UA communication protocol.

This data is used by the ETAP Simulation Engine to generate highly-realistic equipment responses to a series of control actions by a user.

ETAP leverages its load flow engine to perform analysis to determine if there are actions that will result in non-desired situations.

Additionally, all user actions (user controls) are logged for traceability purposes within EcoStruxure Power Operation.

Outputs

The outputs of the ETAP Simulation Engine are displayed in EcoStruxure Power Operation.

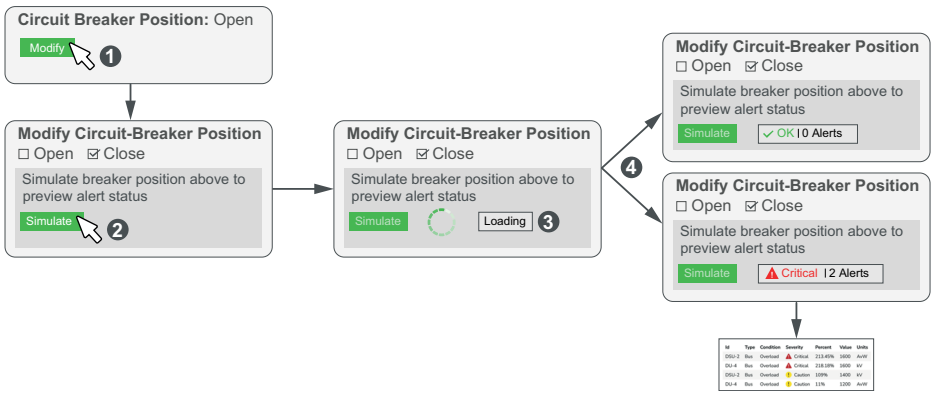
Real-Time Dynamic Simulation

EcoStruxure Power Operation leverages an integrated simulation engine that enables operators to be aware of potential risks of performing various operations prior to execution. It helps to provide a model-driven real-time simulator for early detection and indication of potential power system risks using a complete and consistent set of actual data of the entire electrical network.

Alerts

ETAP Simulation Engine generates and communicates alerts to EcoStruxure Power Operation to display potential incidents prior to any action being executed. Alert notifications can be configured to include, among others:

- Overloads
- Overvoltage/undervoltage
- Overexcitation



Simulate Before Operate Process Flow to Generate Alerts

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