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We Deliver.

Keystone Solar Energy Future Project

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Summary

PPL Electric Utilities' Keystone Solar Future Project (KSFP) leveraged several grid technologies to develop a distributed system platform that bridges the gap between existing and future technologies by monitoring, controlling, and optimizing a high penetration of solar generation. PPL also developed a multi-layer device and communications architecture and a customer engaged pilot on at least 10 distribution circuits. The project team performed an extensive one-year demonstration to validate research findings before deploying it system-wide.

Hosting capacity integrated interconnection portal provides an unprecedented one-day interconnection approval and response to solar customers. In addition, updated radio frequency mesh network communications and robust data management solutions allow back office systems to control the various operational characteristics of end-point field devices.

Scope

Interconnection Web Portal

Interconnection application review times was drastically improved

Decision automation is industry-leading

Builds off PPL's existing Contractor Services Portal

DERMS

Central modeling and control platform with DER-aware algorithms for control

Leverages PPL's existing DMS

Enhances Volt Var Optimization to include DER

Optimizes feeder reconfigurations

Proof of Scalability

Drexel Simulation, SEPA Engagement DERMS Pilot

Interconnection Process

Objective: Full integration into PPL systems allows for a seamless application process while maintaining data integrity

Customer Service System Data

- Premise location information
- Customer account information
- Premise usage data
- Generation served from same transformer
- Customer service representatives are aware of each WO

Work Order Management System

- Automatic work order (WO) creation upon application submission
- Uploads documentation to WO for record retention
- Triggers status updates to ratepayer and/or contractor
- Provides clear metric criteria for tracking effectiveness

Geographic Information System Data

- Service transformer rating
- Model DER systems in GIS automatically
- Prepares PPL for Hosting Capacity and DER Analyses

Communication and Transparency

- Automatic notifications sent to ratepayer and contractor
- User can check status and cancel application through portal

Engineering Approval Criteria

- Single-phase generator < 25kW
- Three-phase generator < 50kW
- Transformer size is adequate for generation
- Sufficient demand history is available
- First generator on a transformer

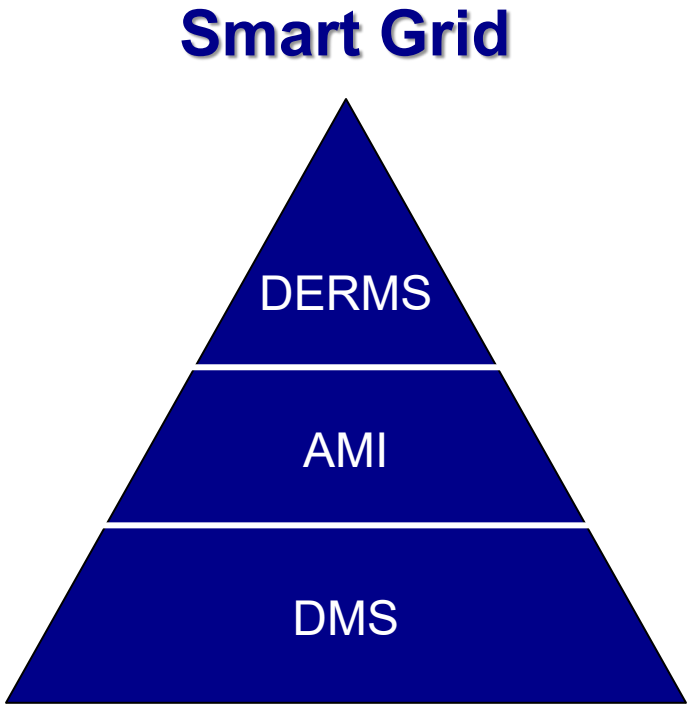
DERMS

Distributed Energy Resource Management System (DERMS)

- Next step in *Smart Grid* evolution
- Makes existing systems “DER aware”

Built upon existing strategic foundational investments:

- **Distribution Management System (DMS)** and it’s applications:
  - Fault Isolation and Service Restoration (FISR)
  - Volt-VAR Control (VVC)
  - Advanced Feeder Reconfiguration (AFR)
- **Advanced Metering Infrastructure (AMI)**



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Enhanced Functions in DERMS

DER Aware Fault Locating

Bi Directional Fault Indication

Enhanced Awareness

FISR Consideration of Hidden Load

DERMS

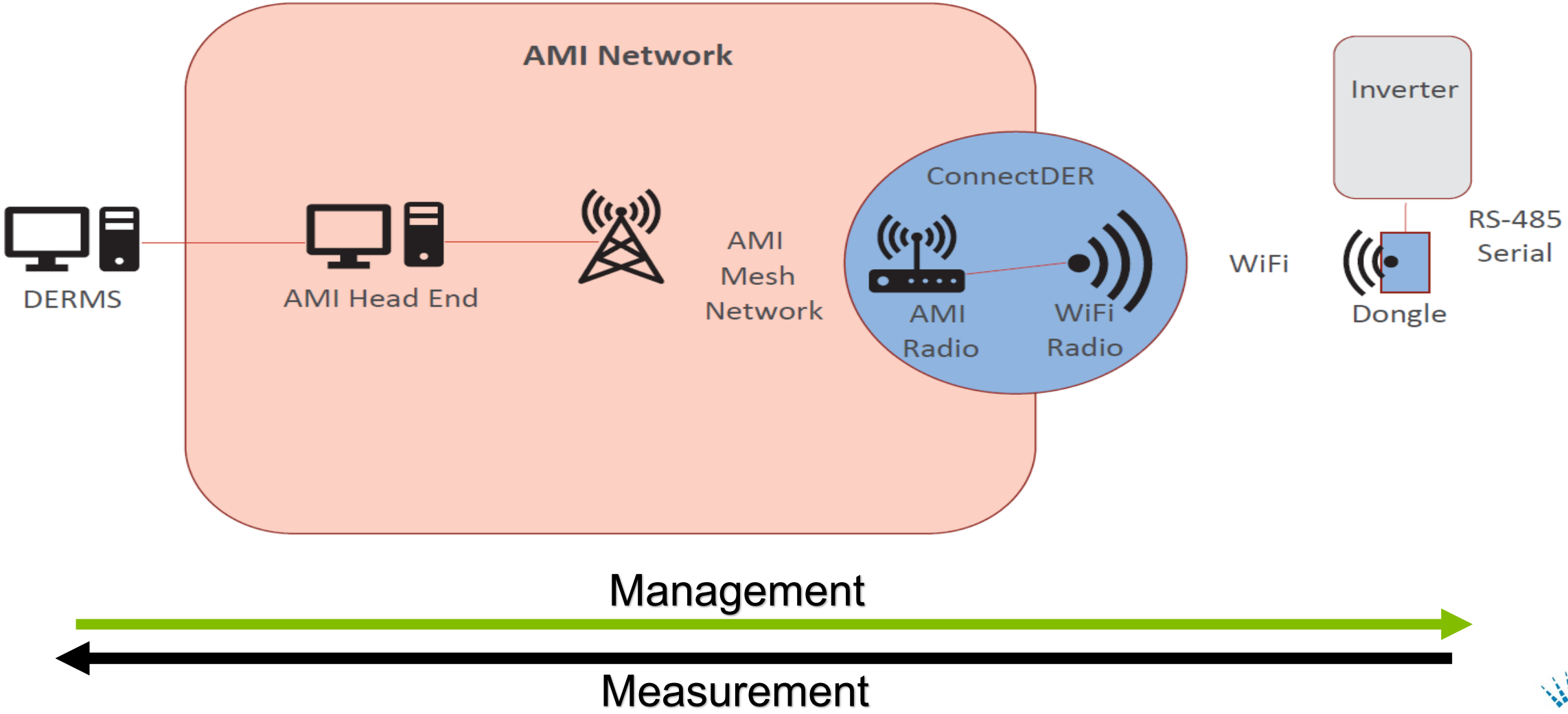
DER Volt Var Management

Training and Change Management

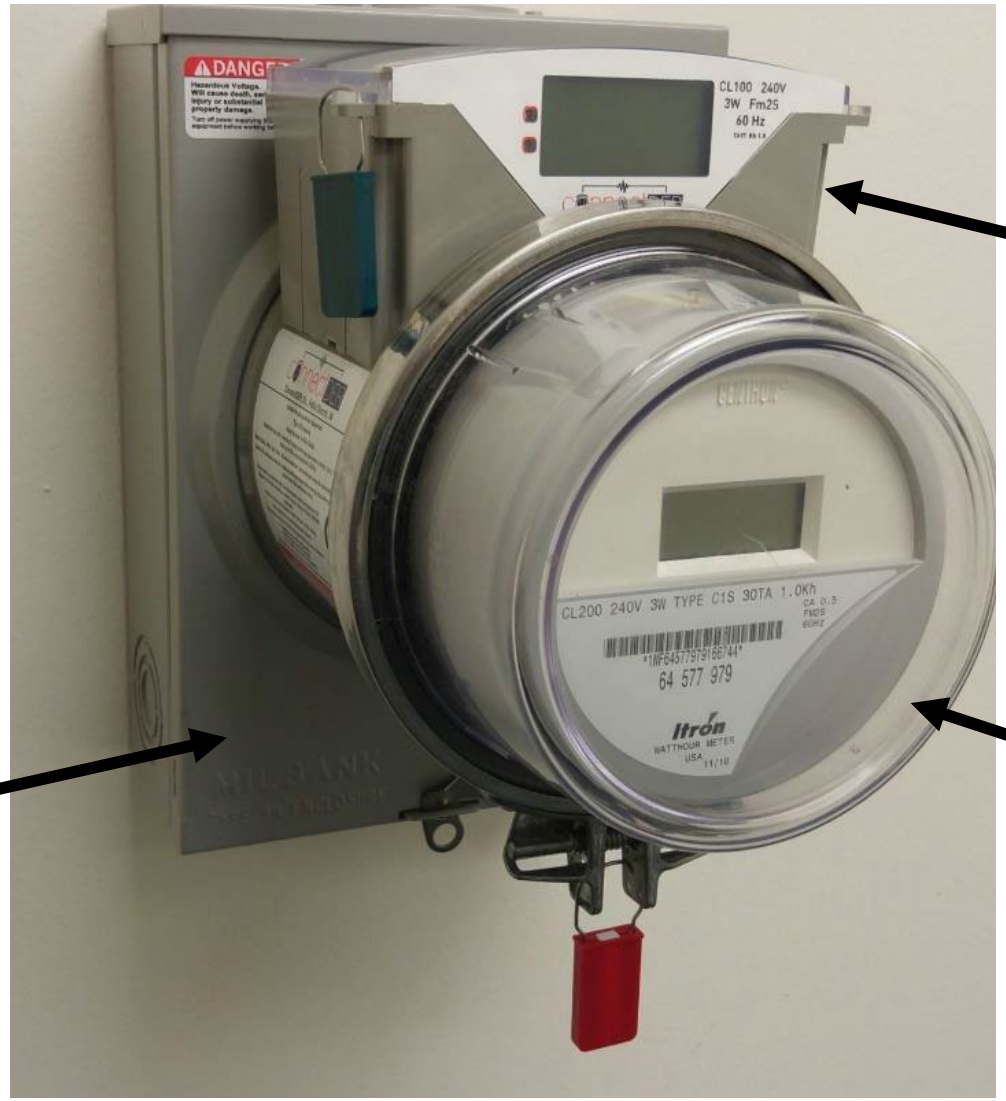
DER Forecasting

DER Communications

SCADA Connected DER Communication



ConnectDER / Dongle



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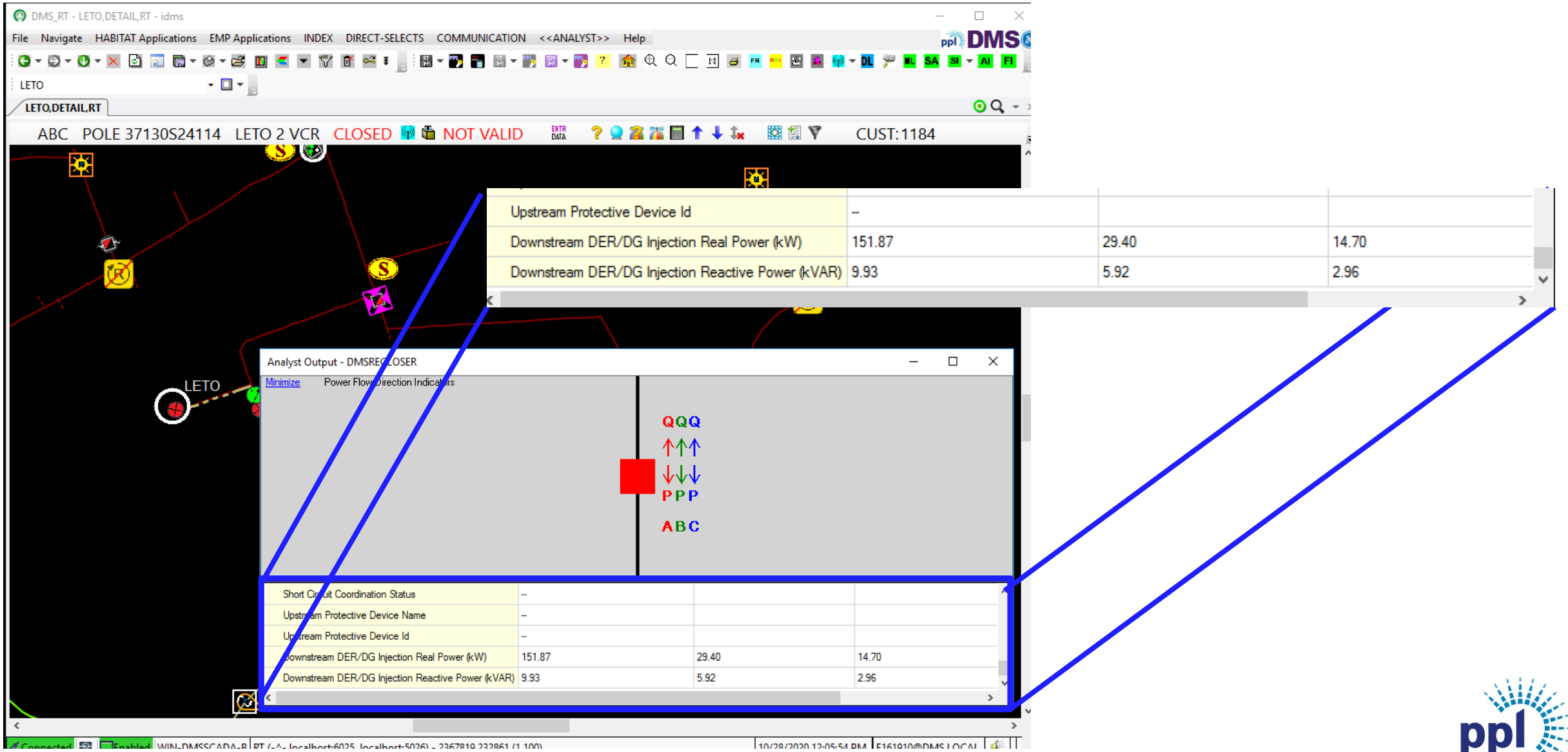
DERMs Enhanced DMS

PPL's DERMs System Overview

- Has These Enhancements Built In

- **FISR**
  - Consideration of hidden load
  - Bidirectional Faults
- **LVM**
  - Uses SCADA connected DERs to support system power quality
- **Power Flow**
  - Provides more accurate modeling of DER provided load (hidden load)

DERMS – DER Caused Hidden Load

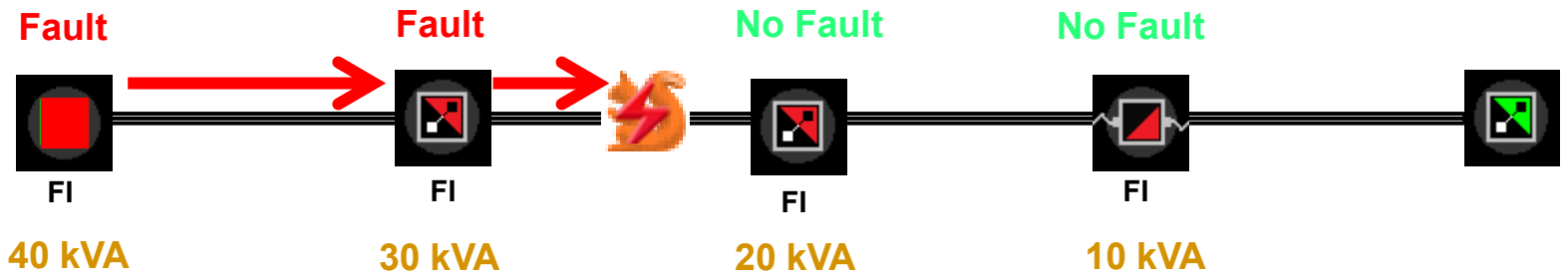


FISR Consideration:

DER Impact On Faults

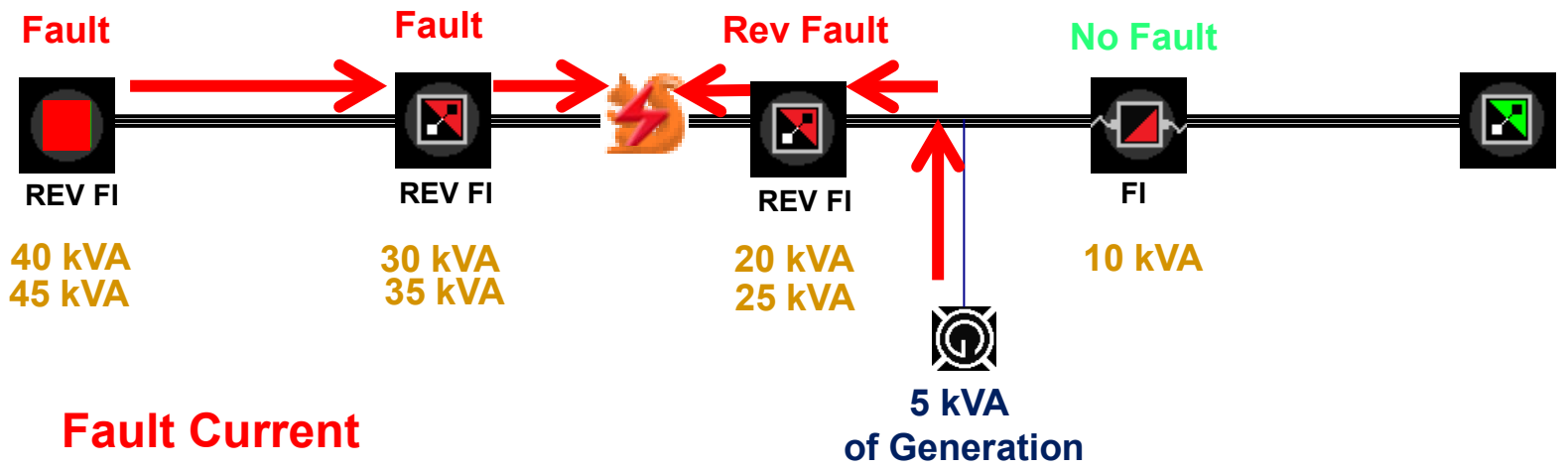
FISR – With DMS and no DERs

- **Fault Currents / Detection:** fault current flows from the source (aka breaker) to fault.
- **Load at Restoration**: DMS determines based on pre-fault load data and circuit ratings plus potential cold load pickup.

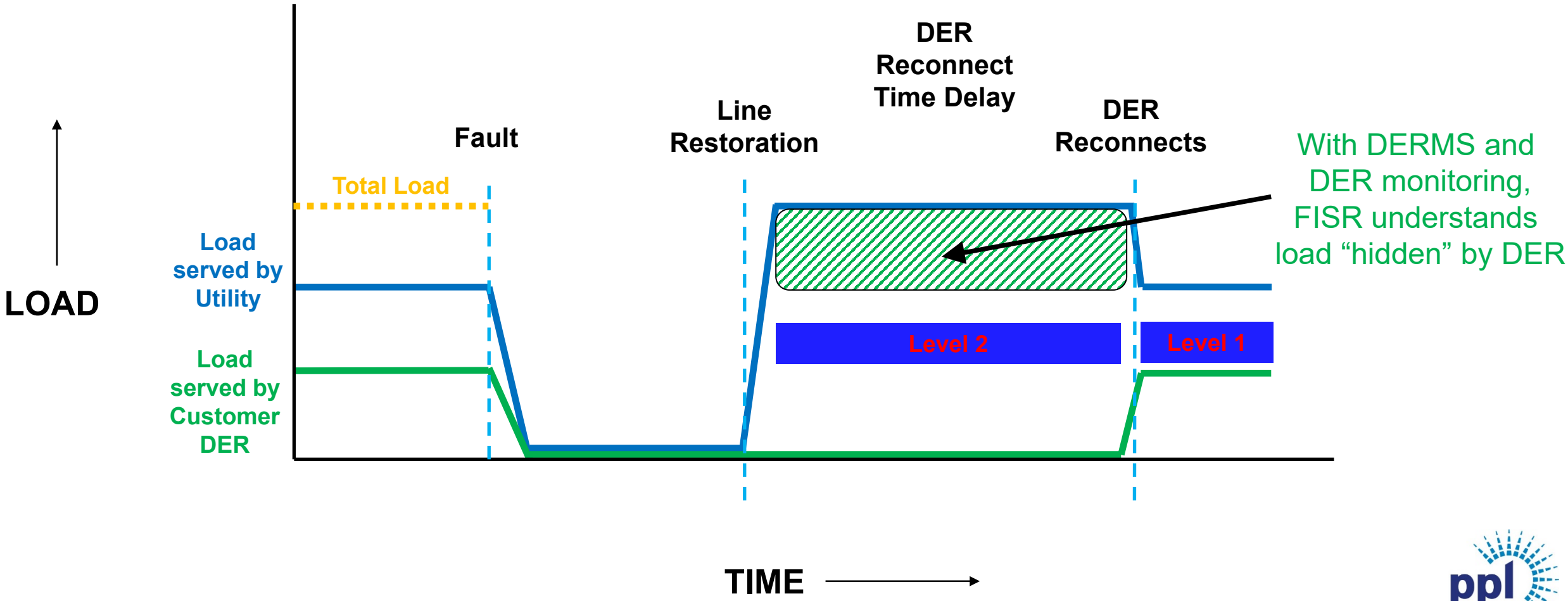


FISR – With DERs and DERMs

- **Fault Currents / Detection:** fault current will flow dependent on strength of generation source to fault.
- **Load at Restoration**: hidden (DER) supplied load does not appear during normal operation. Delays associated with DERs will produce higher return loads plus cold load pickup.



Consideration of Hidden Load



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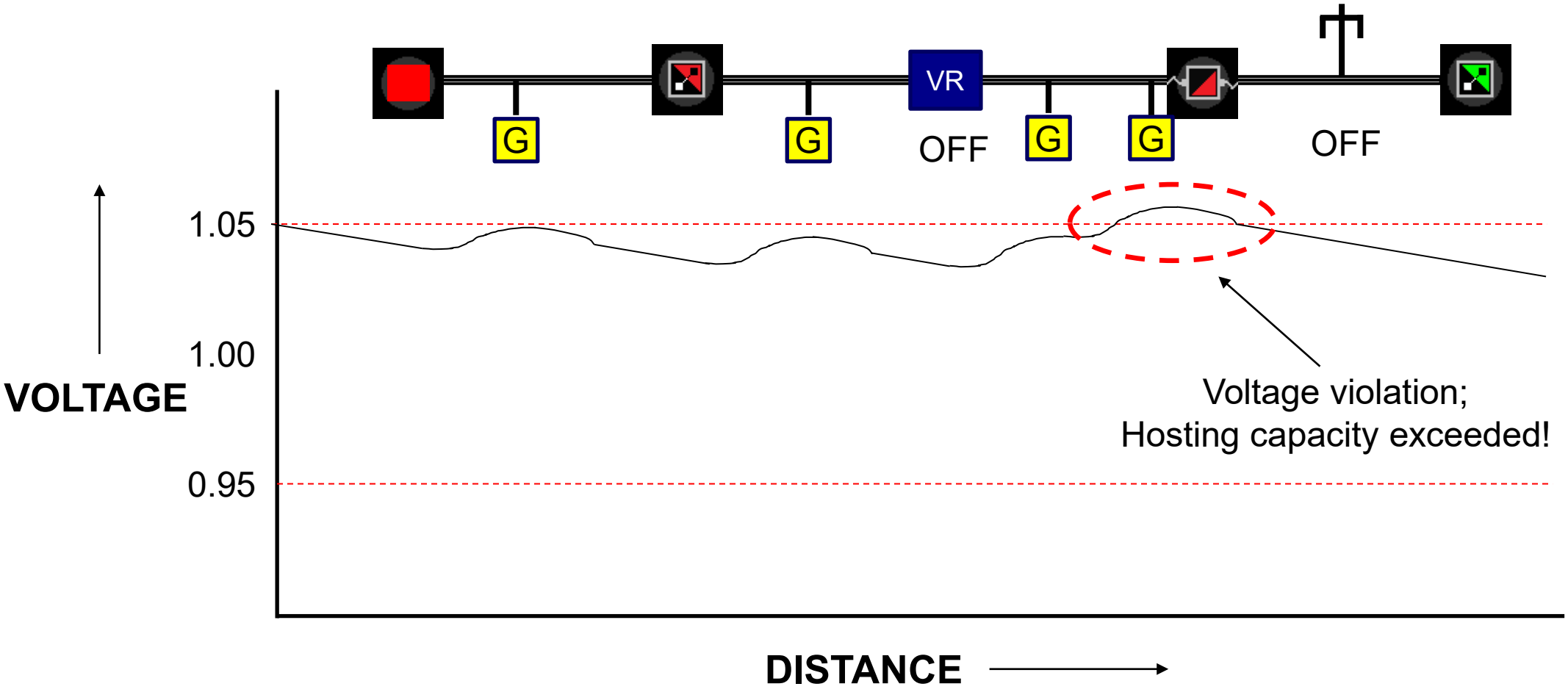
LVM Consideration:

DER Operations Assisting Voltage Support

DER Volt-VAR Management

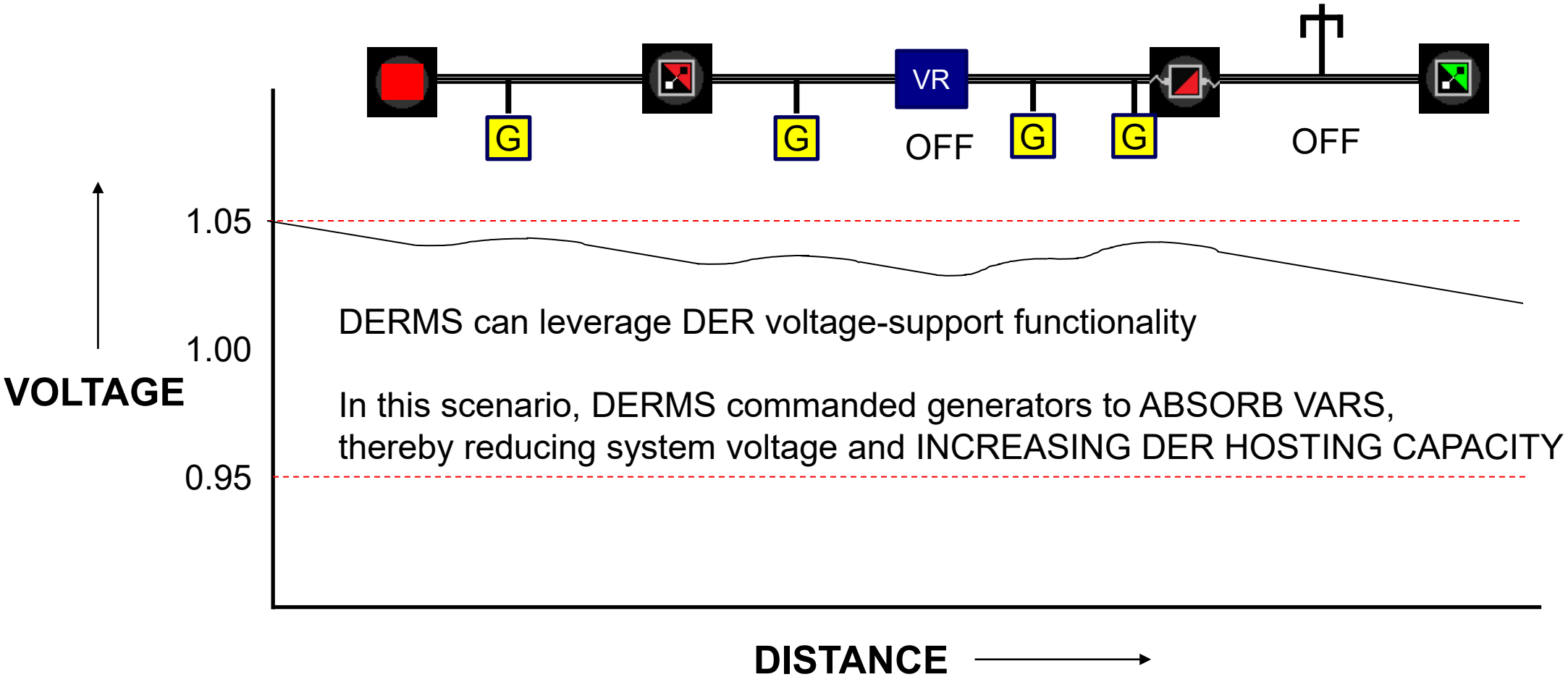
Scenario: Light load (e.g., spring day)



DER Volt-VAR Management

Scenario: Light load (e.g., spring day)

With DERMS



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Questions