PRISM™ Renewables Suite

ACS

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Advanced Control Systems™ (ACS™) offers a very robust suite of applications for the management and optimization of distributed renewable energy sources on the distribution network. These applications are available to be deployed in concert with the industry-leading PRISM ADMS platform, and as an integrated solution with our Centrix™ Feeder Automation platform for decentralized applications. The PRISM renewables applications are designed to analyze, control and manage renewable operations within distribution feeders. Both generation and battery storage usage is supported. Like renewable growth itself, implementation of the PRISM feeder control under renewable deployment can be accomplished incrementally as renewable generation increases at the feeder level.

- Manage and optimize PV injection on the network
- Integrate with DMS platform or deploy as stand-alone automated solution
- Operator analysis tools for decision support
- Identify potential voltage and flow violations in advance
- Create switching plans and enable crews with mobile tool support

PRISM renewable applications support two primary operational use cases:

- Automation mode (closed-loop): This is a real-time mode, whereby all decisions will be made autonomously by the renewable applications, based on the control options that are available using remote control.
- Advisory mode (operator in-the-loop): renewable control is performed under direction of a control center operator from a DMS/ADMS console. Additional information and analysis tools are provided to enable the operator to explore optional actions that he may elect to take to avoid curtailment. The Advisory mode includes a 24-hour forecast schedule to alert the user of pending actions that will be taken by the system.

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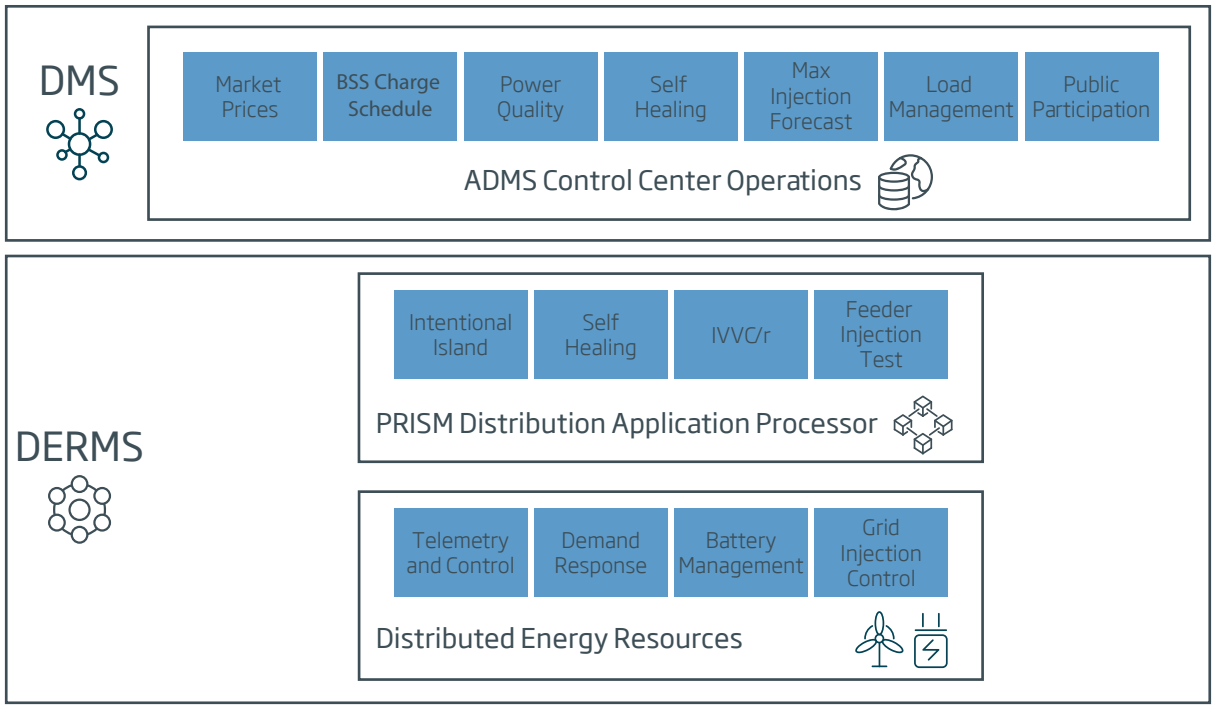
Modular Deployment Options

The PRISM suite enables you to begin renewable support gradually while achieving immediate gains in feeder reliability and resiliency–at a time when penetration levels are minimal and have not yet presented operational issues. The modular architecture of PRISM renewable suite provides you with the option of deploying modules with increasing functionality and complexity as your needs dictate, beginning with the introduction of Integrated Volt/VAr Control (IVVC).

Each of the primary modules support global functional capabilities within PRISM ADMS, while a subset of them may also be deployed for automation on the ACS Centrix feeder automation platform. The available application modules include:

- Real-time Integrated Volt/Var Control (IVVC)
- Real-time IVVC/r, which is extended to add renewable monitoring and control capability
- Emergency Load Transfer (ELT) for feeder reconfiguration through remote switching
- Forecast Feeder Injection Test (FIT) to monitor and predict feeder voltage and excess generation issues, such as flow reversal, arising from significant renewable generation injection
- Maximum feeder Injection Capability (MIC) to optimize the injection amount and location

The individual modules are highlighted in the following sections.



IVVC and IVVC/r

Both PRISM Integrated Volt/VAr Control (IVVC) and the renewable version, IVVC/r, run in real-time in Automatic mode and with operator intervention.

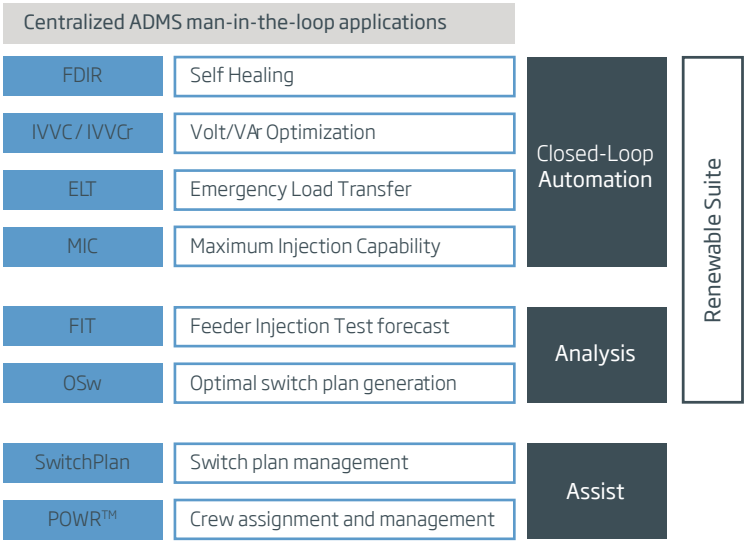
IVVC manages typical feeder violations by issuing controls in real-time to optimize the voltage profile and to reduce losses (improve the power factor) for each feeder under its control. The user can establish the control objective for each feeder, such as Voltage minimization, VAr loss minimization, or both. The primary real-time operational objective of IVVC is to avoid feeder violations which may threaten the reliability of the feeder's continued operation.

IVVC/r is the extended version of IVVC which supports control of the PV inverters, as well as generation and battery storage units. IVVC/r serves to alleviate voltage issues at the point of common coupling and in reverse flow direction, that result for increased renewable penetration on the system. The secondary objective of IVVC/r is to avoid curtailment as much as possible so that the renewable inverter can inject the maximum possible generation.

Emergency Load Transfer

The Emergency Load Transfer (ELT) application runs in conjunction with IVVC/r in real-time. If the projected or forecast injection is greater than can be effectively managed through IVVC/r control, the system will explore the effect of network switching.

ELT is called by IVVC/r when feeder DER injection is excessive, resulting in voltage violations and reverse power flow. If IVVC/r cannot resolve the violations in real-time, then ELT will perform feeder switching to transfer load or DER generation to/from another feeder (or a combination of both). If no possible switching scenarios exist to resolve the violations then IVVC/r will resort to curtailment of the renewable generation.

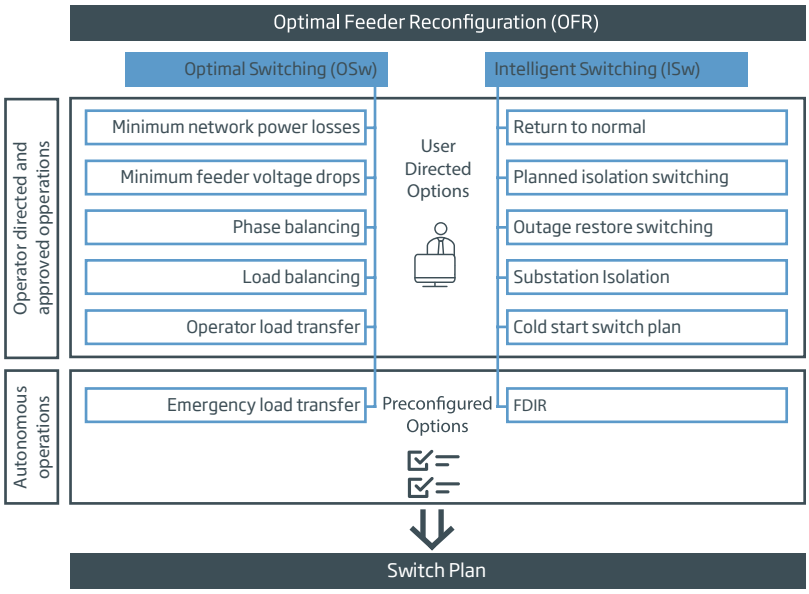


Maximum Injection Capability

Voltage and line limit violations due to load and/or generation variations may fall outside of the range of control that IVVC is able to resolve. In these situations, it is necessary to calculate the Maximum Injection Capability (MIC) at each injection point of common coupling on the feeder in terms of Watts and VArs injection. Renewable curtailment is the last resort to protect the feeder by maintaining operation within limits. MIC will supply the IVVC/r with the maximum allowable injection for each controllable DER on the feeder.

Feeder Injection Test

The primary objective of the PRISM renewable suite is to ensure the maximum possible injection, avoiding curtailment. To head off any potential issues, PRISM offers a look-ahead Feeder Injection Test (FIT) to forewarn of feeder problems caused by excessive renewable injection. FIT is an application that is run by an operator in order to determine if potential emergency conditions exist that could lead to curtailment.



The FIT application analyzes the injection forecast and the load forecast for the feeder to check that there will be no voltage and flow violations that IVVC/r cannot resolve without curtailment. The injection forecast schedule is a 24-hour look-ahead projection supplied by the utility. FIT will run (periodically and event-driven, such as after a topology change) to continuously perform a load flow analysis for each time slice to detect the occurrence of violations. Violations found are presented to the operator in a schedule showing the details for the feeder.

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Optimal Feeder Reconfiguration

PRISM supports a suite of feeder reconfiguration applications that includes Optimal Switching and Intelligent Switching. These switching tools are leveraged by the Renewables Suite to relieve potential curtailment situations identified by the look-ahead FIT over the next 24-hour period. Optimal Switching enables the operator to develop a switching plan which can avoid or minimize the potential curtailment in real-time, and is able to create switching scenarios that are not possible under the Emergency Load Transfer (ELT) function, since ELT is not able to consider manually operated switches or peak shaving functions. The operator can use the advance forecast time to plan for the day ahead problem.

SwitchPlan and POWR™

Adding additional capabilities and value to the PRISM Renewables Suite are the ACS SwitchPlan and POWR mobile applications. SwitchPlan is a tool that supports creation and documentation of the life cycle of a switch plan/procedure, and is designed for mobile operation as a tool for field crew operations when used in combination with the POWR application. POWR provides field crews with operator-assigned DMS and OMS job information on their mobile device. It is a browser-based tool with secure, personalized job-related forms and information concerning the assignment of various job types including switch procedures, emergency work and planned (non-outage) work. POWR mobile also provides supervisors and operators with a view for managing crews and the jobs assigned to them. Additional information can be found in the POWR brochure.

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