GE VERNOVA

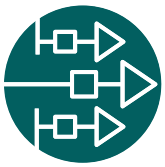
CONSULTING SERVICES

PlanOS

The comprehensive software platform to confidently plan for a reliable, resilient, and stable energy system.

PlanOS* provides a holistic approach to planning for your energy system's most pressing challenges. This platform leverages the robust algorithmic capabilities of our decades-proven planning software (MAPS, MARS, and PSLF) and breaks down traditional planning silos. With PlanOS you can analyze the economics, reliability, and power flow of your system, as well as confidently plan for capacity expansion. With the option to augment your modeling with GE Vernova's robustly mapped power system dataset, you can enhance your analysis capabilities and accelerate model development. Your unified dataset model will seamlessly flow between native single- or multi-function analysis – enabling truly integrated energy systems planning.

Integrated Planning Functions



Steady State Power Flow

Simulates physical behavior of the grid and connected equipment.

Answers the question: Does my transmission system "work"—under stressful conditions will it deliver electricity reliably, protect equipment and people, and comply with regulatory requirements?

Production Cost

Simulate the economic operation of the power system.

Answers the question: What is the most economical way to schedule generation to serve demand, given limitations in the transmission system?

Resource Adequacy

Assesses reliability of supply to serve customers.

Answers the question: Have I built enough generation, storage, and transmission so that I have enough capacity to reliably provide electricity when it is demanded?

Stochastic Capacity Expansion

Helps users develop a plan for building new generation

Answers the question: Knowing what generation we have today, and with estimates of future costs, demand, and regulations, what is the lowest cost reliable and compliant plan for new generation?

PlanOS

RESOURCE ADEQUACY FUNCTION

Formerly “MARS” software

KEY FEATURES & BENEFITS

- Assess reliability of power supply in meeting energy demand.
- Conduct probabilistic power and reliability assessments of generation capacity adequacy, such as NERC PROB-A, to help ensure system reliability and mitigate potential risks.
- Supports unlimited years of renewable generation data while preserving correlation to load.
- Perform calculations such as equivalent load carrying capacity to better meet resource adequacy demands.
- Determine the need for implementing emergency operating procedures down to hours/year to help avoid system failures.

More quickly and accurately assess the ability of a power system to help adequately satisfy load requirements.

The ability to quickly and accurately assess the adequacy of systems is more important now than ever. The Resource Adequacy function of PlanOS enables you to more quickly and accurately assess the ability of a power system, comprised of a number of interconnected areas, to help adequately satisfy demand.

Based on a full sequential Monte Carlo simulation, this PlanOS function performs a chronological hourly simulation of the system, comparing the hourly load demand in each area to the total available generation in the area, adjusted to account for planned maintenance and randomly occurring forced outages.

Reporting the frequency and duration of outages calculated, not just the probability of such events.

Model emergency operating procedures and their effect on resource adequacy.

Calculation results go beyond LOLE and LOEaE/EUE. Detailed and transparent output lets you understand the underlying causes of events.

Complete and ready-to-use datasets major interconnections (or subsets thereof) are available for license.

PUTTING YOUR SYSTEM'S ADEQUACY TO THE TEST

Is your system reliable?

The Resource Adequacy function of PlanOS is a system simulation program that models the generation system, the interconnections between areas, and the chronological hourly demand. The software models the system in great detail with accurate recognition of random events such as equipment failures, as well as deterministic rules and policies that govern system operation.

This software can model any number of areas and pools to study multi-area issues such as:

- Probabilistic resource adequacy assessments against regional system regulations and standards (e.g. NERC PROB-A in the U.S.)
- Generation system adequacy
- Installed capacity requirements
- Benefits of reserve sharing
- Effects of additional transmission capacity
- Need for implementing emergency operating procedures
- Reliability impact and capacity value of variable resources such as wind and solar
- Influence of energy storage

A chronological, sequential Monte Carlo simulation forms the basis of the model. The Monte Carlo method provides a fast, versatile, and easily expandable environment that can be used to fully model various generation and reserve sharing options. The Resource Adequacy function of PlanOS models different resource types including thermal, energy storage, hydro, and variable resources (wind, solar, etc.). And the simulation reports the following reliability indices on both an isolated (zero ties between areas) and interconnected (using the input transfer limits between areas) system basis:

- Daily LOLE (loss-of-load expectation, in days/year)
- Hourly LOLE (hours/year)
- LOEE/EUE (loss-of-energy expectation/ expected unserved energy)
- Frequency of outage (outages/year)
- Duration of outage (hours/outage)
- Need for initiating emergency operating procedures (days/year and hours/year)

Reduce Simulation Time with High Performance Computing (HPC)

Large simulations can take a significant amount of time to process on standard desktop hardware. With the optional Client-Server Manager, these simulations can be run on HPC resources, so rather than running through the entire study on one machine, it can be split into blocks and sent to a separate machine/node. This allows the work to be done in parallel, greatly reducing the amount of time required for a single study. Once processed, the data is then merged, allowing the user to view the results of the study as if it had been executed on a single machine.

With PlanOS you can plan for

TOMORROW'S GRID, TODAY.

HOLISTIC ASSESSMENTS AND STUDIES

With our inhouse experts, we can provide your team holistic studies that include:

- Power economics assessments and software tools that determine economic feasibility
- Grid stability and integration studies that evaluate the grid, transmission and distribution, and pathways to integrate conventional, renewable and emerging power sources; grid code compliance and specialty hardware products
- Carbon management consulting that inform customers' strategies to lower their greenhouse gas and carbon footprint.

POWER ECONOMICS AND SOFTWARE
Is a project worth building?

GRID STABILITY AND INTEGRATION
Can a project safely interconnect and reliably operate?

CARBON MANAGEMENT CONSULTING
Can you operate sustainably in the future?

WE HAVE
~140
ENERGY EXPERTS

THROUGHOUT
12
COUNTRIES

AND MORE THAN
100
PATENTS

PROJECT LEVEL STUDIES

- Is it worth building?
- Can it safely interconnect?
- Does the investment justify upgrades?
- What is the right technology?

SYSTEM LEVEL STUDIES

- Can the system operate with new projects?
- Can frequency and voltage stay stable?
- What technology is needed?
- What market rules to consider?

Powered by

PlanOS:

Power Flow

Production Cost

Resource Adequacy

Capacity Expansion

For more information, contact:
www.gevernova.com/consulting

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