SOLUTION PAPER

STABILITY BY DESIGN: WAMPAC FOR A DYNAMIC GRID

This solution paper will explore:

- The next era of grid operations
- A new approach to maintaining grid stability
- GE Vernova's WAMPAC: A continuous stability management solution
- Transforming grid stability operations

GridOS® Orchestration Software GridBeats™ Software-defined Automation

EXECUTIVE SUMMARY

Grid is becoming increasingly dynamic, reshaping how utilities maintain system stability. Greater visibility alone is no longer enough to manage rapidly changing grid conditions. Utilities need to continuously connect system awareness with operational understanding and response. This requires monitoring, analysis, protection, and control to work as one operational process. The shift is from observing grid conditions to continuously maintaining system stability. We define this approach as the Continuous Stability Operating Model.

GE Vernova's Wide-Area Monitoring, Protection and Control (WAMPAC) brings together GridOS® software and GridBeats™ technologies to enable this operating model. GridOS® provides wide-area visibility, analytics, and operational understanding of dynamic grid behavior. GridBeats™ extends understanding into coordinated protection, automation, and control across the network. Together, they connect synchronized measurement and analysis with timely operational action. This helps utilities identify emerging risks, coordinate response, and maintain secure system operation.

The result is a more integrated approach to operating increasingly dynamic grid networks.

AN INTEGRATED APPROACH TO WIDE-AREA MONITORING, PROTECTION AND CONTROL

01 The next era of grid operations

The grid is entering a fundamentally different operating environment. The rapid growth of inverter-based resources, battery energy storage systems, HVDC interconnections, and increasingly dynamic power flows is changing the behavior of grid networks, making system dynamics more complex, operating margins narrower, and grid conditions more volatile. Utilities have responded by investing in the synchrophasor technology, wide-area monitoring systems, and advanced protection to improve visibility across the network. These investments have significantly strengthened the industry's ability to observe dynamic system behavior, providing operators with unprecedented awareness of conditions across geographically dispersed grid assets.

However, the new challenge is no longer confined to observability. Maintaining stability in grid systems now requires a continuous transformation of operational data to enable coordinated decisions and timely grid response. This ability requires monitoring, analysis, protection, and control to operate as an ongoing, integrated process that enables utilities to anticipate changing system conditions, coordinate action with confidence, and maintain secure grid of system performance.

02 A new approach to maintaining grid stability

Grid stability has traditionally been approached through a collection of independent operational capabilities; wide-area monitoring identifies changing system conditions, analytics provides additional operational context, protection systems respond to predefined events, and control actions are executed through separate operational workflows. While each capability plays an essential role, they often operate sequentially, relying on operators to connect information, assess system conditions, and coordinate response. This fragmented approach limits the speed and consistency with which utilities can respond to evolving grid conditions.

A more resilient approach demands these capabilities to function through a single, interconnected workflow, where each step continuously informs and strengthens the next.

Continuous Stability Operating Model	
Sense	Capture synchronized measurements across the grid network.
Understand	Interpret dynamic system behavior in real time.
Assess	Evaluate stability conditions and determine operational priorities.
Coordinate	Align protection, automation, and operational response.
Respond	Execute timely corrective actions across the network.
Validate	Confirm system response and continuously maintain operational confidence.

This operating process fundamentally changes the role of wide-area technologies. Instead of functioning as independent monitoring, protection, or control systems, they become part of an integrated operational capability that transforms system behavior into coordinated operational action. The value of the operating model lies in its ability to connect every stage into a closed operational loop that continuously maintains grid stability as system conditions evolve.

03 GE Vernova's WAMPAC: A Continuous Stability Management solution

GE Vernova's WAMPAC* is purpose-built to deliver this capability by bringing together industry-leading hardware, software, and automation portfolios into a single solution for modern grid operations.

It enables wide-area monitoring, protection, and control to operate as a continuous operational capability, helping utilities detect, understand, and respond to changing system conditions with greater speed, confidence, and coordination.

At the core of GE Vernova's WAMPAC is an integrated architecture that aligns with every stage of the grid stability lifecycle. High-speed synchronized measurements establish a trusted view of dynamic system behavior across the network.

Advanced wide-area applications continuously interpret those measurements to provide operational understanding of oscillations, angle stability, inertia, disturbances, and evolving system conditions.

Protection, automation, and coordinated control then translate that operational understanding into deterministic actions across geographically distributed grid assets, while continuous validation confirms system response and provides operators with confidence as conditions continue to evolve.

Every stage reinforces the next, creating a closed operational loop rather than a sequence of independent technologies.

Implementing the Continuous Stability Operations Workflow

Sense

GE Vernova's wide-area measurement infrastructure captures synchronized, high-resolution phasor measurements across the grid network using Phasor Measurement Units (PMUs), Phasor Data Concentrators (PDCs), precision time synchronization, and resilient communications. Together, these capabilities provide the high-quality data foundation to accurately observe fast-changing system behavior across geographically dispersed assets.

Understand

GridOS® WAMS transforms synchronized measurements into operational understanding through advanced wide-area applications that continuously interpret dynamic system behavior. Capabilities including oscillation monitoring, disturbance analysis, effective inertia monitoring, linear state estimation, voltage and angle stability assessment, phasor analytics, and event replay help operators understand not only what is happening across the network, but why it is happening and what it means for system stability.

Assess

By continuously evaluating changing stability conditions, GridOS® WAMS helps operators identify emerging risks, assess system impacts, and determine the most appropriate operational response before localized disturbances develop into broader reliability events. This enables a proactive approach to maintaining grid stability.

Coordinate

GridBeats™ portfolio, specifically the Universal Control Platform (UCP), but also including PMU, Phasor Data Concentrator, Device Management, Substation PDC, and Gateway extends operational understanding beyond the control room by connecting protection, automation, and wide-area control into a coordinated operational response. Remedial Action Schemes (RAS), SIPS, adaptive protection, controlled islanding, system restoration, and distributed automation work together to ensure that geographically dispersed assets respond as a coordinated system rather than independent devices.

Respond

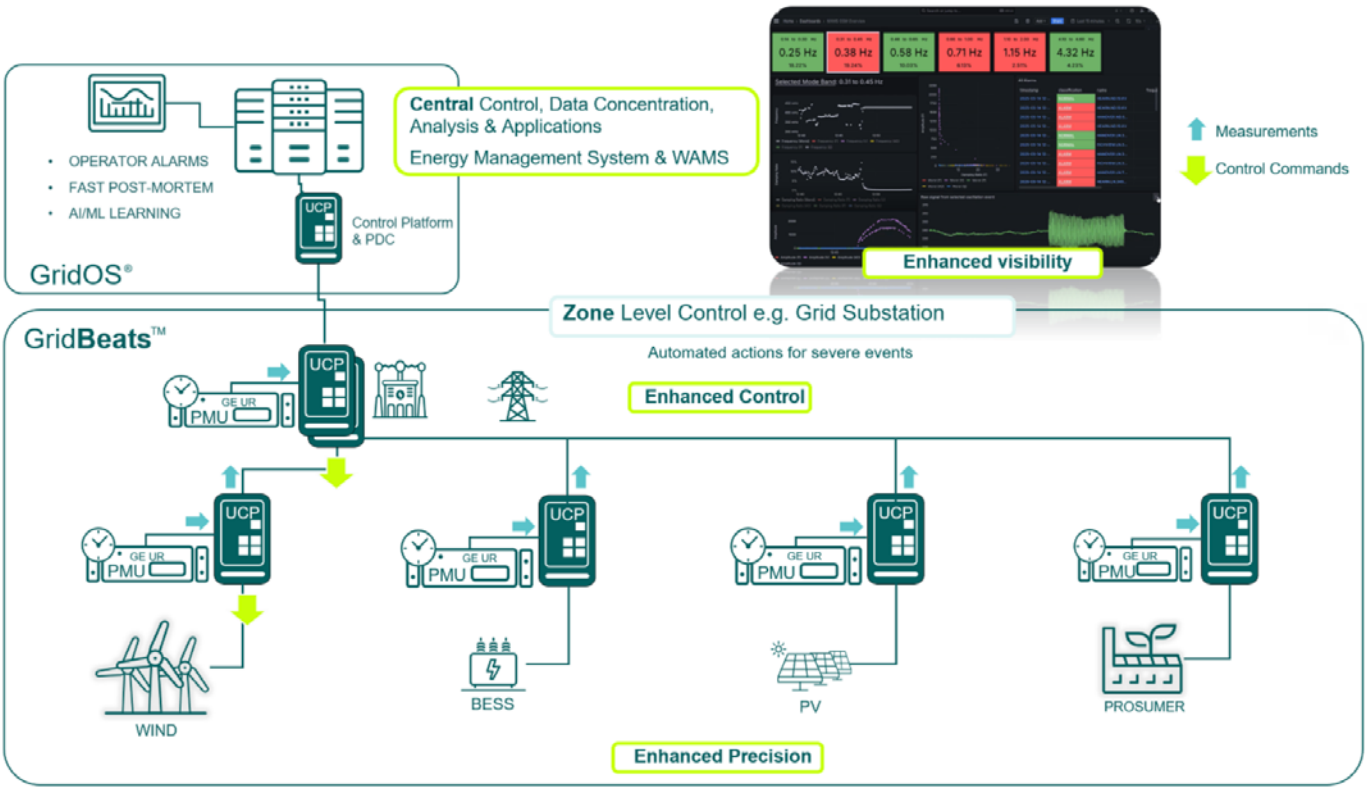
Modern grid networks require deterministic execution when system conditions change rapidly. GE Vernova's WAMPAC enables low-latency operational response through coordinated protection and wide-area control, ensuring that corrective actions are executed with the speed, precision and reliability required to preserve grid stability during complex system events.

Validate

GE Vernova's WAMPAC continuously validates system response following operational actions, enabling operators to confirm expected outcomes, monitor evolving conditions, and refine future operational decisions. This continuous feedback loop strengthens operational confidence and enables utilities to adapt to increasingly dynamic grid conditions.

One integrated architecture. One continuous operational workflow.

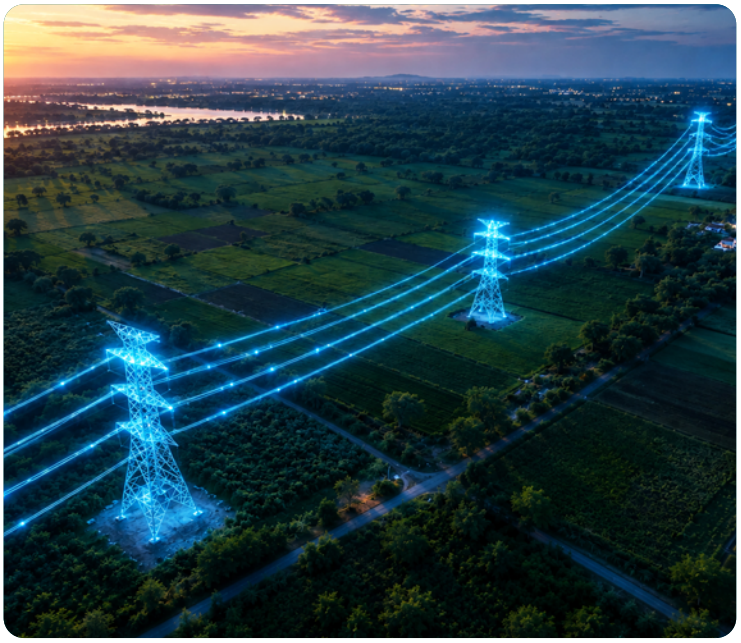
The strength of GE Vernova's WAMPAC lies in the way every component is engineered to support a common operational objective. Synchronized measurement provides the foundation. GridOS® WAMS transforms data into operational understanding. GridBeats™ coordinates protection and control. Together, they create a continuous operational workflow that enables utilities to maintain grid stability with greater confidence, speed, and resilience.



04 Transforming grid stability operations

The evolution of the grid demands a different way of operating; one that continuously connects system awareness, operational understanding, and coordinated response into a single operational process.

The Continuous Stability Operating Model represents a new approach to maintaining grid stability, while GE Vernova's WAMPAC brings that operating model to life through one integrated solution. The future of grid stability will be defined not by the technology utilities to deploy, but by how effectively they operate them together.



Note: WAMPAC Is a joint solution built using the combined capabilities of GridBeats™ and GridOS® software.

GridOS® Orchestration Software

GridBeats™ Software-defined Automation

Powering grid intelligence

FROM CONTROL ROOM TO EDGE

Get in touch with a GE Vernova expert

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