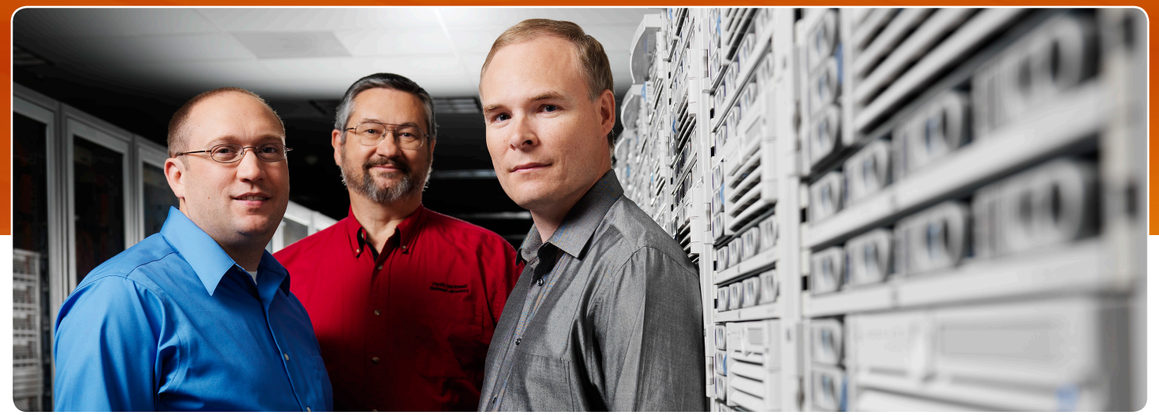

Access to Pacific Northwest National Laboratory's supercomputer and the high-speed connection to the Energy Sciences Network allows the EIOC to develop, test and demonstrate new technologies.

ADVANCED MARKET OPERATIONS

In the future, grid operations will rely as much on indirect, market based "control" of customer and third-party resources as they will on direct control of grid assets. The Pacific Northwest Smart Grid Demonstration Project, managed by Battelle, is the largest smart grid demonstration in the nation testing a transactive control system that coordinates responsive assets to incentivize energy efficiency. As the project's nexus, the EIOC gathers and evaluates data from across the region's power system. Using the center's advanced data management and computing facilities, this smart grid demonstration project has a fully operational shadow market dispatching demand response, as well as distributed generation for grid benefits across the Pacific Northwest—all managed by the EIOC network.

Additionally, the EIOC will monitor the markets for these services and the response of individual homes and businesses to them, and portray their performance and impact in essentially real-time over a web based interface. Further expansion opportunities will involve improved testing facilities for grid technologies, use of PNNL-developed web-based control interfaces, and other projects directed at lower customer energy costs and improving performance.

GRIDOPTICS™ POWERNET TESTBED

The EIOC is the hub for the GridOPTICS™ powerNET Testbed, a remotely accessible, multi-user, experimental user facility focused on enabling cutting edge power system and Smart Grid research. PowerNET users benefit from quick experiment setup, access to real power system equipment, sandbox environment where new ideas can be tested, and a collaborative scientific environment for sharing data and experimental configurations. By integrating real world equipment with virtual and simulation capabilities to create a dynamical resource for grid configuration, powerNET visualizes the future power grid at the EIOC.

ABOUT PNNL

Pacific Northwest National Laboratory, a U.S. Department of Energy Office of Science laboratory, solves complex problems in energy, the environment, and national security by advancing the understanding of science. PNNL employs more than 4,000 staff, has a business volume of approximately $1 billion, and has been managed by Ohio-based Battelle since the lab's inception in 1965.

The EIOC draws upon the expertise and capabilities of many organizations and entities, including DOE's Gridwise program, the Northwest Center for Electric Power Technologies, and the Department of Homeland Security's National Visualization and Analytics Center.

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Pacific Northwest NATIONAL LABORATORY
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U.S. DEPARTMENT OF ENERGY

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Electricity Infrastructure Operations Center

ADVANCING TECHNOLOGIES FOR THE INTEGRATED ENERGY SYSTEM

The Electricity Infrastructure Operations Center (EIOC) at Pacific Northwest National Laboratory serves as a unique platform for researching, developing and deploying technologies to better manage and control the grid. It's a national asset that brings together industry-leading software, cutting edge visualization, real-time grid data and advanced computation into a fully capable control room. Shaped with input from utilities, technology vendors and researchers across the Nation, the EIOC allows industry groups and power sector professionals to train grid operators and do contingency analysis.

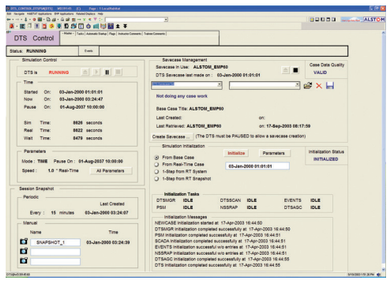
As a platform for energy system research and development, the EIOC's founding philosophies are to encourage the leveraging of tools and facilities by utilities and industry, expand research and facilitate collaboration.

U.S. DEPARTMENT OF ENERGY

STATE-OF-THE-ART FACILITY

Advances in information and communication technologies are creating a more complex and dynamic power grid calling for new approaches to monitor and control the system. The EIOC leverages PNNL's resources in energy research, math and computer science to tackle this challenge. Its 23-foot-wide video wall system provides seamless visualization of incoming data from multiple sources, such as real-time streaming syncrophasor data, market statistics and environmental information. Integrated with the National Visualization and Analytics Center™ (NVAC), the system delivers advanced visualization of power system operation so analysts can better maintain system-wide health, prevent security breaches and prepare for energy demand influxes.

GRID RESEARCH AND DEVELOPMENT PLATFORM

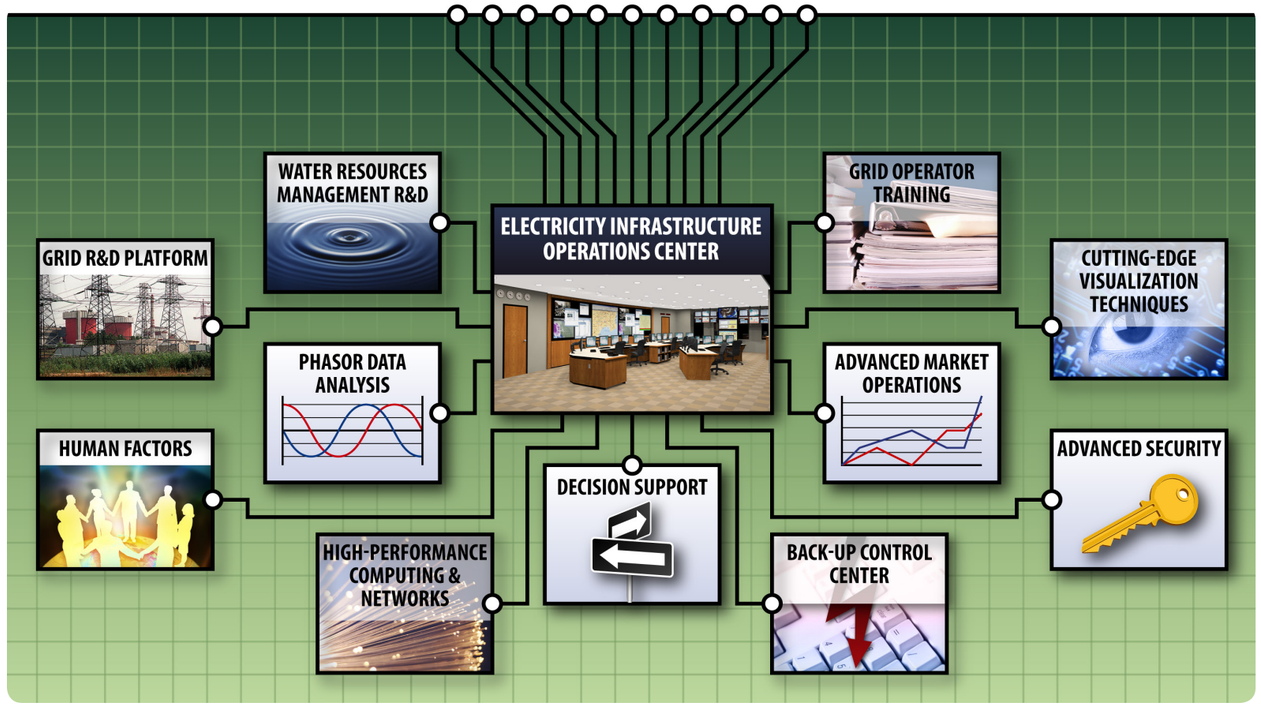


The EIOC incorporates energy management system (EMS) software and other new and existing tools for managing the energy system.

The EIOC is a working grid operations center, complete with live data feeds from actual utility syncrophasor and SCADA systems. The control center operates with a multimillion-dollar energy management system (EMS) software package from leading developer Alstom. The software provides a foundation for the EIOC's users, enabling utility data to be imported from major regional utilities to allow more accurate planning for consumer power needs. Using the computer hardware, operator consoles and displays, communications links, and display and control software, the EIOC can manage the transmission and subtransmission networks of regional utilities. It is a fully functional test bed for emerging technologies in grid analysis, advanced visualization, cyber security, high-performance computing, and integrating human factors.

INTEGRATING CAPABILITIES

The EIOC bridges the capabilities of today's grid control center to tomorrow's complex energy operations. Not only does the EIOC help define the current performance of the overall energy system, it also focuses on how specific technologies or other operational changes can improve it.



VISUALIZING THE FUTURE POWER GRID

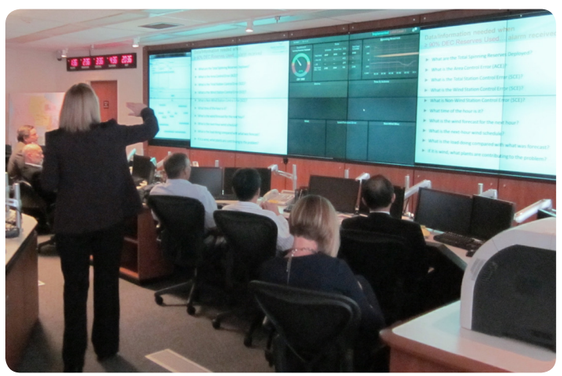
Advanced visualization tools directly support situational awareness, a key factor helping grid operators understand the current environment and accurately anticipate future problems. The EIOC's advanced visualization tools allow for targeted special and temporal representations of the grid, translating system parameters into actionable information for grid operators.

HIGH-PERFORMANCE COMPUTING

The EIOC is the first control center environment to demonstrate the ultra highspeed computational capabilities that make state estimation and contingency analysis processes run at speeds only capable with modern super computers. Connection to the Energy Sciences Network (ESnet) provides ultra high-speed access to DOE and other collaborators. The control center is equipped with an extensive state-of-the-art virtual infrastructure. This virtual infrastructure provides a safe place to house different types of data, which is backed up on a monthly, weekly or daily basis depending on the needs of the project.

CYBER SECURITY

The Center develops capabilities to protect the cyber-based systems that monitor and control our nation's critical infrastructure. The Intrisically Secure Computing™ research center at the EIOC uses trusted base, adaptive defenses, and appropriate responses while incorporating self-organizing, self-healing, and self-optimizing processes. The Center's capabilities help PNNL in its task to evaluate the cyber security plans of all smart grid investment grant projects nationwide.



PNNL-developed tools for power grid applications have been demonstrated and evaluated in the EIOC.

PHASOR DATA

Access to real-time phasor data allows over-the-horizon visibility of the entire power grid.

By displaying real-time phasor data representing grid conditions nationwide, the EIOC supports wide-area measurement systems (WAMS) for the western grid and further deployment of the Eastern Interconnection Phasor Project (EIPP) for the DOE. Regional phasor data networks support grid operators to maintain "over-the-horizon" situational awareness and strengthen homeland security and emergency management capabilities, while access to stored phasor data reaching back to June 2005 bolsters contingency analysis capabilities.

TRAINING THE NEXT GENERATION OF GRID OPERATORS

The EIOC's control center can be leveraged to provide training for grid operators. Training can range from basic and refresher courses for operator licensing to advanced training in the use of new technologies for the grid or its control, data from new kinds of sensors, national security-related contingencies and procedures, and advanced visualization and computational techniques. Through its capabilities, the Center bolsters human factor concepts, situational awareness, cognitive representations (mental models), socio-technical elements such as trust in people and systems, communication engagement and semantics, and traditional issues including workload and ergonomics.

LOOKING TO THE FUTURE

As the user-base for the EIOC grows, additional capabilities and facility expansion continue. These plans will position the EIOC as a national center for grid research and control. A few of these concepts include: Cutting-edge visualization techniques and advanced grid modeling. While grid telemetry becomes richer and more prolific, operators are faced with the complex task of quickly gleaning information from more and more complex sets of data. At the same time, planners are confronted with a vast amount of options to configure the grid of the future. Both will need support to turn the large amount of information and technological capability into results benefitting both current and future grid.