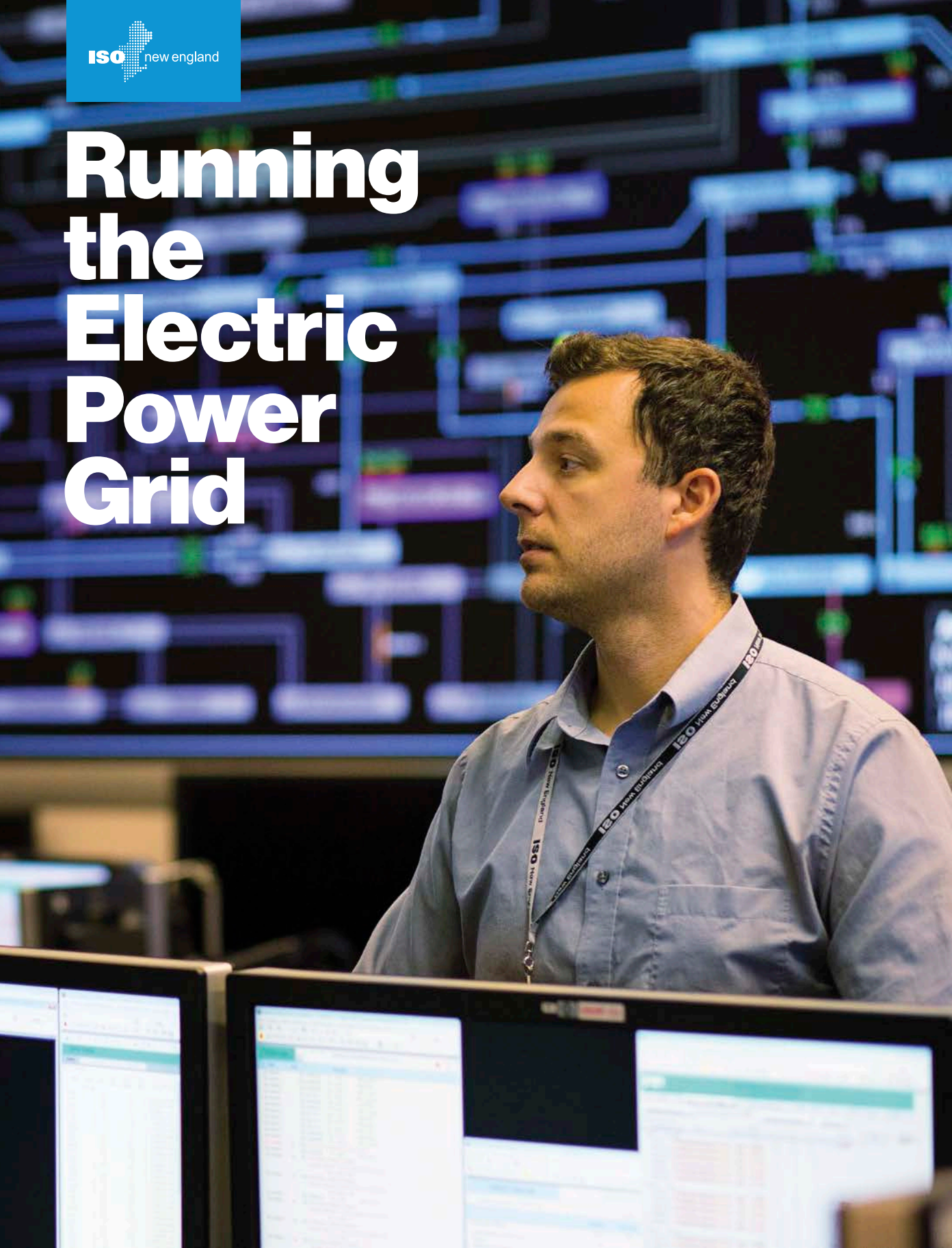
ISO new england

Running the Electric Power Grid



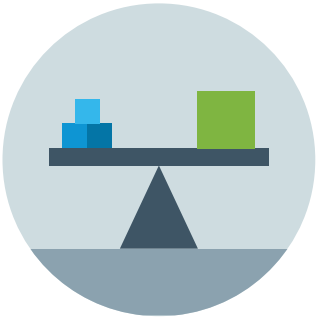
Your electricity needs never stop, and neither do we.

—

We keep power flowing across New England.

Inside Our Control Room

Before electricity is delivered to your street, it's generated and transmitted over "the grid" – the region's high-voltage electric power system. It's ISO New England's job to **forecast**, **dispatch**, and **monitor** the flow of this high-voltage electricity every minute of every day. We do it all from a central control center in Holyoke, Massachusetts.

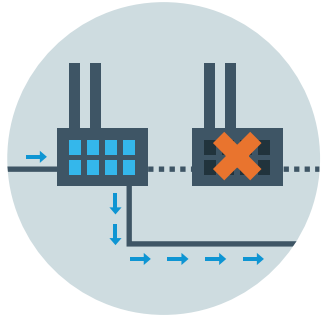


Balancing Electricity Supply and Demand – Instantly

ISO New England coordinates hundreds of diverse power resources and thousands of transmission components that must all work together to supply just the right amount of electricity to meet the region's demand, which changes every time someone flips a switch. If too little electricity is generated, lights don't come on. Too much could damage the system.

Managing Unexpected Risk

The grid must also withstand the sudden loss of a power plant or transmission equipment caused by weather, mechanical failure, or other triggers. While having a large, interconnected system helps achieve highly reliable electric service, a localized problem can quickly cascade across the region – and beyond. The ISO follows hundreds of stringent federal standards and regulations so that small problems do not become big interruptions in regional power supply.



NEW ENGLAND'S ELECTRIC POWER SYSTEM IS...

Complex:
8,600 miles of high-voltage transmission lines and over 300 generators span the six states, with 13 interconnections to neighboring systems

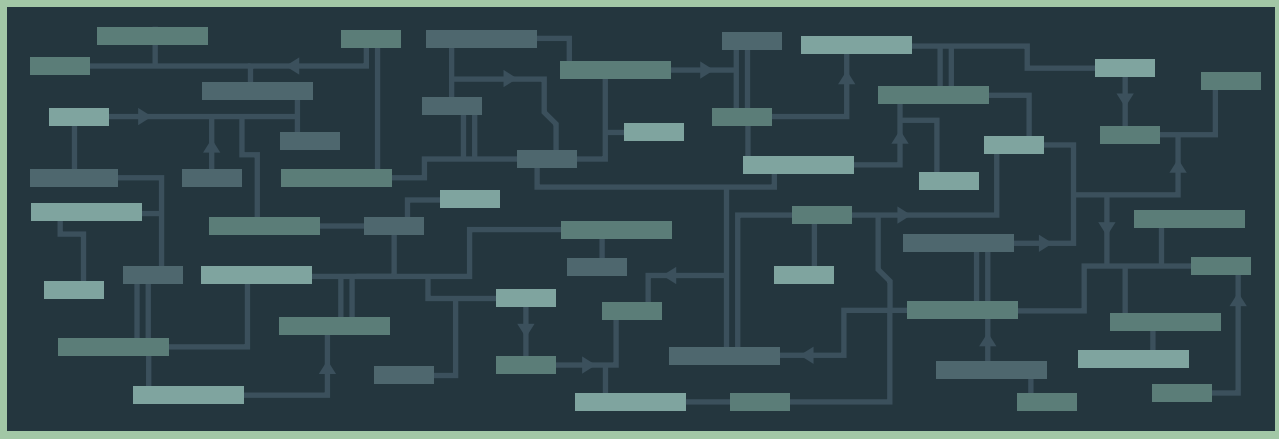
Challenging:
Heat waves, hurricanes, cold snaps, and ice and snow storms can damage lines, trip generators, stress fuel supplies, and cause very high or very low demand

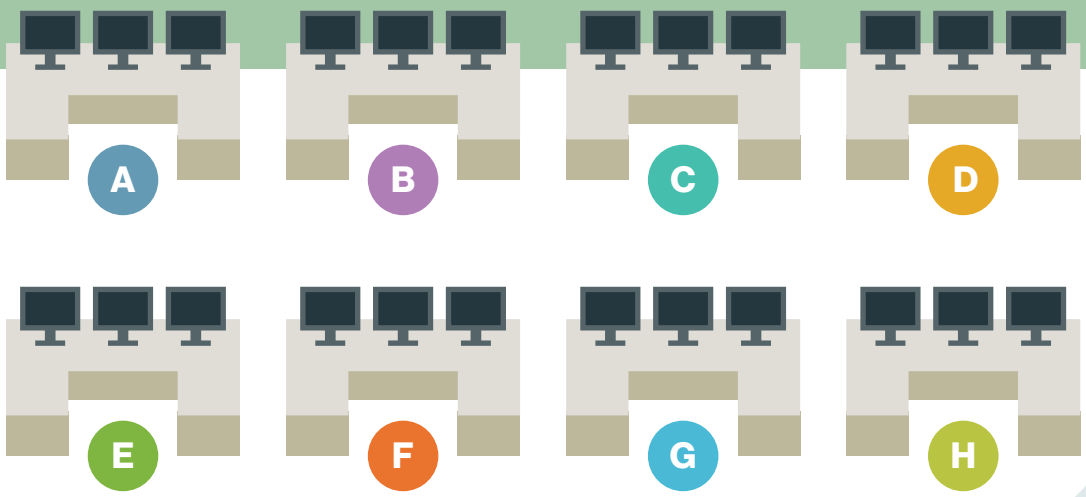
Changing:
Generators powered by natural gas and weather-dependent sources (wind and sun) are replacing coal, oil, and nuclear resources

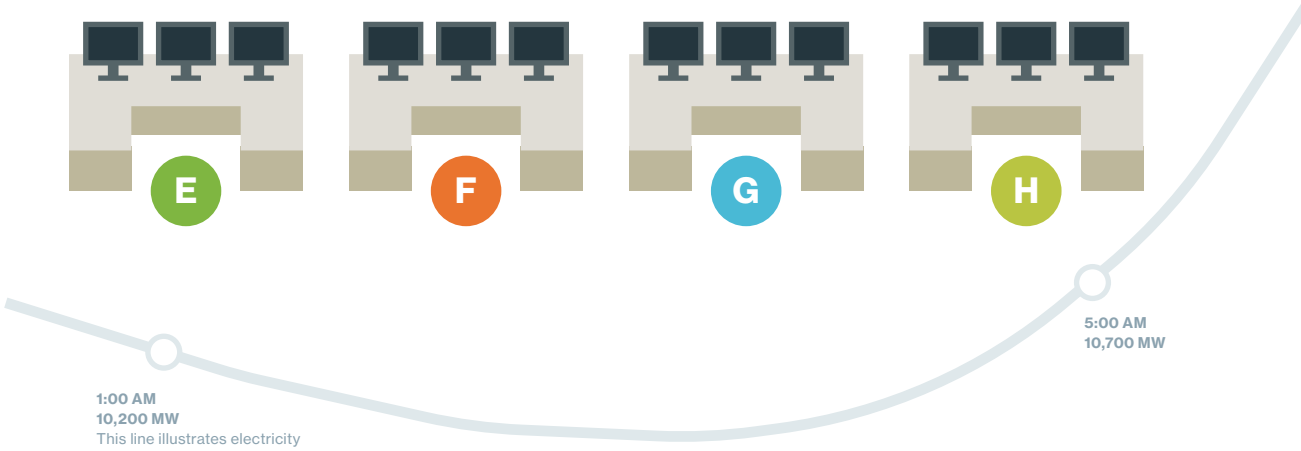

ISO new england
ISO new england
ISO new engla
AGC ON TLBC
NB Transfer NORMAL
SSCM NORMAL
Area ACE
NYISO 0
NBSO -20
ISO 43
Area ACE
PJM 98
MISO 37
TVA -159
Oct 22

Meet Our System Operators

Six teams of system operators alternate 12-hour shifts to keep the ISO control room staffed around the clock.







This line illustrates electricity demand for a typical spring day in New England

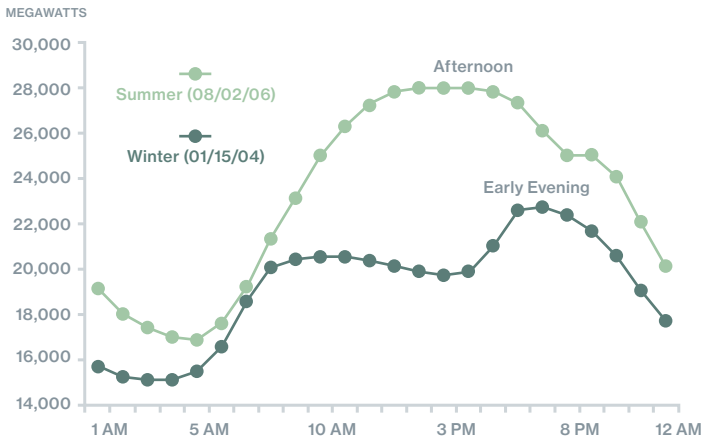
Developing the Operating Plan

The **Forecaster** (F) estimates tomorrow's hourly regional demand for electricity by analyzing multiple weather forecasts, historical weather and demand data, economic trends – even the schedules for major televised sporting events. The forecaster then determines which generating resources will run each hour and how much electric energy they'll provide, taking into consideration their operating parameters and transmission constraints. Sophisticated software selects the resources offering to produce electricity at the *lowest price* in the energy market where wholesale electricity is bought and sold. Because electricity can't yet be stored efficiently in large quantities, the forecaster also schedules resources to be in reserve and ready to provide power within 10 minutes and 30 minutes in an emergency.

10:30 AM
14,300 MW
The work day is in full swing; businesses and offices are using power for lights, computers, and equipment

7:00 AM
13,450 MW
People are waking up and turning on lights and appliances

THE DEMAND CURVE



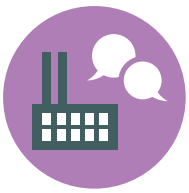
There's a regular pattern to the day's electricity use, but the exact amount can vary by season, day of the week, and more. Every variation affects how we run the system. The ISO must closely analyze trends in electricity production and use, such as the increase in energy efficiency and solar power that are dramatically affecting the pattern of demand on the grid. This graph shows the pattern on the days with the highest seasonal demand recorded by the ISO.

Responding to Real-Time Conditions

Power resources get their hourly schedule a day in advance, but anything can happen during the operating day. Demand can surge with hotter-than-expected conditions. A generator may trip off line or change its bid prices in response to real-time operating factors. A neighboring grid may be in trouble. Every 10 minutes, the system operator at the **Load Desk** C reruns the software that analyzes new scenarios for balancing supply and demand. Dispatch instructions are revised, either directing the next available lowest-priced resource to start up or raise output, or telling the more expensive units to reduce output or shut down.

Many ISO system operators have backgrounds running power plants or nuclear submarines. At the ISO, they receive almost a full year of intensive training in the classroom, on simulators, and on the job, and then pass a series of exams to receive independent certification by the North American Electric Reliability Corporation. Training is ongoing.

3:00 PM
13,700 MW



Maintaining Constant Readiness

At the **Generation Desk** B, the system operator communicates with power resources about their ability to perform, alerts the rest of the control room team to developments, and updates software inputs. They also schedule emergency transfers of energy with other control centers throughout the Northeast.

At the **Security Desk** D, the system operator uses computer simulations, run every few minutes, to calculate the effects of possible losses of hundreds of system components. Plans are made for handling those situations with significant impact. If necessary, the system operator directs transmission owners to switch transmission lines or other system components on or off.

ISO system operators rotate their shifts among the load, generation, and security desks to facilitate effective decision-making and team communication.

Keeping Everyone on the Same Page

The **Tariffs, Schedules, and OASIS (TSO) Administrator** (E) coordinates transfers of electricity with neighboring grid operators in New York, Québec, and New Brunswick. These transfers allow lower-cost electricity to flow into the region and can help during emergencies.

Outside the control room, the ISO manages the maintenance or repair schedule for transmission lines and generators, so that when these resources go off line, power system performance is not compromised. We process thousands of outage requests every year.

7:00 PM
14,500 MW
People are returning to their homes, turning on lights, and cooking dinner

9:30 PM
13,300 MW
As people go to bed, electricity demand decreases

The **Senior System Operator** (G) and **Shift Supervisor** (H) oversee control room activities. If abnormal conditions develop, they'll keep ISO management and federal regulatory agencies informed. The ISO has comprehensive communication protocols in place for alerting the public of serious issues.

A **spare station** (A) is staffed in emergencies and used for training.

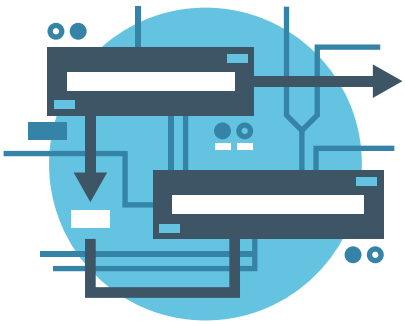
12:00 AM
10,400 MW


ISO new england
ISO new england
RTNET NORMAL
RTCA NORMAL

Tools of the Trade

Visualizing the Grid in Real Time

ISO New England's state-of-the-art, 4,000-square-foot control room is regularly enhanced with the latest tools and alarms that enable system operators to rapidly assess real-time conditions at every point on the grid.



The 60- by 15-foot digital wallboard displays:

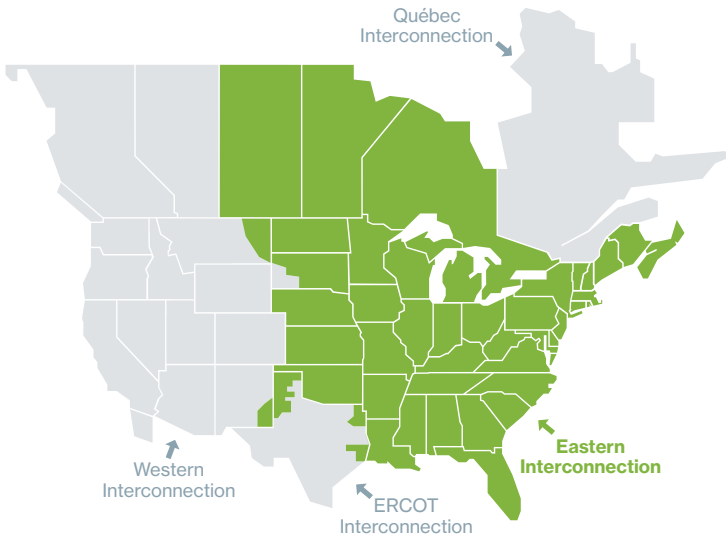
- A dynamic, real-time representation of the six-state generation and transmission system in relative geographic location
- All major substations, all 345 kilovolt (kV) and 230 kV transmission lines, and most 115 kV transmission lines
- Live feeds continuously updated with generating unit output, transmission line voltages, electricity flow amount and direction, system frequency, and other data

Side monitors display power transfers with neighboring regions, news reports, local weather, and regionwide lightning strikes. Desktop monitors display specialized software tools used to run the grid. In total, control room staff can access over 3,000 screens of grid operations information, which are run on hundreds of computer servers and data-storage systems. A 24-hour technical support staff manages these systems.

Entry into the control room is restricted because of critical equipment and sensitive information. Fully redundant systems at a backup control center enable ISO system operators to seamlessly continue to manage the grid in the unlikely event that the room becomes inoperable or must be evacuated.

Taking the Grid's "Pulse"

New England is part of the Eastern Interconnection, one of four major power grids in North America. Considered one of the largest machines in the world, all its components must work synchronously. To make this happen, each grid operator within the interconnection must keep its **system frequency** (the "speed" of the alternating current) as close to 60.0000 hertz as possible. It's that precise.



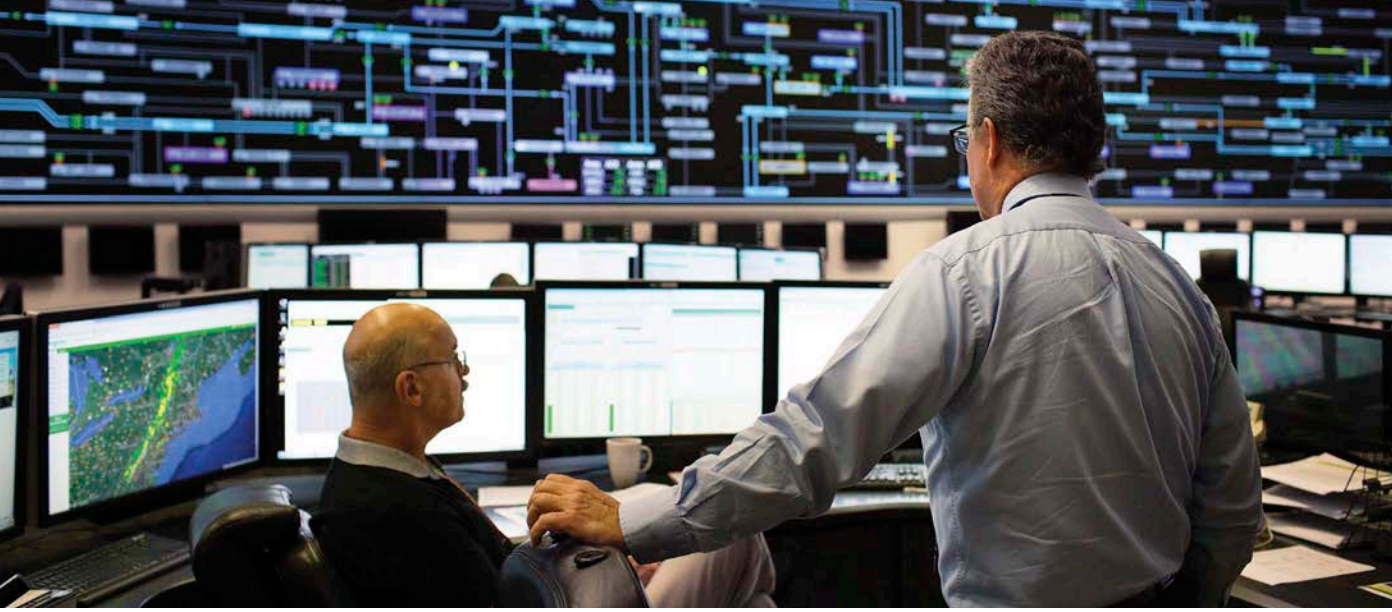
System frequency fluctuates constantly with changes in supply and demand. ISO New England sends automated signals to power resources that can make tiny changes in output to balance frequency throughout the day. A sudden loss of supply (a problem with a power plant or transmission equipment) or demand (a large power outage on a local distribution system) could disrupt that balance in an instant. ISO system operators move quickly to restore the frequency level by issuing instructions to generators to raise or lower output or by scheduling emergency transfers of energy to or from neighboring power systems. Our neighbors' indicators are also displayed in the control room, so we're aware when problems are brewing and can take action to help.

Transmission voltage (the "strength" of the electrical current) must also be kept in constant balance to protect system equipment and keep power flowing. The wallboard highlights areas with high or low voltage conditions to alert ISO system operators, who coordinate action with the six subregional control centers operated by transmission companies.

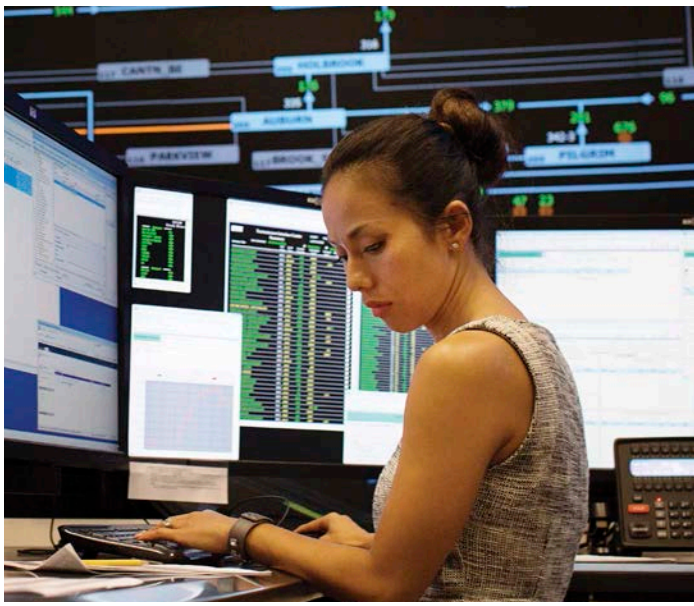
Teamwork. Being able to think on your feet. Staying calm.

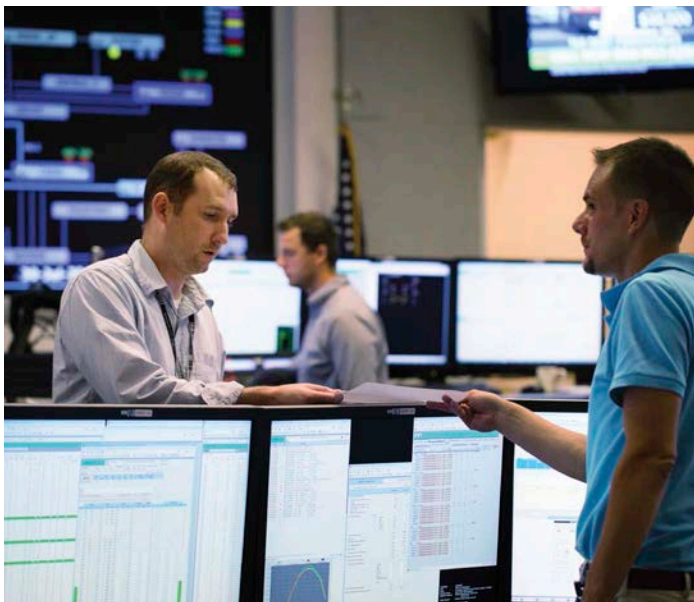
—

There's a new challenge almost every day.




AGC ON TLBC
NB Transfer NORMAL
Jul 30
19:25:20
ACE
NYISO 18
NBSO 14
IESO -110
Area ACE
PJM 645
MISO -37
TVA -15





See What's Happening on the Grid Right Now

iso-ne.com

isoexpress.iso-ne.com

iso-ne.com/isotogo

isonewswire.com

@isonewengland

About ISO New England

Since 1997, ISO New England has been working to ensure the reliable flow of competitively priced wholesale electricity that keeps New England's homes, businesses, and public services up and running. Our mission includes three critical responsibilities:

- Direct the production and flow of high-voltage electricity across the six-state power grid, every minute of every day
- Design and run the region's markets where wholesale electricity is bought and sold
- Direct power system planning to ensure a reliable electricity supply in the region for years to come

We neither own nor maintain the regional power system's infrastructure, nor do we have a stake in companies that do. This independence allows us to make objective decisions and ensure fair access to grid service for all entities buying, selling, and transporting wholesale electricity. The Federal Energy Regulatory Commission defines our authority and responsibilities. **Learn more at www.iso-ne.com/about.**

ISO new england

One Sullivan Road
Holyoke, MA 01040

www.ISO-NE.com