

Who lets the grid act on its own?

Load is growing faster than at any time NERC has measured, and some of it now moves in seconds. AI can help operators keep up, but the binding constraint is not the model: no utility has written down which grid decisions a machine may prepare, propose or take.

By the 6th Wave R&D team · 15 minute read

At 7:56 AM on July 22, 2026, about 3,800 megawatts of large load in Dominion's zone of PJM "disconnected and transferred without warning." PJM's load fell from 99,984 MW to 96,205 MW in moments. Operators dispatched generation down and brought in reactive resources to hold voltage, and the area control error recovered within nine minutes. PJM called it "the largest such event in PJM history."¹ Two years earlier, on July 10, 2024, a single 230 kV fault in the same region had dropped about 1,500 MW of data-center load that NERC said "was not anticipated by the BES operators."² The operators did their jobs both times. The events still happened faster than any person could have decided anything.

That is the shape of the problem for the next decade. The grid is gaining load faster than at any point since NERC started tracking in 1995, the new load behaves like no load before it, and the people who run the system are being asked to decide more, faster, with less experience in the room. Artificial intelligence is the obvious help, and every major operator is now testing it. But the question that will decide whether AI makes the grid safer is not which model to buy. It is which decisions a machine is allowed to prepare, which it may propose, and which, if any, it may take on its own. In 2026 almost no utility or grid operator has written that down.

The load is outrunning the control room

NERC's 2025 Long-Term Reliability Assessment, dated January 2026, forecasts aggregated summer peak demand rising by more than 224 GW over ten years. That is 69 percent higher than the 132 GW projected only a year before. Winter peak growth is forecast at more than

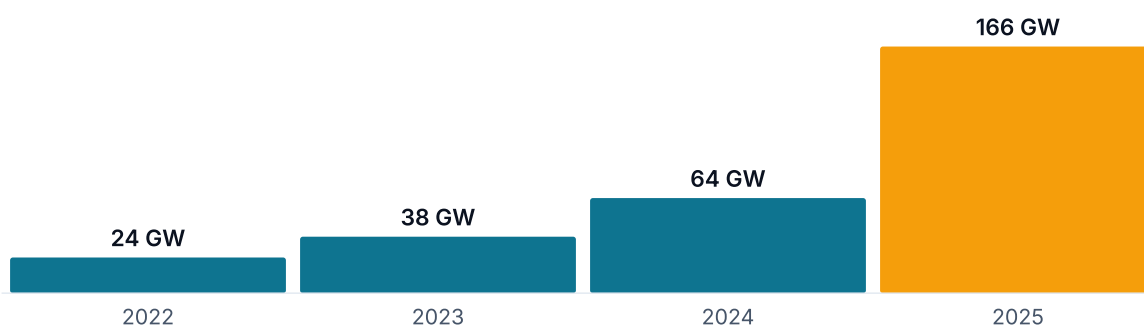
245 GW, up 65 percent from 149 GW. Both growth rates are "the highest since NERC's tracking started in 1995," and 13 of 23 assessment areas face resource adequacy challenges.³ Data centers for "artificial intelligence and the digital economy account for most of the projected" growth.³

The forecasts have been moving faster than the grid. Grid Strategies' November 2025 load growth report found that the five-year utility forecast of peak growth rose more than six-fold in three years, from 24 GW in 2022 to 166 GW in 2025 (Exhibit 1). About 90 GW of that is linked to data centers, a share the authors judge "likely overstated by roughly 25 GW."⁴ Even after that discount, national electricity use is forecast to grow 32 percent by 2030.⁴ Lawrence Berkeley National Laboratory estimated that data centers used about 4.4 percent of US electricity in 2023 and could use 6.7 to 12 percent by 2028.⁵

EXHIBIT 1

The five-year forecast of US peak load growth rose more than six-fold in three years

Five-year summer peak growth in utility forecasts, GW, by year of forecast



Source: Grid Strategies, *Power Demand Forecasts Revised Up for Third Year Running, Led by Data Centers*, November 2025. Roughly 90 GW of the 2025 figure is linked to data centers.

New generation is not arriving at the same speed. LBNL's 2025 *Queued Up* report counts about 10,300 active projects, 1,400 GW of generation and about 890 GW of storage waiting to connect. The median time from request to commercial operation has gone from under two years for plants built from 2000 to 2007 to more than four years for those built from 2018 to 2024, and only 13 percent of capacity that asked to connect from 2000 to 2019 had reached operation by the end of 2024.⁶ Operators will run a tighter system for years, with more inverter-based resources that, as NERC puts it, "increase the complexity of planning and operating a reliable grid."³

The new load moves in seconds

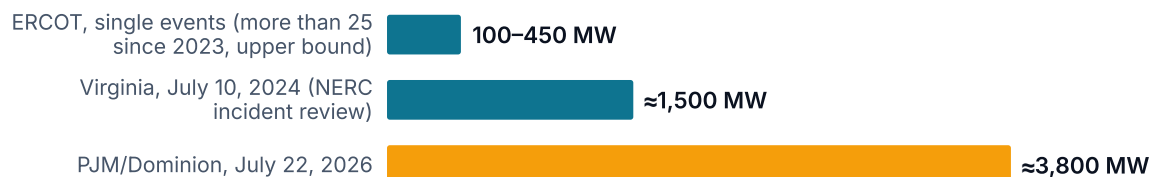
What changed in 2024 to 2026 is not only how much load is coming but how it behaves. Large computational loads protect themselves. When voltage dips, their own controls can transfer them to backup power in a fraction of a second, which looks to the grid like a sudden loss of hundreds or thousands of megawatts. The July 2024 incident involved six successive faults within 82 seconds because line auto-reclose was set for three attempts at each end; load was "disconnected on the customer side by customer protection and controls," and NERC noted the grid "has not historically experienced simultaneous load losses of this magnitude."² ERCOT has faced more than 25 incidents, each losing 100 to 450 MW of large computational load.⁷

NERC's own conclusion is blunt. After a Level 2 alert in September 2025, it reviewed industry responses and issued a Level 3 alert on May 4, 2026, finding that entities "generally did not have sufficient processes, procedures, or methods" to manage these loads. One of its essential actions asks operators to set up communications "and joint operating procedures" with them.⁸ On July 16, 2026, FERC directed NERC to write mandatory reliability standards for computational loads, with filings due December 31, 2026. Citing NERC, the order's commentators note that these load reductions and oscillations occur "in seconds, leaving little or no room for real-time operator response."⁷ PJM's David Souder put the lesson plainly after July 22: "you really need these requirements in place before the load comes on the system."¹

EXHIBIT 2

Large-load events are getting larger, and they outpace manual response

Load lost or transferred in a single event, MW



Source: NERC, *Incident Review: Considering Simultaneous Voltage-Sensitive Load Reductions*, January 2025; Willkie Farr & Gallagher summary of FERC Docket RD26-7000, July 30, 2026; PJM Inside Lines, August 11, 2026.

This is the clearest case yet for automation in grid operations, and it is also the clearest warning. When a disturbance unfolds in seconds, the decision about what to do has to be

made before the disturbance: as a setting, a procedure or a delegated authority. Somebody has to decide in advance what the machine may do when no person can.

The rules a machine would need are partly unwritten

The Iberian blackout of April 28, 2025 shows what happens when they are not. ENTSO-E's expert panel published its final report on March 20, 2026. In the last overvoltage episode before the collapse, "Red Eléctrica's dispatchers were unable to implement manual remedial actions due to the rapid development of the incident." Earlier episodes that day had been brought back under the alarm threshold, "typically less than 5 minutes." The report's root-cause analysis finds that renewable plants "followed a fixed power factor," that "shunt reactors are operated manually, requiring decision-making and processing time," and that many overvoltage protection settings "diverged from applicable requirements."⁹

The finding that matters most for AI is quieter. The voltage-control requirements in Spain's operating procedures were, in the panel's words, "interpreted differently by two generators, the TSO" and others; "some parties had differing interpretations of the applicable requirements." The report adds that "technical rules may become outdated or ineffective over time."⁹ A grid that ran for decades on those rules could not agree, on its hardest day, on what they meant. No model could have applied them correctly, because there was no single correct reading to apply.

The 2003 Northeast blackout, which affected about 50 million people and 61,800 MW of load, carries the same lesson from the opposite side. FirstEnergy's alarm software failed at 2:14 PM, and "neither FE's control room operators nor FE's IT EMS support personnel were aware." Operators "did not know that they were operating without alarms."¹⁰ Automation that fails silently is as dangerous as automation that acts without authority. Both failures come from the same gap: no explicit, tested statement of what the system is supposed to do, what the human is supposed to see, and who decides when they disagree.

The table lists five things every control room relies on that are rarely written down in a form a machine could apply.

What a grid decision depends on, and where it usually lives

Switching and restoration rules	Which switching sequence is safe for this feeder in this configuration, and what the exceptions are. Often in procedures, one-line diagrams and senior operators' memory.
Voltage and protection settings	How each requirement is interpreted, by whom, and as of what date. Iberia showed parties can read the same rule differently.
Escalation thresholds	Which conditions must reach a supervisor, a reliability coordinator or a neighbor before action. Often a judgment call made in the moment.
Large-load procedures	What the operator and the load do when voltage dips. NERC found most entities had none.
Decision rights	Who may approve an action, who must be told, and what a tool may do alone, only propose, or only prepare. Almost never written as a register.

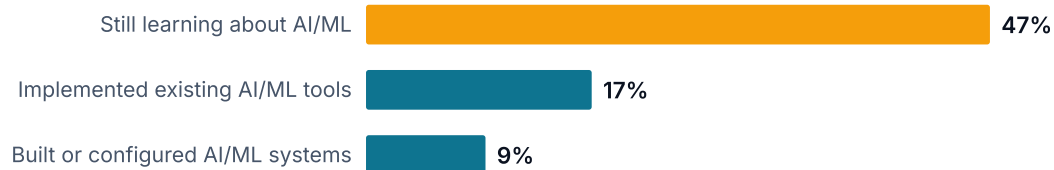
The industry already has the ladder. It has not assigned the rungs

The vocabulary for autonomy exists. NERC's white paper on AI and machine learning in real-time operations defines three modes: Decision-Making Support, in which AI informs a human who decides; Co-Pilot, a partnership; and Active Control, in which AI is "empowered to make decisions, actuate devices... with or without final approval of a human." It warns that "'human-in-the-loop' operation requires explicit design decisions to ensure that it is not in name only," and that active-control systems are "particularly susceptible to 'out of the loop syndrome.'" ¹¹ In NERC's survey of 47 respondents for that paper, 47 percent were still learning about AI and machine learning, 17 percent had implemented existing tools and 9 percent had built or configured systems of their own (Exhibit 3). ¹¹

EXHIBIT 3

Most grid entities were still learning about AI when NERC asked

Share of respondents by stage of AI/ML adoption in real-time operations, %



Source: NERC, *Artificial Intelligence and Machine Learning in Real-Time System Operations*, White Paper Revision 1, November 2024 (n=47). Remaining respondents gave other answers.

Idaho National Laboratory's September 2025 report on AI in transmission and distribution goes further toward a rule. It recommends that "an AI that controls a transmission breaker should be under human supervision," that oversight be chosen by the consequence of the action, that every system include "a manual override or 'off-switch,'" and that new tools run in a "shadow mode" alongside human decisions for some months before they act. It observes that "fully autonomous grid optimization by AI is still approached cautiously due to safety" and names a gap no procedure covers: "It may be unclear who is liable if an AI-enabled device causes a grid event."¹²

Federal security guidance draws the outer line. The December 2025 joint principles from CISA, NSA, the FBI and allied agencies state that "AI such as LLMs almost certainly should not be used to make safety decisions for OT environments," urge operators to "limit active control of OT infrastructure by AI without a human in the loop," and warn that "problems can escalate before operators become aware of them." They also flag the long-run risk that operators lose "valuable skills for safely operating equipment manually."¹³

The projects underway in 2026 sit almost entirely on the lower rungs. CAISO is piloting an AI assistant for outage-management workflows,¹² and frames its strategy in three tiers, from governed productivity tools to bespoke models and agents.¹⁴ Argonne's GridMind is a multi-agent "reasoning co-pilot"; its developers say it "doesn't replace operators; it empowers them."¹⁵ A DOE Genesis Mission project with Siemens Energy, Los Alamos and Orlando Utilities Commission is called "Autonomous Topology Control at Scale," yet its AI will "generate safe switching options" while human operators "would remain in control, reviewing any recommendation before action is taken."¹⁶ MISO's January 2026 platform with Microsoft aims at AI insights "to detect, diagnose, and respond to grid conditions."¹⁷ EPRI's Open Power AI Consortium reports more than 300 organizations engaged, including more

than 120 utilities and energy companies, and gives members a sandbox to test use cases "prior to field testing and deployment."¹⁸

The pattern is consistent. The industry names its projects autonomous and builds them as advisors, because nobody has decided where the line between proposing and acting should sit for each decision. That is sensible caution. It is not yet a design.

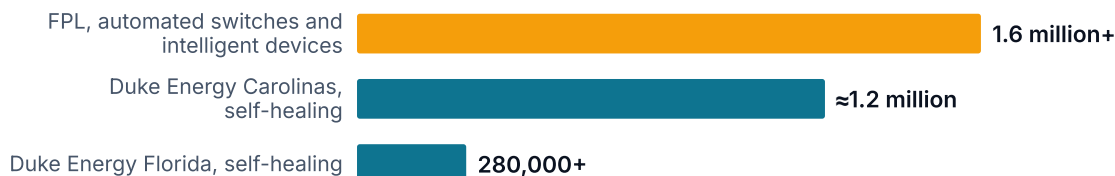
Automation already works where the rules were written first

The grid is not new to machines acting on their own. Protection relays have tripped lines without asking for a century. Self-healing distribution, fault location, isolation and service restoration, is the closest analogue to what AI will be asked to do, and its results are measurable. Florida Power & Light reports that automated switches and other intelligent devices avoided more than 1.6 million customer interruptions in 2025 and more than 17 million since 2011.¹⁹ Duke Energy Florida's self-healing technology, covering 82 percent of about 2 million customers, avoided more than 280,000 extended outages and more than 300,000 hours of outages in 2025, and saved about 3.3 million outage hours in Hurricane Milton alone.²⁰ In the Carolinas, a Duke spokesperson put 2025 avoided outages at about 1.2 million (Exhibit 4).²¹

EXHIBIT 4

Where the switching rules were written down, automation already acts on its own at scale

Customer interruptions or outages avoided by automated switching and self-healing, 2025



Source: FPL Newsroom, March 30, 2026; ABC11, June 3, 2026 (Duke Energy spokesperson); Duke Energy Florida release, February 6, 2026. Company-reported figures; definitions differ slightly by utility.

Self-healing works for a reason that matters for AI. Its scope is narrow, its permitted actions are enumerated in advance, its settings are engineered and owned, and its behavior can be tested before a storm. It acts alone because someone wrote down exactly what it may do. The

task for AI in grid operations is to extend that discipline from a feeder's switches to the much larger set of decisions that today live in procedures, interpretations and operator judgment.

Regulators have started to ask for the inventory

Regulators spent 2026 asking utilities to show what AI they use and how they govern it. The New York Public Service Commission's order of September 17, 2026 requires electric, gas and water utilities to file an inventory of "all" AI use cases and their governing policies within 60 days, to be tested against "commonly accepted AI Governance frameworks." The commission noted that "the actual extent and scope of AI systems in New York utility operations remains unclear," and its chair, Rory Christian, called AI "a double-edged sword for utilities."²² The Arizona Corporation Commission opened a docket on March 24, 2026 asking utilities to report AI use in daily plant operations, distribution, planning, storm response and procurement.²³

In Britain, Ofgem's second edition of its ethical AI guidance, published May 13, 2026, says AI "has moved from early pilot deployment to increasing operational use across the sector," that in critical infrastructure it "could, for example, result in power outages if not effectively managed," and that "human oversight from the earliest stage is recommended." It also flags the risk of "loss of skill base due to the introduction of AI."²⁴ In Europe, AI used as a safety component in the supply of electricity is high-risk under Annex III of the AI Act, and Article 14 requires that people overseeing it can "disregard, override or reverse the output" and stop the system. The Digital Omnibus, published July 24, 2026, delays those obligations to December 2, 2027, and narrows "safety component" to systems whose purpose is to prevent risks to health and safety.²⁵ An advisory copilot may fall outside the high-risk class; a tool that operates switches will not.

At the federal level in the United States, the conversation is about speed rather than authority. FERC Commissioner David Rosner told the Senate in July that he is "encouraging grid operators to deploy automation and artificial intelligence tools," citing interconnection studies accelerated "from years to weeks."²⁶ NERC's CEO, Jim Robb, said of the large-load work, "We've never moved anything as quickly as we're moving this right now."²⁷ We found no on-record statement in 2025 or 2026 from an ISO or RTO chief executive, or from a FERC chair, about the decision rights of AI in real-time operations. That silence is itself a finding. The rules for large loads are being written in 2026; the rules for AI acting on the grid have not been started.

The experience in the room is thinner than it looks

The argument for writing decisions down is reinforced by who is now making them. The most recent Center for Energy Workforce Development survey, covering 41 utilities and almost 315,000 jobs, found that 56 percent of workers have fewer than ten years of service, and more than 60 percent of engineers and lineworkers. CEWD concluded that the retirement gap "has largely been filled" and urged a shift "from recruitment to training, mentorship."²⁸ The risk is not an empty control room. It is a younger one, running a far more complex system, with the judgment of the people who handled the last generation of hard days increasingly held in memory rather than in procedure. DOE's 2026 energy employment report found transmission, distribution and storage was the only major energy sector to grow in 2025, adding about 28,000 workers, while employers reported difficulty finding "electrically skilled workers."²⁹

AI can carry some of that judgment, but only the part that has been made explicit. A model trained on what experienced operators did cannot tell which of their choices were policy, which were preference and which were luck. The rule has to be written before the machine can apply it, and before a younger operator can trust that the machine is applying it.

What the people shaping the next four years expect

Forecasts from people with a mandate at stake converged in 2026, though not all in the same direction.

- **AI will reach the control room quickly.** Gartner predicted that "by 2027, 40% of power and utilities will deploy AI-driven operators in control rooms," and said organizations "must establish guardrails, such as access control and scope enforcement."³⁰
- **Government will push for speed.** DOE's Genesis Mission set a grid challenge to use AI for "planning, interconnection, operations, and security," targeting decisions "up to 20–100 times faster."³¹ These are targets, not results.
- **The reliability regulator will move faster than it ever has.** NERC's standards for computational loads are due at FERC by December 31, 2026.⁷ John Moura of NERC: "We must treat large loads as part of system planning, not just demand forecasts."³²
- **State commissions will audit first.** New York and Arizona have opened inquiries; others will follow the inventory model.^{22,23}

Our own expectation follows from the evidence. AI will enter grid operations through decision support and copilots over the next two years, as it already is, and it will be useful.

The step from proposing to acting will not be decided by model quality. It will be decided by whether a utility can show, for a named decision, what the machine may do, under whose authority, within what limits, with what fallback, and how that was tested. We expect the first regulatory findings on AI in grid operations, likely in 2027 or 2028, to turn on exactly that question, and we expect the utilities that move fastest to be those that already treat their switching rules, settings interpretations and escalation thresholds as governed assets with owners and effective dates. By 2030 we expect a decision-rights register for grid AI to be as ordinary as a protection settings database is today.

A decision framework for the COO and the head of grid operations: four moves

The evidence points to four moves, roughly in this order.

1. Write a decision-rights register before buying the next tool

List the operating decisions that matter on a hard day: switching and restoration, voltage control, load shed, de-energization, large-load response, crew dispatch. For each, record who owns it today and whether a tool may prepare it, propose it or execute it. Use NERC's three modes as the vocabulary.¹¹ Most entries will start at "prepare." That is the point: the register makes every later promotion a deliberate decision rather than a vendor default.

CONCRETE MARKER

Every AI or automation tool in operations is mapped to the decisions it touches, with an owner and a permitted mode for each.

CONCRETE MARKER

No tool moves from "propose" to "execute" for any decision without a recorded approval, a stated fallback and a test result.

2. Turn interpretations into governed rules

Iberia showed that a rule two parties read differently is not a rule.⁹ Take the procedures, settings and thresholds that govern the decisions in the register and record, for each, the governing interpretation, its owner, its effective date and the exceptions experienced operators actually apply. This is the knowledge a younger workforce and any AI tool will both depend on.²⁸

CONCRETE MARKER

Each operating procedure behind a registered decision has a named owner, an effective date and a recorded interpretation.

CONCRETE MARKER

Exceptions that operators apply in practice are captured and either adopted into the rule or retired.

3. Promote automation by consequence, through shadow mode

Follow INL's logic: choose oversight by the consequence of the action, run every new tool in shadow mode alongside human decisions before it acts, and keep a manual off-switch.¹²

Measure agreement, disagreement and the reasons for each. Promote a decision up the ladder only when the record shows the tool and the rule agree with good operators, and the failure mode is understood. Design human-in-the-loop so that it is "not in name only":¹¹ the operator must see enough, early enough, to intervene.

CONCRETE MARKER

Every tool's shadow-mode record shows agreement rate, overrides and the reason for each before promotion.

CONCRETE MARKER

Alarms on the tool's own health are tested, so that an operator always knows when the tool is not working.

4. Be ready to answer the inventory question in an afternoon

New York gave its utilities 60 days to list every AI use case and its governing policy.²² Build the register so that the answer comes from the system, not from interviews: tool, owner, decisions touched, permitted mode, fallback, test record, review date. Report to the board the share of registered decisions at each rung, and every override and its reason.

CONCRETE MARKER

The AI inventory for operations can be produced on request, with owners and permitted modes, without a data call.

CONCRETE MARKER

Board reporting shows decisions by rung of the ladder and the override rate, not the number of pilots.

The leadership test

Leaders can locate their utility by asking six questions:

1. For the ten decisions that matter most on a storm or a load-loss day, can we name who owns each and what any tool may do with it today?
2. If two parties read one of our voltage, switching or protection requirements differently, how would we find out before the event, and who decides which reading governs?
3. Which of our automation acts without a person today, and is the list of what it may do written down, tested and owned?
4. When a large load drops a thousand megawatts in seconds, what does our procedure say, and was it written before the load connected?
5. If the commission asked tomorrow for every AI use case in operations with its governing policy, could we answer from a system?
6. When our most experienced operator retires, which of their judgments will remain as rules, and which will leave with them?

Utilities that can answer these questions are ready to let machines do more. Those that cannot will find that a better model only applies the missing rules faster.

The grid will act more on its own in the coming decade. It already does wherever someone wrote down exactly what a relay or a switch may do. The work now is to extend that discipline to the decisions that today live in procedures, interpretations and memory, and to decide, rung by rung, which ones a machine may take. The model is the easy part. The decision rights are the work, and in most control rooms they have not been written yet.

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About 6th Wave R&D

6th Wave R&D is the research and development team of 6th Wave Ventures. It publishes independent analysis on how utilities forecast, assess and act on their hardest days, and what that means for AI and autonomy on the grid. Every figure in this paper is drawn from public sources, listed in the notes.