Climate Resilience Working Group

September 9, 2026

nationalgrid

Agenda

- **Extreme Heat Events – Presented by: Glen Aichinger**
  Vice President, New York Emergency Preparedness & Resilience Planning

- **Securing and Operating During Peak Load Events – Presented by: Matt Antonio –** Director, Transmission Control Center Operations

- **National Grid Updates - Presented by: Gavin MacLean –** Associate Engineer, NY Climate Resiliency Lead

  JU MIT Future Wind & Icing,
  Jupiter Riverside Flood Mitigation,
  EPRI P262A Physical Climate Resiliency Engagement

- **Community and Stakeholder Updates and Feedback**

Emergency Preparedness & Resilience Planning

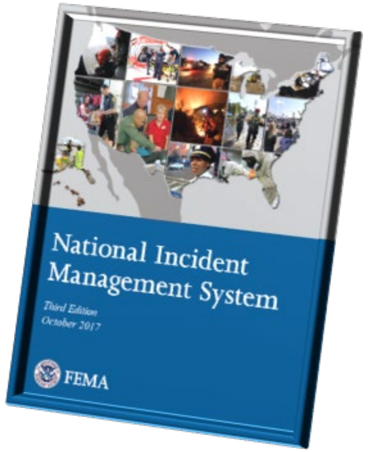
Sept. 9, 2026

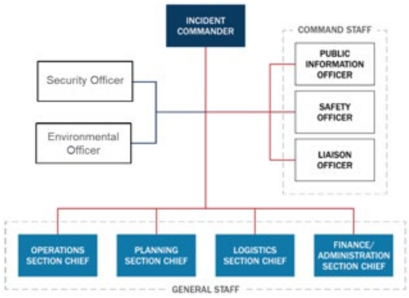
When Storms Come In...

We Head Out.

Extreme Heat - Event Preparedness and Response

- National Grid has established our **Emergency Response Plans (ERP)** for the purpose of **preparing for and responding to electric outages caused by storms and other natural disasters, major equipment failure, civil unrest, cyber events, or other emergencies. The ERP outlines specific actions to be taken leading up to and during a particular emergency, focusing on immediate response procedures that are intended to be simple, flexible, and easily adapted under an approach for any hazard that could impact electric service to our customers.**
- The ERP utilizes the **National Incident Management System (NIMS)** as a guide to a comprehensive approach to incident management that is applicable at all levels of the Company's Emergency Response Organization (ERO) and across functional disciplines.
- The ERP applies the **principles of the Incident Command System (ICS)** and the Company's Group Crisis Management Framework to the structure of the ERO.
- **The ERO establishes a chain of command that sets an orderly line of authority** and relationships in place within the ranks of the organization where lower levels are subordinate to and connected to higher levels.





Emergency Preparedness & Resilience Planning

Manage our Emergency Response Plan that specifies procedures for response to operational disruptions while remaining compliant with governing laws and regulatory obligations with a focus on the safety of our customers and employees.

Local / Jurisdictional Ownership / Focus

- Internal and external stakeholder management
- Ownership of National Grid’s Electric & Gas Emergency Response Plans

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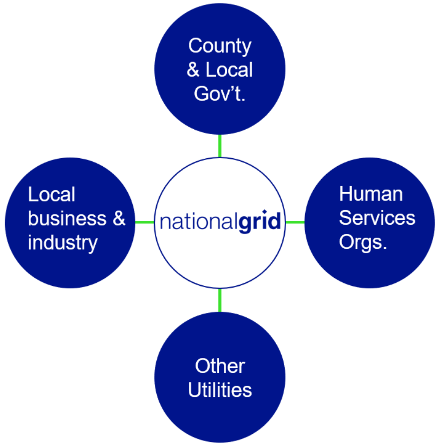
- Interpret policy, develop, and implement emergency response procedures for, and in response to operational disruptions within the framework of company policy, national and regional protocols, and the legal, legislative, and regulatory requirements that govern our plans to ensure employees are prepared to respond.
- Management of ERP Compliance:
  - Maintain compliance with legislative, legal, and regulatory requirements
  - Incorporate legislative, legal, and regulatory requirements in our response and planning activities
  - Coordination of internal and external communication
  - Support Exercise and Training initiatives
- Preparation, response, and regulatory compliance associated with National Grid’s Emergency Response Plans and Planning activities across New York State.

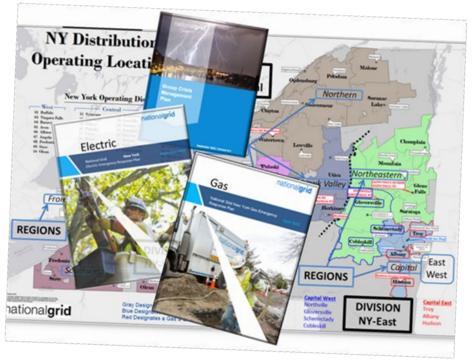
- Establish / implement process and policy consistency across the jurisdictions (New York and Massachusetts) where possible
- Plan, prepare for, and support event & incident response

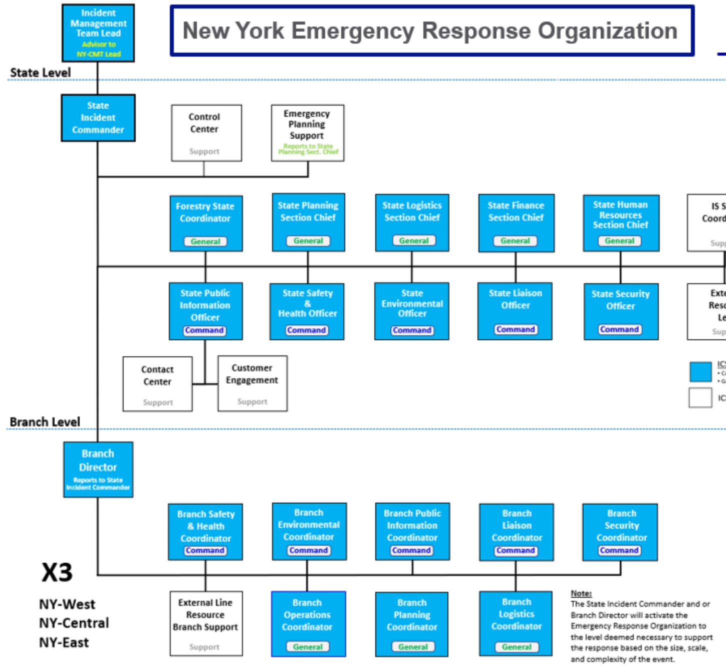
National Grid is Accountable to:

- Our customers / Our regulators
- NYS Department of Public Service



Emergency Response Plans





Incident Command System (ICS)

One of the most critical foundations of our emergency response performance is our utilization of the Incident Command System (ICS) modeled under the principles of FEMA’s National Incident Management System.

Command: clear accountability and decision-making authority through chain of command and unity of command principles delegated to the Incident Commander

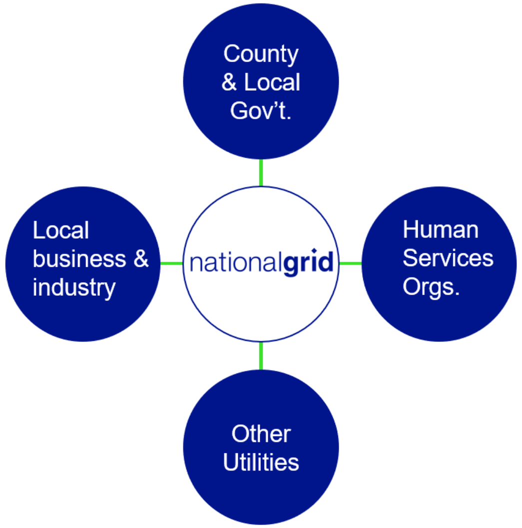
Flexibility: allows for staffing and activation of the Emergency Response Organization to appropriately match the size, scale, and complexity of the event

Staffing: every management employee receives an emergency assignment based on their home/work town, department, etc. Represent workforce each have storm function based upon role they currently hold.

Emergency Preparedness & Resilience Planning

Manage our Emergency Response Plan that specifies procedures for response to operational disruptions while remaining compliant with governing laws and regulatory obligations with a focus on the safety of our customers and employees.

National Grid is Accountable to:



Blue Sky

- **Identify & execute process improvement** opportunities
- **Validate storm role assignments**
- **Support training and exercises** for Company employees
- **Interact with external agencies**: local, state, federal and media
- **Emergency Response Plan**, Preliminary Reports, Final Cost Recovery Report, Discovery Requests
- **After Action Reviews**

ICS

- National Grids response is modeled under the ICS structure
- Activations are based on size & scope of the incident

Event Response

- **Pre-Event preparation activities:** Monitor Weather, EP & Operations Planning, Activations, Pre-Event ICS calls, Early Notifications
- **Pre-stage** personnel, equipment & materials
- **Event Response:** ICS Briefings, Outage Tracking, Restoration Updates
- **Communication:** Government & Municipal Leaders, Key Stakeholders, Regulators and Employees

Life Cycle of an Event

While each event is unique – our approach to every event is consistent, repeatable, sustainable, and anchored to our Emergency Response Plans and informed by the extensive experience of our team.

Plan and Prepare

- Monitor weather – vendor provided 3 times/day looking out 6-10 days, consultation conference calls, consultation w/ UAlbany Weather CoE, NWS products and calls
- Strategy meetings w/ Incident/Branch Commanders and Emergency Planning
- Implement resourcing strategy – as necessary (secure additional resources, schedule extended internal crew shifts, etc.)
- Pre-Event outreach, communication, messaging, and other Emergency Response Plan activities (as required)

Respond and Restore

- Facilitate Life and Safety phase response activities (911 calls, wire down, etc.)
- Facilitate restoration phase response activities in accordance with Emergency Response Plan (community conference calls, ETR's, media, dry ice, etc.)
- Communication and reporting to NYS government officials and regulators (Public Service Commission)
- Coordination with internal/external stakeholders as required

Report and Improve

- Implement de-mobilization plan focused on safety of employees and contractor partners
- Maintain compliance with legislative, legal, and regulatory requirements
- Completion of any After Action Reviews and implementation of improvement plan
- Complete scorecard and post storm reporting (if applicable)
- Collection of data and evidence for compliance requirements
- Collaboration and coordination with other NY Utilities around improvement initiatives
- Provide storm summaries and reporting to the business as needed

Training & Exercise Program

Comprehensive approach to exercises and training associated with critical processes

Safety

Protecting the safety of our employees and communities is our #1 priority

Continuous Improvement

Proactive and strategic implementation of process improvement projects and activities

Mutual Assistance

Peak Load Operations

Ensuring reliability today. Preparing for tomorrow.

The challenges of maintaining enough reserves, transmission capability and operational flexibility to survive tomorrow's contingencies while load growth accelerates.

Storyline

Core message

Reliability is more than serving load—it is **serving load and knowing that you can survive the next major loss of supply or transmission capability.** That is why contingency management guides decisions, both in real time by operators and during outage planning.

Why it matters

Peak days compress margin, expose resource adequacy risk, and increase uncertainty of reliance on neighboring systems.

What to know

Customer outages are the final layer of defense. Commitments, imports, demand response, voltage reduction and emergency procedures come first.

This presentation will

- Define Governance structure, Reserve Requirements and the Most Severe Single Contingency (MSSC)
- Show the day-ahead operating sequence that ensures system security and reliability
- Identify current and future reliability challenges

Reliability governance framework

NERC → NPCC → NYSRC → NYISO → National Grid

North American Electric Reliability Corporation
Responsible to reduce risk to the bulk electric system by:
- Developing reliability standards
- Assessing system reliability
- Monitoring compliance

Northeast Power Coordinating Council
Responsible to NERC to:
- Develop and enforce regional reliability rules
- Monitor compliance and assess reliability
- Coordinate planning and operational activities

New York State Reliability Council
- Develops and enforces reliability standards for New York
- Enforces compliance with the New York reliability standards
- Performs reliability assessments of the bulk power system

New York Independent System Operator
- Operates the NYCA power system to keep it safe and reliable
- Balances generation and load
- Enables and administers the open energy market
- **Procures operating reserves and monitors reserve sufficiency**

Supports reliable grid operations through:
- Implementation of operating procedures
- Control-room coordination and situation awareness
- Forecasting
- Outage Management
- Trip response

Peak load operations sit inside a layered governance structure.
The Operator' s job is to ensure enough capability, reserve and flexibility exist to withstand the next loss.

Most severe single contingency (MSSC) and the reserve stack

MSSC is the first single component outage that would cause the largest loss of MW resource output. It is the contingency used to size contingency reserves.

10-minute Spinning Reserve	655 MW
Total 10-minute Reserve	1,310 MW
30 Minute Reserve Requirement	1,965 MW
NYISO Manual Target	2,620 MW

NPCC Directory 5: Reserve

R1. Each Balancing Authority shall have ten-minute reserve available to it that is at least equal to its **Most Severe Single Contingency (MSSC).**

R2. Each Balancing Authority shall have thirty-minute reserve available to it that is at least equal to one-half its **Second Most Severe Single Contingency (SMSSC)**

- In New York, the MSSC and SMSSC are typically set to the same value in planning: **1310 MW**.
  - This represents the capability of **Nine Mile Point Unit 2** as well as the import limit of the **Chateaugay HVDC tie** with Hydro Quebec.
- Operators plan around the largest loss so the system can survive the next contingency.

Most severe single contingency (MSSC) and the reserve stack

MSSC is the first single component outage that would cause the largest loss of MW resource output. It is the contingency used to size contingency reserves.

NYSRC Reliability Rules & Compliance Manual

- Requires at least one-half of the 10-minute reserves to be spinning (1.5x the MSSC)

NYISO Locational Reserve Requirements*

- NYISO requires 30-minute reserves equal to twice the MSSC

10-minute Spinning Reserve	655 MW
Total 10-minute Reserve	1,310 MW
30 Minute Reserve Requirement	1,965 MW
NYISO Manual Target*	2,620 MW

NYISO reserves are procured through the Ancillary Services Market to cover unexpected loss of generation or transmission and to restore the power system to a secure state.

- 10-Minute Spinning reserves are synchronized resources already online that can change output or reduce demand within 10 minutes and are considered faster reserves.
- 10-Minute Non-Synchronized Reserves can start, synchronize and provide required output in 10 minutes.
- 30-Minute Reserves (synchronized or start-able) both replace the contingency and replenish faster reserves, and are larger than the 10-minute requirement
- * 2620 MW target is found in NYISO manual and is bound by demand curve – it will be procured day-ahead up to a certain price. 30 minute reserve is procured irrespective of price.

What Operators are Managing During Peak Load Conditions

Load

- Forecasted demand
- Actual demand
- Peak hour
- Load Shape
- Weather sensitivity
- Demand Response

Transmission

- Outages
- Real Time Loading
- Post-Contingency Loading
- Interface / Local constraints
- Hands Off risk reduction

Supply

- Available generation
- Imports (+)
- SRE commitments (+)
- External ICAP* (+)
- Emergency purchases (+)
- Forced outages (-)

Reserves

- 10 Minute Spinning
- 10 Minute Total
- 30 Minute Total
- Reliability Margin

Day-ahead coordination → In-day monitoring → Escalation → Load relief only as final defense

*External Installed CAPacity – Resources external to NYISO may participate in the Installed Capacity Market. When necessary, NYISO will "call" External ICAP on their associated proxy bus. They are obligated to fulfil that commitment before selling energy into any other market.

Peak Day-Ahead Coordination Timeline

05:00 — Day-Ahead Market closes

All generators must have bids submitted.

At or before 0800, NYISO checks for overnight changes that could impact the next day's outlook.

10:00 — DAMGEN posted

NYISO market completes economic dispatch for next day (DAMGEN).

Energy and reserves procured for next day's load forecast.

That dispatch is posted publicly no later than 1100.

11:00 — NYISO leadership review

After DAMGEN is posted, NYISO leadership determines if additional energy is needed for the next day to for unplanned generator outages or lack of support from neighboring areas. **(Reliability Margin)**

12:00 — Commitments and curtailment notifications

By 12:00, NYISO should have initiated all additional commitments of generation resource as well as put demand response resources on notice for the next day.

12:00 — NYISO / TO next-day outlook call

At 12:00, the NYISO hosts a next day outlook call with the Transmission Owners to cover the load forecast, outlook for resource availability, how much margin there is for the next day and allow the group to share operating restrictions for the next day.

14:00 — NYISO External Coordination "CO-8 Call"

Most external entities have settled their day ahead markets and NYISO confirms / checks out what the NY market solved for external transactions. At this time, additional commitments may be made to cover transactions that may no longer be available.

16:00 — Final regional coordination

The New England DAM posts (Last to post). At this time, NYISO and the other ISOs coordinate to ensure external assumptions were all accurate in their day ahead plans. By the end of this call, the clearest picture of the next day is available.

Operational point

Key reliability decisions are made before the peak hour through forecast validation, commitments, demand response notice, outage/work decisions and inter-ISO coordination.

System Operations Advisory Subcommittee (SOAS) Coordination (12:00 PM)

On peak load days, the SOAS conducts a call with the NYISO and NY utilities to determine expected reserves available at the peak load hour. Here the latest forecasts, up-to-date resource availability and transmission information is provided. The NYISO utilizes this information to evaluate if additional actions will be needed to meet the required reserve obligations.

Forecast load

Expected peak MW and hour

Resource availability

Generation, SRE status and forced outages

Reserve margins

How much room remains after requirements

Outages / restrictions

Transmission work, operating constraints and local issues

Neighboring systems

Imports, support, emergency purchases and regional stress

Purpose: To validate the latest forecast, resource availability, transmission status and regional capability.

Escalation Framework

NYISO "System States"

Normal	Warning	Alert	Major emergency*	Restoration
System within limits	Post-contingency actions may be necessary to return the system to within limits	Immediate action is necessary to return the system to within limits	Immediate actions required to avoid equipment damage or loss of load. **TO's must comply with NYISO directives if safe to do so**	A major power system failure or islanding has occurred, and action must be taken to restore the system.
Sufficient Operating Reserves to meet NYSRC requirements	Sufficient Operating Reserve, but possible Transmission System security issues.	Sufficient Operating Reserves, but only by counting Voltage Reduction and or sales from reference bus. Operating Reserve Deficiency is predicted.	Insufficient 10 minute or Operating Reserves even when counting QRVR and recallable sales.	

Energy Emergency Alert Levels

EEA-0

All criteria met

EEA-1

All available generation in use and there could be issues sustaining required reserves. Non-firm sales being curtailed.

EEA-2

Energy Deficient, but firm load being met. Load management procedures in effect. Requesting external support.

EEA-3

Most critical energy emergency condition. Unable to maintain minimum reserves. Firm load shedding imminent or in progress

***Major Emergencies are not common. Prior to 2025, the previous ME occurred in February 2021.**
A lack of reserves is not enough to drive the NYISO to issue a load shed order. They will wait until generation cannot cover the load in NY.

Layers of defense before outages

1. **Additional generation commitments-** performed by the NYISO
2. **Emergency purchases-** performed by the NYISO
3. **EDRP/SCR activation-** performed by the NYISO as part of the In-day Peak Hour Forecast response to an Operating Reserve Peak Forecast Shortage. EDRP is a demand response program used to reduced system load.
4. **CSRP activation-** performed by NGrid as part of our day-ahead load forecasting. Another demand response program used to reduce system load. Can also be initiated as an emergency control action real time.
5. **Conservation appeals-** performed by NGrid to request voluntary load reduction by public appeals and direct calls to large industrial customers. May be requested by NYISO per their Emergency Operations Manual.
6. **Voltage reduction-** Performed by NGrid, may be directed by NYISO. VR temporarily reduces load (30 minutes) while maintaining service by lowering distribution system voltage, which reduces real power demand.
7. **Load shedding** Performed by NGrid, may be directed by NYISO to reduce load across the state. Implemented by the Regional Control Centers to open distribution feeder breakers as part of a pre-planed load shed plan.

Defense-in-depth: Operators will take actions before customers see any service impact.

Future reliability challenges

Data Centers

- Large concentrated load growth
- Modern data centers are dominated by power electronics, UPS systems & advanced controllers.
- Many datacenters are not dispatchable: cloud storage, AI, banking.
- AI datacenters can consume up to 30% electricity in cooling load alone.
- Load ramping is much quicker than legacy spinning loads.
- Data centers respond differently to disturbances than other loads: they can disconnect or ride through differently and auto connect when not expected.

Electrification

- Increasing load due to consumer preference or incentives
- Electric vehicles
- Home heat pumps
- Elimination of NG for new home construction.
- Changing load shape

Resource Adequacy

- Growing need for energy, reserves and flexibility

Weather

- Heat waves and severe winter events tax the electric and gas infrastructure

Summary

Today's operating challenge is a preview of the planning challenge: reliability will increasingly depend on flexible resources, robust transmission capability, accurate forecasts and coordinated emergency procedures.

MIT Wind/Icing Projection Updates

Background:

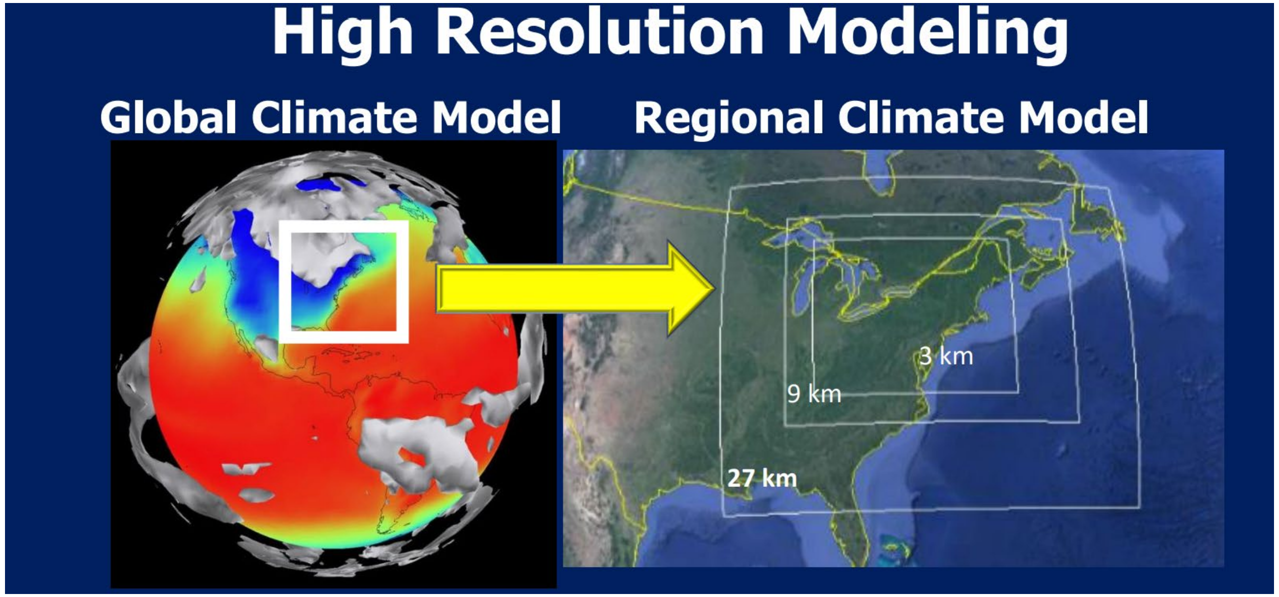
- Refresh of the original 2021 study
- Delivers hourly climate data across most of the Northeast in 3km resolution
- This time around we have expanded the scope to include data analysis

Updates:

- We have moved to signatures
- Have engagement from six different electric utilities across NY and New England
- Receiving highly granular wind/icing data out to 2080

Project Timeline

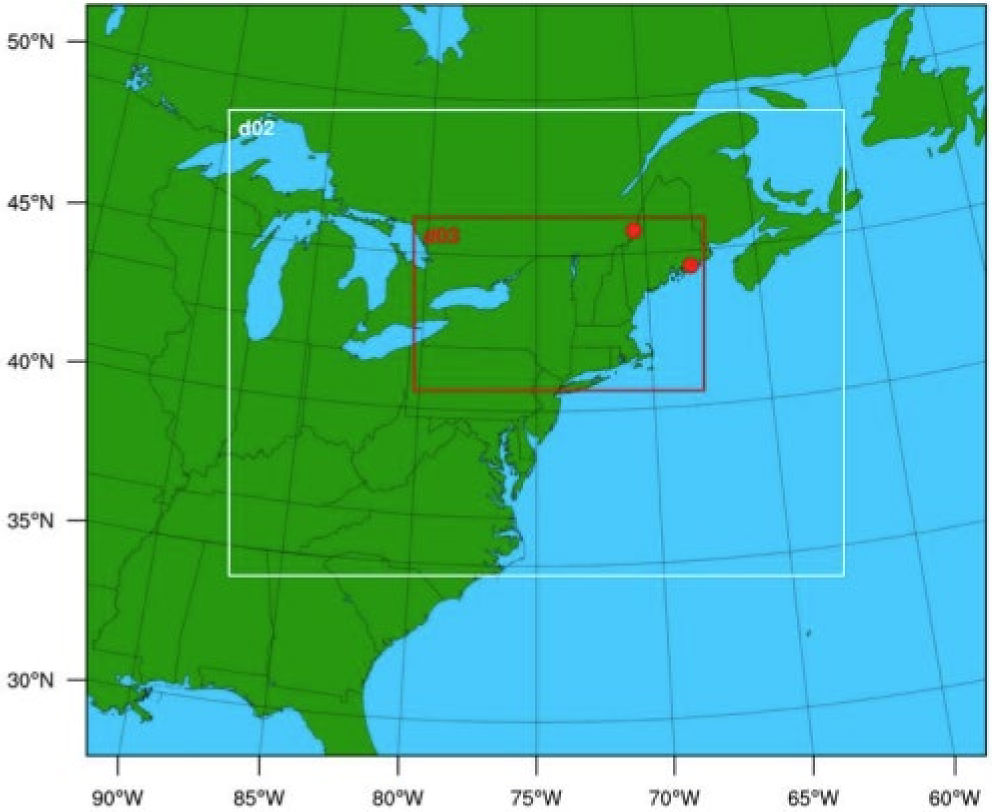
- Phase 1 – Historical Simulations (Reanalysis driven):
  - 2011-2025, 15-year simulation
  - ERA5 Reanalysis as boundary conditions
  - Nested domains: 27 km (d01), 9 km (d02)
- Phase 2 – Historical simulations (CMIP6 driven):
  - 2011-2025, 15-year simulation
  - CMIP6 GCMs as boundary conditions (at least 4 models)
  - Nested domains: 27 km (d01), 9 km (d02)
- Phase 3 – Future simulations (CMIP6 driven):
  - 2026-2040, 15-year simulation
  - Same CMIP6 GCMs as boundary conditions (at least 4 models)
  - Nested domains: 27 km (d01), 9 km (d02)



Phases 2 and 3 will provide ensemble-mean statistics as well as an assessment of the possible range of outcomes (and possibly more rigorous intra-ensemble variance statistics provided enough CMIP6 models are performed). For these proposed future simulations, use the SSP585 scenarios generated by the CMIP6 models.

Project Timeline

- Phase 4 (Optional) – Extended Future (CMIP6-driven)
  - 2041–2055 (extension of Phase 3)
  - CMIP6 GCMs as boundary conditions (at least 4 models)
  - Optional further extension: 2056–2070
  - Nested domains: 27 km (d01), 9 km (d02)
- Phase 5 (Optional) – High-Resolution Simulations
  - 3 km horizontal resolution
  - Nested domains: 27 km (d01), 9 km (d02), 3 km (d03)
  - Time periods: Phase 2 (2011-2025) & Phase 3 (2026-2040)
  - CMIP6 sub-selection (likely single model)

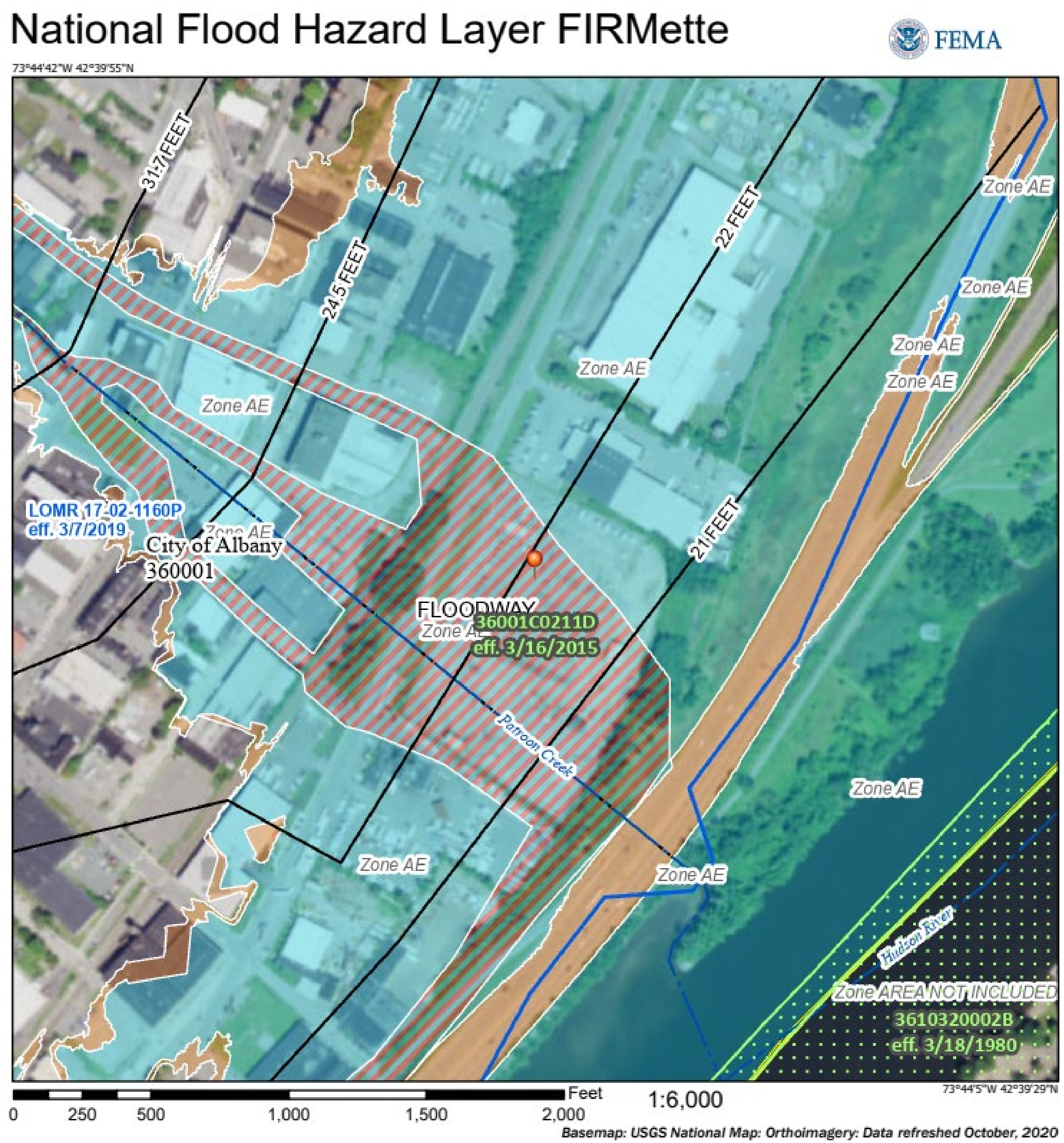


Similar to Phases 2 and 3: We could provide ensemble-mean statistics as well as an assessment of the possible range of outcomes (and possibly more rigorous intra-ensemble variance statistics provided enough CMIP6 models are performed). For these proposed future simulations, use the SSP585 scenarios generated by the CMIP6 models.

Flood Risk Modelling

We contracted Jupiter Intelligence to apply climate projections to predict the future flood risk for Riverside substation:

- The core of this pilot is to get in-depth future flood data for Riverside Substation
- With this information National Grid will be able to make a more informed decision of the right course of action
- We already have identified that Riverside is at a high risk for flooding, but this information will allow us to take a future-looking approach
- Jupiter explored 5 solutions to reduce the flood levels of the area and analyzed how those solutions would perform in future climate scenarios



How the different solutions performed

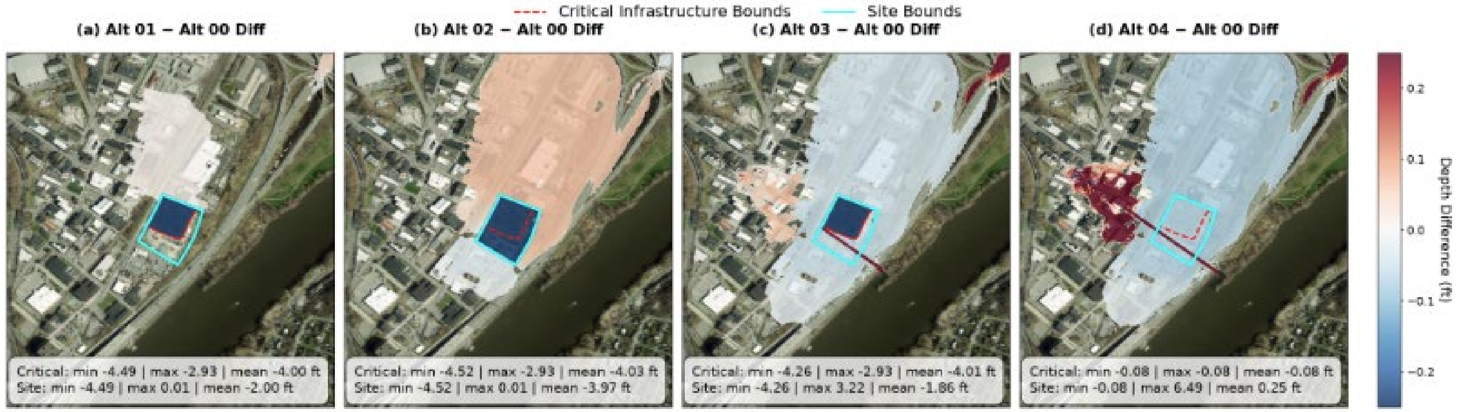


Figure 13. Change in 2025 combined flood for each alternative (100yr, SSP5-8.5). Depth difference is the alternative minus the base model. Blues indicate reduced depths due to the alternative, reds indicate increased depths due to the alternative.

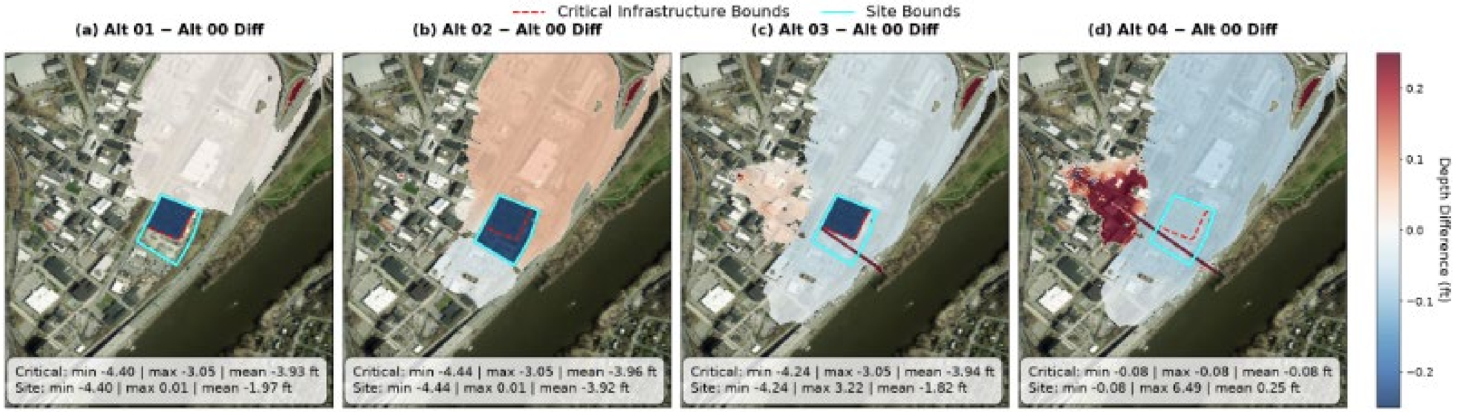


Figure 14. Change in 2080 combined flood from current geometry for each alternative (100yr, SSP5-8.5). Depth difference is the alternative minus the base model. Blues indicate reduced depths due to the alternative, reds indicate increased depths due to the alternative.

Flood Risk Modelling

Deliverables:

- 1 meter resolution output
- Develop 1-in-10, **100**, 500... year probabilities
- Project different time horizons (2050, 2080...)
- Include different types of flooding (rainfall, river...)
- Consider worst case as well as most likely climate scenarios

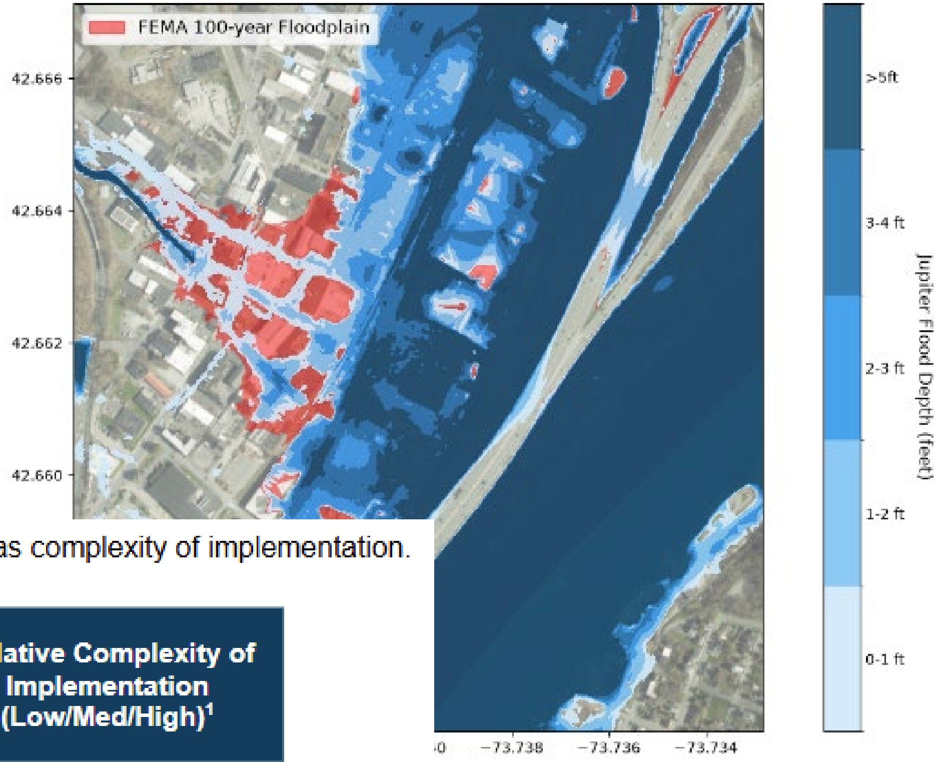


Table 4. Comparison of alternatives relative to increased flooding in the area, critical equipment, inside the property, as well as complexity of implementation.

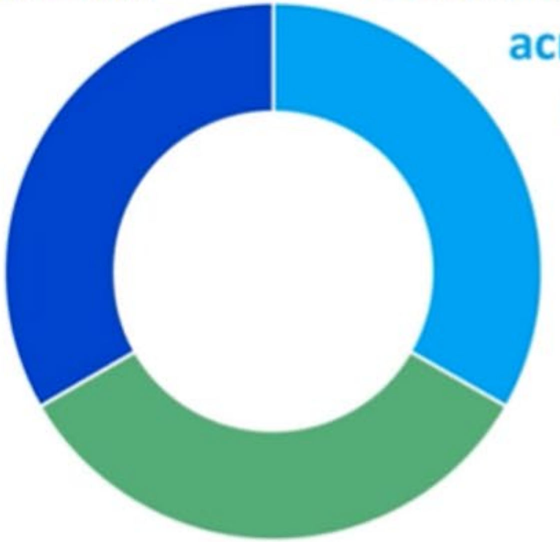
Flood Impact	Any Increased Flooding in the Surrounding Area? (Y/N)[2]	Average Critical Equipment Flood Depth (<1ft, 1 - 4ft, >4ft)[2]		Average Property Footprint Flood Depth (<1ft, 1 - 4ft, >4ft)[2]		Relative Complexity of Implementation (Low/Med/High)[1]
	Any peril	Fluvial	Pluvial	Fluvial	Pluvial	
Alt 1: Critical Equipment Wall	Y	<1ft	<1ft	1-4ft	<1ft	Med
Alt 2: Property Wall	Y	<1ft	<1ft	<1ft	<1ft	Med
Alt 3: Critical Equipment Wall + Open Channel	Y	<1ft	<1ft	1-4ft	<1ft	High
Alt 4: Channelize Patroon Creek	Y	>4ft	1-4ft	>4ft	1-4ft	High
Alt 5: Elevating Equipment to BFE+2ft	N	>4ft**	1-4ft**	>4ft	1-4ft	Low

Physical Climate Risk & Resilience: The Basics

What are the climate risks relevant to the electric power sector?

How are they expected to change?

How can we represent current and future risks across all aspects of the electric power sector in models and tools?



If the risks are deemed too large, what can we do to manage them?

How do we evaluate and prioritize options?

P262A will tackle these questions and the ways that they intersect

Research is designed to aid analysts, modelers, decision-makers, and stakeholders in understanding the full ecosystem of physical climate risk and strategies to manage these risks

EPRI P262A: Physical Climate Change and Resilience

P262A will tackle risk and *Resilience* from several angles

With technical advances in…

Climate Data Knowledge and Relevance

- Understand, quantify, and model complex hazards
- Track and evaluate new data sources for power system applications
- Study tradeoffs and limitations in climate data use
- Benchmark climate extremes for planning across scales

Method and Analysis Needs

- Address needs within a specific tool or process to better handle climate risk
- Develop, evaluate, and compare novel capabilities and implementation options within tools
- Provide and refine inputs for asset vulnerabilities, loads, and scenarios

Investment Decision Making

- Explore robust decision-making approaches under deep uncertainty
- Demonstrate use of decision criteria for valuing resliience, including societal impacts, health, and equity
- Evaluate sensitivities to data and modeling scoping decisions

Integrated Modeling Capabilities

- Improve understanding of full-system resilience across generation, transmission, distribution, and customers
- Streamline touchpoints between tools for consistent climate data, load, and technology assumptions
- Explore coordinated planning among stakeholders or regions

Foundational Efforts:

Climate READi | Climate READi Framework Coordination | Education and Outreach | Climate Data Services | CRAG Engagement | Tracking Climate Risk Developments

Project Ideas for 2026

Project Title	Technical Focus Area	Potential Collaborations
Evaluating the Use of Global Warming Levels in Long-Term Planning	Climate Data Knowledge and Relevance	Technology Innovation
Tracking High-Risk Climate Hazards: How are Storm Events Changing?	Climate Data Knowledge and Relevance	
Decision-Making under Deep Uncertainty for Generator Site Adaptation Investments	Investment Decision Making	Nuclear Risk and Safety Management
Unpacking Resilience Metrics for Planning and Performance Tracking	Investment Decision Making	Distribution Planning, Resource Adequacy
Assessing Wide-Area High-Stress Climate Events with the Risk Screening Tool	Integrated Modeling Capabilities	Resource Adequacy
Managing Climate Risk: Creating an Adaptation Catalog for Power System Applications	Method and Analysis Needs	Generation Resilience, Asset-class experts
Risk-Informed Siting: Building Climate Risk into the Cost of New Assets	Method and Analysis Needs	Resource Planning
Evaluating Potential Changes in Planned Outage and Seasonal Maintenance Windows	Integrated Modeling Capabilities	Transmission Operations

Next Steps

Understanding local concerns and priorities is important to National Grid.   To that end, we will meet twice annually to seek your feedback and recommendations to be incorporated into our Resilience Plan.

We also look forward to hearing about emergency planning and resilience efforts happening in your communities.

Thank you to our presenters and thank you for your attendance!