New York ISO
Independent System Operator

Maintenance Modeling & Output Factor Curves: Modeling Seasonal Generator Maintenance

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Background

- This whitepaper assesses potential enhancements to planned maintenance derates and outages modeled for the installed reserve margin (IRM) study.
- At the March 4, 2026 ICS meeting,[1] the NYISO provided an overview of its maintenance outage management practices and timelines.
  - Maintenance outages are evaluated and approved on a weekly basis using seasonal capacity assessments and updated peak load and maintenance margin assessments.
  - Maintenance outages are approved and scheduled during Summer and Winter peak months only when sufficient capacity margins exists to preserve reliability.
  - If system conditions change and capacity margins are at risk of being violated, the NYISO may cancel and reschedule previously approved outages.
- At the March 31, 2026 ICS meeting,[2] the NYISO reviewed the use of the GE Multi-Area Reliability Simulation (MARS) program to model planned and forced outages and derates, providing a basis to evaluate alternative approaches and enhancements.[3]
  - Maintenance derating event types (D4, DM, and PD) are represented in the MARS generating rate transition matrix (GTRM) through upper or lower derating states based on available capacity.
  - Maintenance outage event types (PO, MO, etc.) are not represented in the MARS GTRM.
- This presentation outlines the methodology and recommendation for seasonal maintenance modeling considerations for the IRM study, including an impact assessment of the recommendation and an implementation process for the current and future IRM study cycles

1. ICS #314: Maintenance Modeling & Output Factor Curves: NYISO Outage Scheduling Process
2. ICS #315: Maintenance Modeling & Output Curves
3. Refer to the Appendix for additional information regarding GADS event type codes

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Potential Enhancements to Modeling Maintenance Outages

- **Currently, the IRM study includes a fixed 50 MW summer maintenance assumption, allocated equally between Load Zones J and K (i.e., 25 MW of assumed maintenance outages in each zone).[1]**
  - The summer maintenance assumption is informed by an annual review of historical GADS reported planned and maintenance events occurring during the prior June 1 through September 15 period.
  - In Load Zones J and K, 25 MW of capacity is assumed to be unavailable in each zone from June 1 through August 31 to represent the potential risk of unit maintenance on resource adequacy during the summer season.
  - Planned and maintenance outage event types (PO, MO, etc.) are not modeled in MARS unit-level stochastic state transitions but are instead reflected only through this aggregate summer assumption.
- **Potential enhancements considered:**
  - Proposing an alternative methodology that refines the current maintenance outage modeling approach.
  - Assessing winter maintenance outage assumptions and modeling approach.
  - Developing a repeatable process for modeling maintenance outages in the current and future IRM study cycles.

1. Review of the GADS 2024 Summer Maintenance Events

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Seasonal Maintenance Outage Assessment

- **The proposed alternative seasonal maintenance outage assessment applied the following criteria:**

I. The review used the most recent five seasons of GADS outage data.
   - The most recent five seasons of outage data were used to better align with the MARS GTRM process which uses rolling 5-years of GADS data.
   - Using only one year of data may skew the results and make them overly dependent on a small number of outlier outages.
   - PO, PE, MO, and ME outage events were used to quantify maintenance MW.

II. The review focused on peak summer (June to August) and peak winter (December to February) periods.
   - Three-month seasonal windows were used to better reflect seasonal risk periods.
   - Is also consistent with how maintenance outages are currently modeled in the peak summer months

III. Maintenance Outages exceeding seven calendar days.
   - The NYISO uses a seven-day day-ahead load forecast from the Day-Ahead-Market (DAM) in the outage scheduling process to approve weekly scheduled maintenance outages.
   - Because some outages extend beyond that forecast horizon, the proposed assessment focused on outages lasting more than seven days to assess maintenance risk over a longer period

IV. Historical daily load data
   - Most recent five years of historical daily load data was used to identify near-peak load days (i.e. defined as days when daily peak load was at or above 90% of the applicable coincident seasonal peak load during the review period).
   - Only maintenance outages occurring during identified near-peak load days were included in the assessment
   - This aligns with system stress conditions where maintenance outages could potentially result in system risk

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Summer Maintenance Outage Analysis

Average 5-year Summer Maintenance Outage (MW)											
NYCA	A	B	C	D	E	F	G	H	I	J	K
70.8	11.4	0.0	0.0	0.0	0.0	2.0	16.9	0.0	0.0	13.2	27.4

- **Maintenance outages were concentrated in few load zones rather than occurring in all zones.**
  - Consistent with the current maintenance modeling assumptions, the results for the study period identified that maintenance outages are most persistent in Load Zones J and K.
  - Considerable maintenance outages were also observed in Load Zone G.

- **NYISO's Initial Recommendation: Assign 25 MW of maintenance to each of Load Zones G, J, and K, for a total of 75 MW of assumed summer maintenance during peak periods (i.e., June through August).**
  - The initial recommendation is to round the NYCA requirement to the nearest 25 MW and allocate it evenly across the zones with the highest average maintenance over the past five years.
  - This results in an allocation of approximately 25 MW per selected zone, reflecting NYISO's analysis that identifies these zones as having the highest frequency of peak summer maintenance outages, as well as relatively higher peak load levels.

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Winter Maintenance Analysis and Initial Recommendation

- **Results from winter maintenance analysis indicate that historical data analysis over an extended period (e.g., the most recent five years) is potentially less representative and informative of future expectations at this time.**
  - Winter reliability concerns started to emerge in recent years. Historical data going further back may reflect a greater magnitude of maintenance during the winter season which may not be indicative for current trends.
  - Implementation of firm fuel elections for capacity accreditation beginning with the 2026-2027 Capability Year may also encourage changes in generator behavior of managing units during the winter season.
    - Notably, ~91% of historically observed maintenance outages during peak winter periods were associated with generators that submitted firm-fuel elections for the 2026-2027 Capability Year, and heavily concentrated in Load Zones J and K.
  - The NYISO will be proposing enhancements to its current outage scheduling practices to assist in maintaining system reliability during the winter peak load period.
  - The Market Monitoring Unit's 2025 State of the Market report[1] also supports improvements to the NYISO's current outage scheduling practices, particularly to discourage firm-fuel generators from taking outages during high-risk winter periods and to encourage maintenance during periods that do not undermine system reliability.

- **NYISO's Initial Recommendation:**
  - In the near term, the NYISO initially recommends applying the proposed summer maintenance modeling assumptions to the winter for the 2027-2028 IRM study (i.e., 25 MW of assumed maintenance in each of Load Zones G, J and K during winter peak periods (i.e., December through February).
  - In the future, the NYISO recommends revisiting the evaluation of winter maintenance outages once enough historical winters with new outage scheduling practices is available

1. 2025 State of the Market Report

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Parametric Impact Assessment

- The NYISO conducted a parametric assessment of the potential impact of the initial recommended improvements to the maintenance modeling assumptions (i.e., 25 MW of assumed maintenance in each of Load Zones G, J, and K during both the summer and winter peak periods) using the 2026-2027 IRM FBC Special Sensitivity Case.
- The analysis identified an IRM impact of 0.095%.
- The analysis also found that the introduction of assumed winter maintenance outages increased the share of seasonal reliability risk during the winter months as measured by the proportion of loss of load events occurring in each season.

Case	IRM (%)	J LCR (%)	K LCR (%)	G-J LCR (%)	Winter Risk (%)	Summer Risk (%)
2026-2027 FBC (Special Sensitivity)	25.60	79.85	107.50	89.22	14.80	85.20
Recommended Maintenance Modeling	25.695	79.92	107.59	89.29	15.81	84.91
Delta	+0.095	+0.07	+0.09	+0.07	+1.01	-1.01

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Process and Implementation

- **The NYISO recommends conducting an annual seasonal maintenance analysis prior to completion of the PBC (June/July timeframe) to support the development of the PBC.**
  - The current summer maintenance analysis will continue to be conducted at FBC to refine the maintenance assumption, using the data from the most recent summer.
- **For future IRM study cycles, the NYISO recommends using a rolling 5 years of maintenance outage and load data to inform the seasonal maintenance outage modeling assumptions.**
  - To determine summer maintenance assumptions:
    - Conduct maintenance outage assessments using qualifying high-load days (≥90% of coincident peak load forecast) during the peak summer period (June–August).
  - To determine winter maintenance assumptions:
    - For the near term (i.e., approximately the next four winters), apply summer-derived assumptions.
    - Once sufficient representative historical data under improved winter outage scheduling practices and the firm fuel framework is available, the NYISO recommends development of analogous winter-specific high-load day assessment of historical maintenance outages during the peak winter period (December–February).
  - Aggregate results at the zonal level to quantify seasonal maintenance outage MW and identify Load Zones with high levels of maintenance. Allocate the target MW by splitting it equally across the selected high-maintenance Load Zones.
  - Based on the assessment results, develop recommended seasonal zonal maintenance outage MW assumptions for each IRM study.

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Next Steps

- Seek ICS approval of a final recommendation for maintenance outage modeling for the 2027-2028 IRM study at the July 8, 2026 ICS meeting
- Apply the final recommended maintenance assumptions in the upcoming 2027-2028 IRM Preliminary Base Case and evaluate the resulting IRM impacts.

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Questions?

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Appendix

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GADS Event Type Codes

Scheduled Derates

Planned Derating	PD	Schedule well in advance for a predetermined duration
Maintenance Derating	D4	Approved by NYISO, and there are no reliability issues when the unit's output is reduced Flexible start time and does not require a predetermined duration
Maintenance Derating Extension	DM	Extension of a D4 for work within original scope and start date/time must match the original D4 end date/time
Planned Derating Extension	DP	Extension of a PD for work within original scope and Start date/time must match the original PD end date/time

Scheduled Outages

Planned Outage	PO	Scheduled well in advance, defined duration (weeks), once or twice /year
Maintenance Outage	MO	An outage that received NYISO's approval (with minimum two days notice) and there are no reliability issues if the unit is removed from service
Planned Outage Extension	PE	Extension of a PO for work that is in the original scope. Start date/time must match the original PO end date/time
Maintenance Outage Extension	ME	Extension of a MO for work that is in the original scope. Start date/time must match the original MO end date/time

- Planned GADS Event Types Codes [1]

1. Generating Availability Data System

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Our Mission and Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

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