Supply Uncertainty

RCSTF

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Monitoring Analytics

Supply Uncertainty

- Reserve products were created to address supply uncertainty.
- Supply is uncertain because generating units fail.
- PJM is responsible to ensure that supply meets demand.
- In order to accomplish that, PJM needs to procure supply (in the form of unloaded MW or headroom) that can be deployed within defined periods and duration.
- The periods and duration define the type of product (e.g. regulation, synchronized reserves, 30 minute reserves).
- Reserves are procured to ensure reliability.
- Reliability can be measured based on the NERC standards.

NERC BAL-002-3

- **R1: The Responsible Entity experiencing a Reportable Balancing Contingency Event shall:**
  - **1.1 within the Contingency Event Recovery Period, demonstrate recovery by returning its Reporting ACE to at least the recovery value of:**
    - zero (if its Pre-Reporting Contingency Event ACE Value was positive or equal to zero); however, any Balancing Contingency Event that occurs during the Contingency Event Recovery Period shall reduce the required recovery: (i) beginning at the time of, and (ii) by the magnitude of, such individual Balancing Contingency Event,

      or,
    - its Pre-Reporting Contingency Event ACE Value (if its Pre-Reporting Contingency Event ACE Value was negative); however, any Balancing Contingency Event that occurs during the Contingency Event Recovery Period shall reduce the required recovery: (i) beginning at the time of, and (ii) by the magnitude of, such individual Balancing Contingency Event.

NERC BAL-002-3

- **R2: Each Responsible Entity shall develop, review and maintain annually, and implement an Operating Process as part of its Operating Plan to determine its Most Severe Single Contingency and make preparations to have Contingency Reserve equal to, or greater than the Responsible Entity's Most Severe Single Contingency available for maintaining system reliability.**

NERC BAL-002-3

- **R3: Each Responsible Entity, following a Reportable Balancing Contingency Event, shall restore its Contingency Reserve to at least its Most Severe Single Contingency, before the end of the Contingency Reserve Restoration Period, but any Balancing Contingency Event that occurs before the end of a Contingency Reserve Restoration Period resets the beginning of the Contingency Event Recovery Period.**

NERC BAL-002-3 – Relevant Definitions

- **Contingency Reserve Restoration Period: A period not exceeding 90 minutes following the end of the Contingency Event Recovery Period.**
- **Contingency Event Recovery Period: A period that begins at the time that the resource output begins to decline within the first one-minute interval of a Reportable Balancing Contingency Event and extends for fifteen minutes thereafter.**
- **Contingency Reserve: This is the provision of capacity deployed by the BA to respond to a balancing contingency event and other contingency requirements, such as Energy Emergency Alerts (EEAs) as specified in the associated NERC Reliability Standards.**

NERC BAL-002-3 Summary

- **R1: After a Reportable Balancing Contingency Event, reportable ACE must recover within 15 minutes.**
- **R2: Contingency Reserves must equal or exceed the MSSC.**
- **R3: After the end of a Contingency Event Recovery Period, Contingency Reserves must be restored within 90 minutes.**

PJM's Status Quo Approach

- **R1 and R2 are the basis for procuring the synchronized reserve product.**
  - **Requirement equal to the MSSC**
  - **Product:**
    - 10 minute ramping
    - Online
- **R3 is the basis for 30 minute product.**
  - **Requirement equal to 3,000 MW (based on an outdated 2X MSSC).**
  - **Product**
    - 30 minute ramping
    - Online and offline

PJM's Status Quo Approach

- **The primary reserve requirement and product sits somewhere in the middle of these standards:**
  - **Requirement equal to 1.5X MSSC**
  - **Product:**
    - 10 minute ramping
    - Online and offline

IMM Analysis

- The only explicit requirement is R2. Contingency reserves must equal or exceed the MSSC.
- R1 and R3 are about the method used by PJM to ensure that:
  - After a Reportable Balancing Contingency Event, reportable ACE is restored within 15 minutes.
  - After the end of a Contingency Event Recovery Period, Contingency Reserves are restored within 90 minutes.

IMM Analysis

- The quantities that define these requirements are subjective.
- They were set and they have worked.
- One approach to analyzing the reserve quantities needed is to compare their level to the amount of supply uncertainty that PJM has historically faced.
- This approach can be improved and done systematically to determine reserve requirements.

IMM Analysis

- **Supply uncertainty: Compile all outages in eDART that were submitted within 30 minutes of the start of the outage. Period: Nov 2021 – Oct 2025**
- **Aggregate the data into three periods:**
  - **Outages that occurred within 30 minutes of each other.**
  - **Outages that occurred within 60 minutes of each other.**
  - **Outages that occurred within 120 minutes of each other.**

IMM Analysis

- **Example:**
  - **Four outages: 25 MW at 00:10, 25 MW at 00:45, 25 MW at 01:15 and 25 MW at 1:55.**

	30 minutes	60 minutes	120 minutes
Period	00:00 - 00:30	00:00 - 01:00	00:00 - 02:00
Outages (MW)	25	50	100

IMM Analysis

- Compare the current requirements to the data.
- Outages that started within the defined period that started within 30 minutes of submission.
- Supply uncertainty (MW) by period:

Percentiles	Hours per year	30 minutes	60 minutes	120 minutes
100%	0.000002	6,301	7,926	10,719
99.999%	0.1	4,688	7,214	10,202
99.99%	0.9	3,038	4,571	8,667
99.9%	8.8	1,685	2,306	3,646
99%	87.6	887	1,332	1,891
95%	438.2	460	715	1,151
90%	876.4	244	505	841

IMM Analysis – SR Requirement

- **The Synchronized Reserve (SR) requirement equal to the MSSC**
  - **Assumed 1,790 MW.**
- **Outages that started within 30 minutes of each other exceeded the MSSC in 24.5 hours.**
  - **8.5 hours occurred during Winter Storm Elliott (Dec 23-24, 2022).**
  - **The balance (16 hours) are not clustered around any particular event.**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021											1.5	0.0
2022	1.0	0.5	0.0	1.0	0.5	1.0	0.5	0.0	0.0	0.0	0.5	0.0
2023	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.5	0.5	0.0	0.0	0.0
2024	0.5	0.0	0.0	0.0	0.0	1.5	0.5	0.0	0.0	0.0	0.0	0.0
2025	2.5	0.5	0.0	0.0	0.0	0.0	1.0	0.5	0.5	0.0		

IMM Analysis – PR Requirement

- **The Primary Reserve (PR) requirement equal to 1.5XMSSC.**
  - **Assumed 2,685 MW.**
- **Outages within 30 minutes exceeded the 1.5XMSSC in 4.5 hours.**
  - **3.0 hours occurred during Winter Storm Elliott (Dec 23-24, 2022).**
  - **The balance (1.5 hours) occurred on:**
    - Aug 3, 2023
    - Sep 3, 2023
    - Jan 17, 2025

IMM Analysis – 30M Requirement

- The 30 Minute Reserve (30MR) requirement equal to 2XMSSC.
  - Assumed 3,580 MW.
- Outages within 120 minutes exceeded the 2X MSSC in 38 hours.
  - 28.5 hours occurred during Winter Storm Elliott (Dec 23-24, 2022).
  - The balance (16 hours) are not clustered around any particular event.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021											0.0	0.0
2022	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0
2024	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
2025	3.5	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0		

IMM Analysis

- These three requirements cover equal or similar percentiles:
  - SR Requirement: 99.9%
  - PR Requirement: 99.9%
  - 30MR Requirement: 99.8%
- SR and PR requirements can remain as status quo to cover supply uncertainty.
  - PR requirement can be increased to address net load uncertainty.
- 30MR requirement must be updated to cover the initial intent of 2X MSSC and also address net load uncertainty.

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