



Establishment of the Regional Energy Shortfall Threshold (REST)

*Review of ISO's current thinking and recent
stakeholder feedback*

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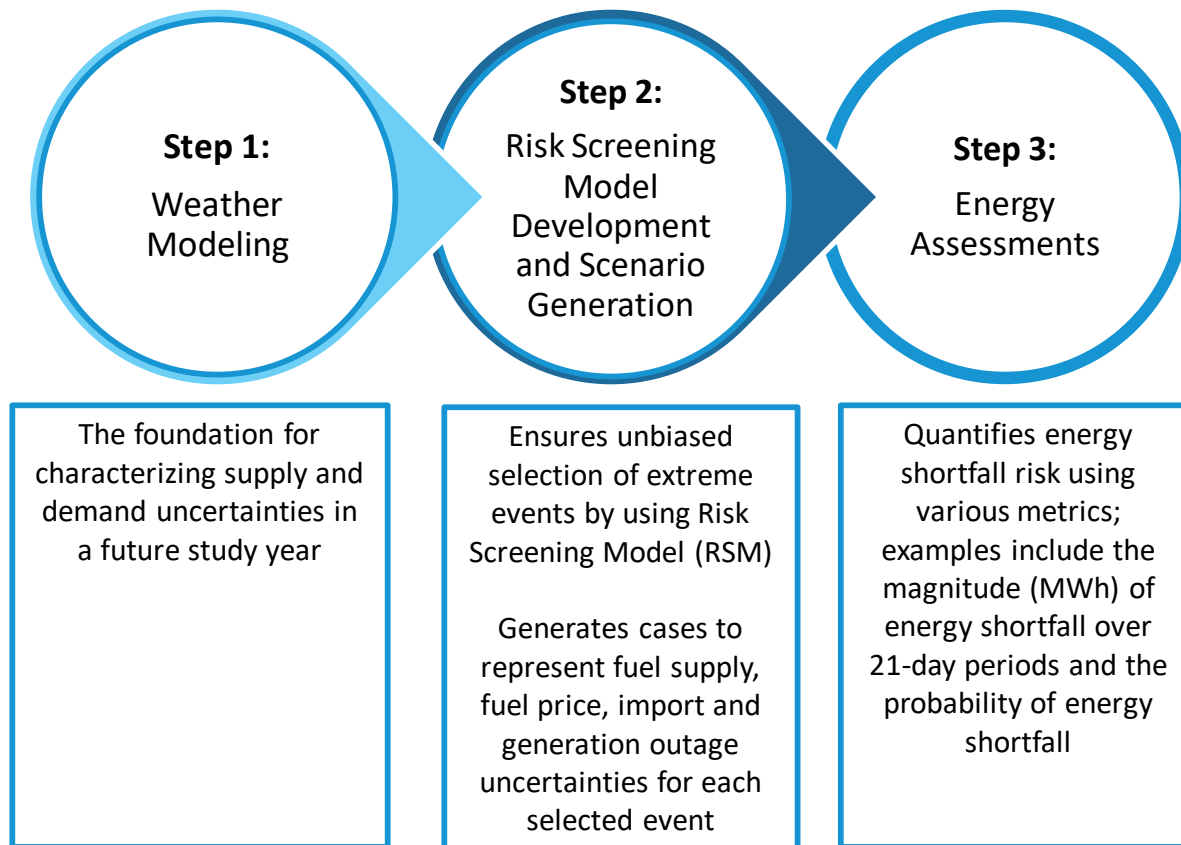


Background: PEAT and REST

- [Study results](#) from ISO's probabilistic energy adequacy study have informed the region on energy shortfall risks during extreme weather events over the next decade
- The Probabilistic Energy Adequacy Tool (PEAT) framework for risk analysis under extreme weather events will be essential for evaluating regional energy shortfall risk as the resource mix evolves and as climate projections are refined
- ISO's initial 2027 and 2032 energy adequacy study results from the PEAT are expected to help inform the development of a Regional Energy Shortfall Threshold (REST)
 - ISO expects that the REST will be a reliability-based threshold that reflects the region's level of risk tolerance with respect to energy shortfalls during extreme weather

Background: PEAT Framework Contains Three Components

- The PEAT framework, consisting of the three steps outlined below, facilitates the performance of probabilistic energy adequacy studies in the operational timeframe under extreme weather events



Introduction to REST

- Following the establishment of the REST, a subsequent effort will evaluate if adherence to the REST requires development of specific regional solutions
 - Examples of possible solutions include market enhancements, responsiveness by end-use consumers, etc.
- This presentation reviews feedback received via the recent stakeholder input form and provides insight to ISO's current thinking with regard to the key components of the REST scope of work
 - ISO's current thinking is intended to prompt continued discussion and stakeholder feedback
 - Part of this presentation also highlights a recent [report](#) from the Energy System Integration Group (ESIG), published in March 2024
 - Highlights the benefits of a multi-metric framework for resource and energy adequacy that considers the impacts of extreme events

Stakeholder Outreach on REST

- A stakeholder input form was distributed by ISO to the members of the Reliability Committee on March 22 and responses were received from 16 organizations
- The form contained 4 questions:
 - 3 questions on the “what”, “when”, and “how” components of the REST scope of work
 - 1 open-ended question to gather general stakeholder feedback on REST
- Responses are summarized throughout this presentation

Review of the REST Scope of Work

- ISO anticipates that the REST scope of work will include, at a minimum, the following components:
 - **When:** Determine the periodicity (*e.g.*, annual, seasonal, etc.) and, as applicable, specify the time horizon over which the region’s energy shortfall risk is assessed against the REST
 - **How:** Specify the event selection process to be used in determining the set of 21-day events to be considered when using the PEAT framework to assess the region’s energy shortfall risk against the REST
 - **What:** Identify the key risk metrics and establish the “threshold(s)”, or criteria, that define the region’s level of risk tolerance with respect to energy shortfall in extreme weather
- An additional item to determine as part of the REST scope of work is the effective date (*i.e.*, the date when the REST first becomes effective); the effective date is expected to represent the first season where the PEAT framework is used to measure energy shortfall risk against the REST

Periodicity of Energy Shortfall Risk Assessments

- The PEAT framework enables ISO to evaluate energy shortfall risk at several periodicities (*e.g.*, annual, seasonal, in-season) over various time horizons
- As part of the REST stakeholder input form, the following question was asked:
 - *Provide recommendations related to the periodicity and horizons for conducting energy assessments, using the PEAT, and applying them to the REST*
- Summary of feedback:
 - There was a notable preference for seasonal assessments ahead of the winter and summer seasons and for annual assessments looking further ahead (*e.g.*, 3-5 years)
 - Several stakeholders made note of the intricacies of timing between seasonal REST assessments and a seasonal capacity market which is currently under consideration

Periodicity of Energy Shortfall Risk Assessments, cont.

- The ISO is considering the application of the PEAT framework in three time horizons:
 - Seasonal (upcoming winters and summers)
 - Annual (future time periods)
 - In-season (contemporaneous, 21-day energy forecasting)

Periodicity of Energy Shortfall Risk Assessments: Seasonal

- ISO's current thinking is that a seasonal assessment of operational peak periods for the energy shortfall risk against the REST criteria is most appropriate
 - This assessment would be performed several months (*e.g.*, 2-4 months) in advance of the start of winter (December – February) and summer (June – August) operational periods
 - The seasonal assessment will evaluate energy shortfall risk over the 21-day operational timeframe within the upcoming season
 - This timing would facilitate the use of the most up-to-date resource mix, demand profiles, and fuel inventory assumptions and also would allow adequate time for implementation of yet-to-be defined solutions in the event that the measured risk exceeds the REST criteria

Periodicity of Energy Shortfall Risk Assessments: Annual

- ISO is also considering the performance of annual assessments of energy shortfall risk with longer look-ahead time horizons (*e.g.*, 3-5 years) beyond the next season
 - Results of annual assessments may provide directional insight into trends of energy shortfall risk when compared to the REST criteria
 - Alternatives include look-ahead periods possibly beyond 3-5 years, but changing trends and transitions may be more speculative

Periodicity of Energy Shortfall Risk Assessments: In-season

- ISO's current thinking is that in-season energy shortfall assessments (*i.e.*, the existing 21-day Energy Assessment forecasts) are *not* best suited for comparison against the REST criteria
 - In-season assessments are expected to continue to be highly effective when used to provide the region with enhanced situational awareness, advance warning, and relief through the implementation of ISO's emergency procedures
 - ISO is considering the extent to which existing Energy Alert and Energy Emergency triggers (documented in ISO's OP-21) will need to be adjusted for better alignment with REST criteria and capabilities of the PEAT framework (ISO intends to include this as part of the REST scope of work)

Extreme Event Selection Process

- With regard to selection of events to evaluate against the REST criteria, ISO's objective is to define a process for selecting a set of extreme 21-day events for study that ensures comprehensive coverage of energy shortfall tail risks
- ISO's initial 2027 and 2032 energy adequacy studies focused on representative extreme 21-day events whereas a comprehensive set of extreme 21-day events will be considered for assessment against the REST criteria
 - In ISO's analysis of extreme weather events in the 2027 and 2032 study years, the PEAT framework was used to select three representative 21-day events from each cluster*, emphasizing from the most extreme to the median weather events; in total, six winter events and nine summer events were studied for each study year
- Event selection is highly dependent on characteristics associated with the weather, the region's resource mix, and demand forecasts

*In ISO's analysis of the 2027/2032 study years, to avoid studying very similar events, clustering techniques were used to group similar events into clusters; several clusters were identified for each year of study

Extreme Event Selection Process, cont.

- As part of the recent REST stakeholder input form, the following question was asked:
 - *Does your organization have any specific recommendations related to the process of extreme event selection? In other words, does the event selection process used in ISO's 2027 and 2032 energy adequacy studies seem appropriate for an analysis of energy shortfall risk against the REST, or should it be enhanced?*
- Summary of feedback:
 - In general, minimal feedback was received on this question, though several stakeholders commented that ISO should study the same events as were studied in the 2027 and 2032 analysis with event selection being updated periodically as assumptions change
 - Some stakeholders commented that ISO should study events representative of the most extreme and the median (similar to 2027/2032 analysis)
 - Some stakeholders commented that deterministic sensitivity analysis should supplement the probabilistic analysis

Extreme Event Selection Process, cont.

- Outline of ISO's current thinking for the extreme event selection process:
 - Rank all possible 21-day events based on average system risk using the PEAT Risk Screening Model (4,680 possible 21-day events exist for each seasonal study period*)
 - Identify extreme event candidates by selecting a percentage (*e.g.*, 3%) of all ranked events
 - Quantify energy shortfall risk for extreme event candidates using the PEAT 21-day energy assessment tool
 - Each extreme event candidate entails multiple cases (*e.g.*, 720 cases); each case is a unique combination of LNG inventories, oil inventories, generator forced outages, fuel prices, and imports uncertainties
 - Energy shortfall metrics can be calculated for each case and for each event, though some extreme events may not show any energy shortfall risk

*4,680 21-day events are possible for each season; 13 weeks/season * 72 years of weather data * 5 global climate models = 4,680 events

REST Metric(s) and Thresholds

- ISO expects that the REST will be a reliability-based criterion that focuses on extreme events and quantifies energy shortfall risk above which may require the implementation of any pre-defined REST solutions beyond existing protocols
 - In defining an energy shortfall risk tolerance, REST metrics are expected to focus on risks associated with extreme events
 - The NPCC “1-in-10” criteria influences procurement of resource capacity to meet resource adequacy; no defined energy shortfall threshold for extreme events exists either regionally or nationally
 - ISO sees the REST criteria as being complementary to the “1-in-10” criteria

REST Metric(s) and Thresholds, cont.

- As part of the recent REST stakeholder input form, the following question was asked:
 - *Provide recommendations with respect to metrics and criteria that your organization believes would be meaningful toward defining a reliability-based threshold that reflects the region's level of risk tolerance for energy shortfalls during extreme weather (i.e., the REST)*
- Summary of stakeholder feedback:
 - Notable preference for an EUE-based metric with some mention of other metrics that capture extreme weather risk
 - Preference for metric(s) that consider probability, magnitude and duration of energy shortfall, % of unserved load, customer impacts, and seasonal differences

REST Metric(s)

- ISO's criteria and considerations for possible REST metric(s):
 - Sensitive to system conditions; it should be expected that margin to the threshold decreases as system conditions worsen
 - Considers the key tail risk attributes, such as the magnitude of energy shortfall over a period of time, energy shortfall duration, and the probability of energy shortfall
 - Correlates to impacts on customers (*e.g.*, potential for customer outages in extreme events)
 - Able to be calculated by ISO, given existing tools and available data
 - Simple to interpret and understand; a single REST metric may be beneficial in terms of enhancing clarity (and facilitating the establishment of well-defined thresholds)
 - Facilitates a cost/benefit comparison of actions to reduce potential energy shortfall
 - Should not need to be modified frequently as the system resource and demand profiles evolve

REST Metric(s), cont.

- A number of options for the REST metric(s) have been considered and ISO's current thinking is that Maximum Normalized 7-day Energy Shortfall is worth considering further
- This metric would represent the system's energy shortfall as a percentage of the system's demand over rolling 7-day periods within the 21-day events
- Maximum Normalized 7-day Energy Shortfall would be calculated as follows:

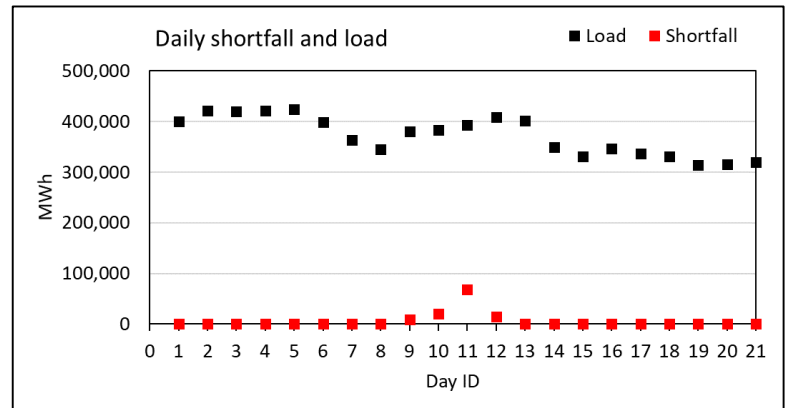
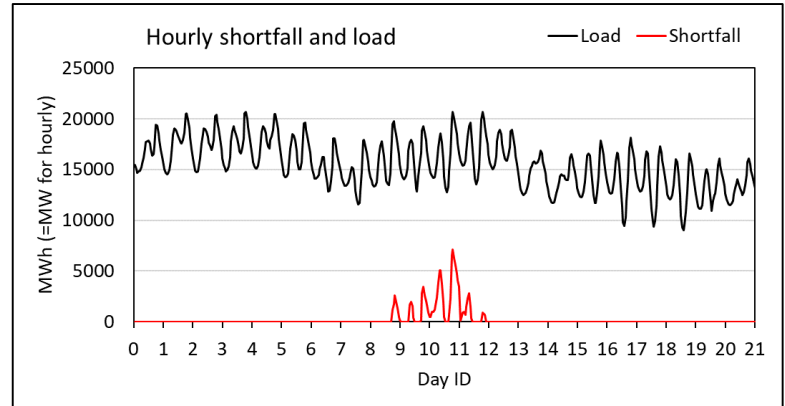
$$MAX \left(\frac{\text{Total MWh shortfall over 7 days}}{\text{Total MWh demand over 7 days}} \right)$$

REST Metric(s), cont.

Maximum Normalized 7-day Energy Shortfall Metric Example

Illustrative examples of metrics based upon the 2027 version of the Jan 22, 1961 event: No NECEC, With EMT, worst case

- Several options for REST metric(s) have been considered, see the table below for a representative sample
- The figures to the right plot energy shortfall and load by hour (top-right) and by day (bottom-right) in one case
- The typical duration of events with energy shortfall is ~7-10 days in ISO's analysis of 2027 and 2032 21-day extreme events



| Metric Option | Value: Absolute | Value: as % of load |
|---|--------------------|---------------------|
| Total energy shortfall over 21 days | 111,352 MWh | 1.4% |
| Max total energy shortfall over 7 days | 111,352 MWh | 4.2% |
| Max total energy shortfall over 1 day | 68,284 MWh | 17.4% |
| Max hourly shortfall | 7,112 MW | 34.4% |
| Shortfall duration | 54 hours | N/A |

REST Metric(s), cont.

- The Maximum Normalized 7-day Energy Shortfall metric meets many of ISO's considerations for candidate REST metric(s), including:
 - Considers key tail risk attributes such as magnitude and duration of energy shortfall
 - Expresses energy shortfall as a percentage of regional demand which is relatable to customer experience in the event that energy shortfall is realized
 - Should not need to be modified frequently as the system resource and demand profiles evolve
- ISO is still considering whether selected REST metric(s) should be calculated based on a subset of the studied events in order to quantify the energy shortfall risk based *only* on tail events (*i.e.*, a conditional expectation of normalized unserved energy (CENUE))

REST Thresholds

- For each metric selected to be part of the REST, ISO expects that appropriate thresholds will be established; thresholds are expected to be informed by the relief expected to be obtained by existing risk mitigation actions
 - ISO is still evaluating whether metrics (and thresholds) are best defined as being representative of energy shortfall risk in *all cases* across all studied events or *only for selected cases* (i.e., those with non-zero risk) within all studied events
- ISO is in the process of studying a number of additional 2027 winter events in order to help quantify a meaningful threshold; this work is expected to continue over the next several months
 - These additional studies are expected to help inform the process for selection of a comprehensive set of extreme events
- ISO expects to return to the Reliability Committee in July with a presentation that reviews ISO's thinking regarding REST metric(s) and associated thresholds

Stakeholder Outreach, General Feedback

- As part of the recent REST stakeholder input form, stakeholders were also asked for general comments or feedback for ISO to consider with regard to the development of the REST
- Summary:
 - Some stakeholders commented that REST should be “customer-centric;” in other words, the REST should relate to the risk to customers
 - Some stakeholders reiterated a preference for deterministic sensitivity analysis in addition to probabilistic analysis
 - Strong stakeholder preference for “in-market” solutions
 - Many commented on importance of study assumptions

Summary of ISO's Current Thinking Regarding the Development of the REST

- Periodicity (*When?*)
 - A seasonal assessment of energy shortfall risk against the REST criteria; longer-term assessments can inform risk trends over time
- Extreme Event Selection Process (*How?*)
 - PEAT-based selection of a set of extreme events would efficiently facilitate the assessment of energy shortfall risk and calculation of REST metrics based on tail risk events
- REST Metrics and Thresholds (*What?*)
 - Maximum Normalized 7-day Energy Shortfall may be an appropriate EUE-based metric that focuses on the unserved energy risk during extreme events
- Additional work is in progress which will aid in finalizing ISO's initial proposal, specifically as it relates to the extreme event selection process and the identification of the appropriate metric(s) and associated threshold(s)

Stakeholder Schedule

**Schedule is subject to change based on progress*

| Stakeholder Committee and Date | Scheduled Project Milestone |
|--|--|
| Reliability Committee December 18, 2023 | Presentation of REST Scope of Work by ISO |
| Reliability Committee May 14, 2024 | Review of ISO's current thinking and stakeholder feedback |
| Reliability Committee July 16, 2024 | Review of ISO's current thinking regarding REST metric(s) and threshold(s) |
| Reliability Committee August/September 2024 | Presentation of ISO's REST proposal |
| Reliability Committee October 2024 | Presentation of any modifications to ISO's REST proposal based on stakeholder feedback |
| Reliability Committee November 2024 | Review of ISO's near-final REST proposal |
| Reliability Committee December 2024 | Presentation of ISO's final REST proposal |

Questions

