Resource Accreditation White Paper

Version 2.1

March 2024

Highlights

- As the resource portfolio rapidly evolves toward more intermittent resources and reliability risk continues to shift, it is critical to improve resource adequacy practices overall and resource accreditation specifically.

- MISO's proposed accreditation reform balances a range of reliability risks by incorporating forward-looking probabilistic analysis and measuring historical performance during periods of high system risk.

Revision History

Version	Date	Note
1.0	05/17/23	First posted draft
1.1	11/01/23	Updates to address stakeholder feedback and additional design details
2	02/27/24	Updates to include additional design details on accreditation method and requirement calculations
2.1	03/28/24	Updates to include clean ups and clarifications to align with MISO's tariff filing

Purpose Statement

This paper provides a primer for the resource accreditation methodology discussed with stakeholders at MISO's Resource Adequacy Subcommittee (RASC). This work began in January 2022 following reforms made to thermal resource accreditation and the transition to a seasonal resource adequacy construct.

This document provides a detailed explanation of MISO's proposed methodology, briefly reviews resource adequacy principles, and provides an overview of accreditation methods. This white paper was first published on May 17, 2023 in draft form with an invitation to stakeholders for input on improvement as the work progressed. The final accreditation design was published on Feb 27, 2024 to educate and provide clarity to stakeholders in preparation for a March 2024 filing. This version contains further revisions made in conjunction with MISO's tariff filing.

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1 Introduction

The transformation of the electricity sector — shaped by a changing resource mix, more frequent extreme weather events, and increasing electrification — creates new and shifting needs and increases the challenges of ensuring sufficient resources during high-risk periods. The Reliability Imperative is the term MISO uses to describe the shared responsibility of its members and states to address the urgent and complex challenges to electric system reliability in the MISO region. MISO's response to the Reliability Imperative consists of a host of interconnected, comprehensive, and prioritized initiatives that aim to address the region's challenges. The Reliability Imperative is organized into four primary pillars: Market Redefinition, Operations of the Future, Transmission Evolution and System Enhancements. Resource accreditation reform is a key component of the Market Redefinition pillar. MISO's August 2020 whitepaper, *Aligning Resource Availability and Need, Changing Reliability Requirements for an Evolving Fleet* highlighted the significant resource portfolio transformation underway in the MISO footprint and provided an analysis that showed changes to planning, markets and operations will be needed to manage these developments.

In 2021, MISO filed with the Federal Energy Regulatory Commission two significant changes to MISO's resource adequacy construct:

- **Sub-annual resource adequacy requirements**: Transition from the summer-based construct to four distinct seasons. Expected outcomes were:
  - Identify reliability needs unique to each season
  - Align resource availability with seasonal needs
  - Facilitate seasonal outages or partial year operations
- **Improved availability-based accreditation for thermal resources**: Assure resources are available when needed most by aligning resource accreditation with availability in the highest-risk periods. Expected outcomes were:
  - Increased confidence that capacity can be counted on when needed most
  - Improved signals for availability and coordination
  - Improved outage coordination processes

These changes were accepted by the Federal Energy Regulatory Commission (Commission) on August 31, 2022,[1] and were implemented as part of MISO's 2023-2024 Planning Resource Auction. After the above filing, MISO and stakeholders turned to the next challenge and began a review of non-thermal accreditation with a priority focus on the greatest reliability impact in the near term. The exploration, analysis and results of that multi-year effort are provided in this whitepaper.

As the resource portfolio rapidly evolves toward more intermittent resources, the reliability risk continues to shift. It is critical that MISO and its stakeholders find additional ways to improve resource adequacy practices overall and resource accreditation specifically. Operational learning from the integration of the nascent battery storage fleet, increasing reliance on load modifying resources, as well as findings from MISO's exploration and identification of sufficient system reliability attributes will continue to inform and shape further accreditation reforms.

[1] *Midcontinent Independent System Operator, Inc.*, 180 FERC ¶61,141 (2022)

1.1 Resource Adequacy Objectives

Resource adequacy refers to the ability of the bulk electric system to serve electricity demand while providing enough excess supply to achieve a threshold level of grid reliability of an industry-accepted target for Loss-of-Load Expectation (LOLE) is one day Loss of Load (LOL) every ten years. In the MISO footprint, the responsibility for achieving resource adequacy rests with Load Serving Entities (LSE) overseen by states as applicable by jurisdiction. MISO facilitates these efforts by administering tariff-defined Resource Adequacy Requirements and Planning Resource Auction, which LSEs use to demonstrate their ability to serve peak demand and provide a sufficient margin of excess supply.

Resource accreditation is the process of accurately measuring and assigning a capacity value to a resource based on its contribution to system reliability during *periods of highest risk*. MISO's role is to measure current accreditation values and forecast future values to inform investment and retirement decisions. If the accreditation methodology is inaccurate, the system is in danger of not having a reliable mix of resources, which increases the likelihood of involuntary load shedding or blackouts.

MISO Market Design Guiding Principles

- Support an economically efficient wholesale market system that minimizes cost to distribute and deliver electricity
- Facilitate non-discriminatory market participation regardless of resource type, business model, sector or location
- Develop transparent market prices reflective of marginal system cost and cost allocation reflective of cost-causation and service beneficiaries
- Support market participants in making efficient operational and investment decisions
- Maximize alignment of market requirements with system reliability requirements

MISO's Market Design Guiding Principles are an important guide to evaluating and developing market enhancements and have been, and will continue to be, used as a foundation for accreditation reform. With these principles as a guide, the fundamental goals of resource accreditation are:

1) Ensure seasonal reserve requirements are met
2) Inform long-term investment and retirement decisions by accurately representing the capacity value of a resource in the prompt year
3) Provide an incentive for resources to develop operating practices and attributes that serve the greatest system need

MISO and stakeholders debated the problem statement related to the accreditation of non-thermal resources, which went through several iterations of feedback and refinement before finalizing the problem statement at the March 2022 RASC meeting.

Problem Statement: Resource accreditation should reflect the availability of resources when they are most needed. Significant growth of variable, energy-limited resources in the MISO footprint, along with changing weather impacts and operational practices, are shifting risk profiles in highly dynamic ways, with implications for resource adequacy and planning. MISO's existing accreditation methods for non-thermal resources require further evaluation to ensure that the accredited capacity value reflects the capability and availability of the resource during the periods of highest reliability risk.

Discussions at the RASC identified the following key considerations to ensure a robust accreditation methodology:

- Reliability contribution during periods of highest reliability risk
- Availability correlation within and across resource types
- All high-risk periods should be considered throughout the year
- Ensure comparability across resource types
- Ability to change availability as needed
- Volatility of reliability contribution over time
- Ability to continuously be available (energy limitations)

1.2 Scope

The scope of the accreditation reform, as identified at the January 2022 RASC, was "to revisit the established accreditation practices for non-thermal resources with a priority focus on those with the greatest reliability impact in the near term, i.e., wind and solar". At the January 2023 RASC, MISO recommended extending the scope of this reform effort to cover accreditation changes for all non-emergency resources instead of just non-thermal resources. This approach aligns the accreditation of all such resources based on a standard method.

MISO follows a product development process, illustrated below in Figure 1-1, to ensure the right solutions are built at the right time and solve the right issues. This paper reviews the framing, evaluation, and design work for Resource Adequacy Accreditation Reform.

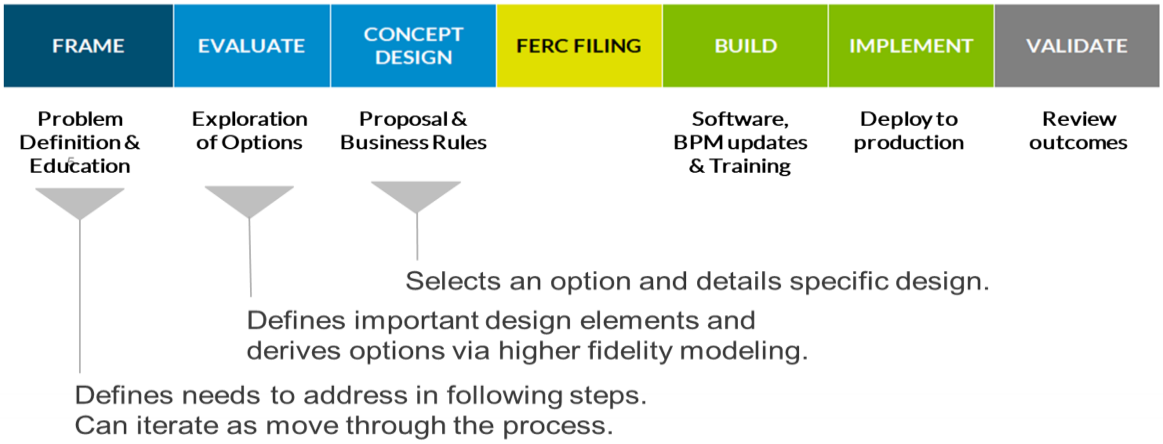


Figure 1-1: MISO's product development process

2 MISO's Accreditation Proposal

2.1 Proposed Accreditation Methodology

MISO's proposed resource accreditation method is based on measuring a resource's expected contribution to reliability using expected class level performance (probabilistic approach) and historical resource level performance (deterministic approach). The proposed accreditation methodology balances a range of reliability risks in the planning and operations horizons by incorporating forward-looking probabilistic analysis and measuring a resource's performance during recent periods of high system risk. Critical hours, defined as the set of Loss of Load (LOL) hours and low-margin hours in the probabilistic model, will be used to determine resource class-level accreditation. Resource Adequacy (RA) hours, which reflect only one observed realization out of many possible scenarios covered in the probabilistic model, will be used to determine resource-specific level accreditation. Critical hours capture the expected contribution of resources under a more comprehensive range of conditions and thus capture a broader set of system conditions than RA hours. On the other hand, RA hours examine the actual performance of the resources during historical high-risk hours. The combination of class-level and unit-level methodologies accounts for both probabilistic and realized risk.

The proposed reform aligns with Market Design Guiding Principles by aligning operational needs with non-discriminatory market and planning requirements and results in transparent market prices that reflect reliability contributions during highest-risk hours.

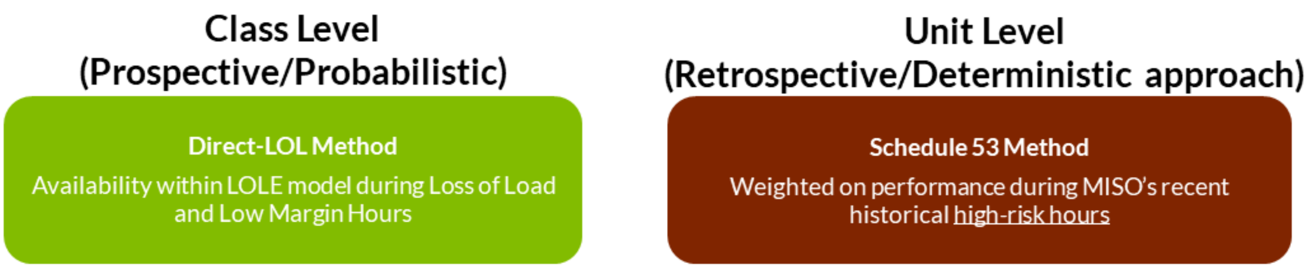


Figure 2-1: MISO's proposed accreditation methodology

MISO proposes a change in how all capacity resources, except external resources, receive capacity credit at the resource class-level as well as how the resource class-level unforced capacity (UCAP) megawatts are allocated amongst specific resources using a two-step process in Figure 2-1.[2,3]

First, the resource class-level UCAP will be determined by the Direct Loss-of-Load (DLOL) method, described in Section 2.2. This step involves the calculation of weighted averages of the availability of each resource during critical hours within the LOLE model as described in Section 2.2.1 and aggregates these values by resource class. The DLOL method provides significant benefits compared to other methodologies, including:

1) Direct alignment between system Planning Reserve Margin Requirements (PRMR), risk, availability, and accreditation

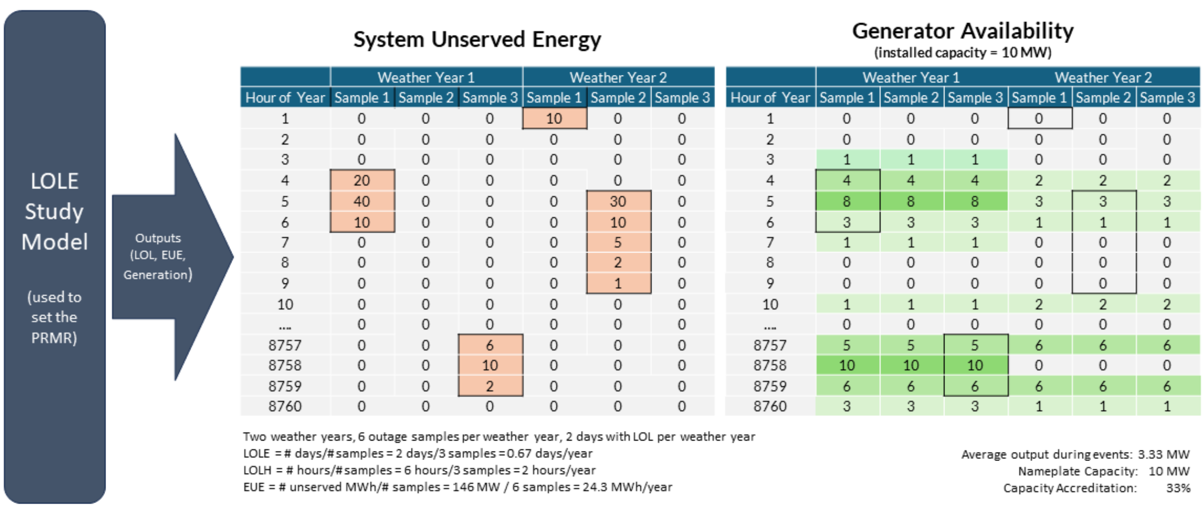
2) A wide range of simulated system conditions that better account for infrequent risks without penalizing individual resources

[2] Accreditation of Load Modifying Resources (LMR) is being considered separately.
[3] All capitalized terms are defined in the Tariff or BPM as appropriate.

As described in Section 2.3, the second step of the proposed process allocates resource class-level UCAP megawatts, determined by the DLOL method, among the individual resources in the class using individual resource real-time availability during Tier 1 and Tier 2 RA hours, which are based on the prior three years of operational experience.[4] This allocation methodology builds on MISO's implementation of tiered weighting of hours for Schedule 53 resources. Tier 2 hours will be weighted at 80%, and Tier 1 hours will be weighted at 20%, consistent with MISO's Commission-accepted RAN methodology for Schedule 53 resources. This approach will create performance incentives for individual resources and improve performance over time when those resources are most needed.

2.2 Direct Loss-of-Load Method for Resource Class

The DLOL resource class-level method examines an individual resource's RA contribution by measuring its ability to serve load during system scarcity in the probabilistic LOLE model. Figure 2-2 illustrates how the DLOL method matches critical hours to resource performance during those hours. The boxes in the two panels show the overlap of resource availability during LOL periods (as an example of critical hours). The hours during which the LOLE model experienced LOL are highlighted in red, and the DLOL results (MW) are the values contained within the black boxes highlighted in green. In the illustration below, the values were averaged across all occurrences of critical hours for each modeled resource and then aggregated to determine the class-level value by resource class.



System Unserved Energy

	Weather Year 1			Weather Year 2		
Hour of Year	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
1	0	0	0	10	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	20	0	0	0	0	0
5	40	0	0	0	30	0
6	10	0	0	0	10	0
7	0	0	0	0	5	0
8	0	0	0	0	2	0
9	0	0	0	0	1	0
10	0	0	0	0	0	0
....	0	0	0	0	0	0
8757	0	0	6	0	0	0
8758	0	0	10	0	0	0
8759	0	0	2	0	0	0
8760	0	0	0	0	0	0

Generator Availability (installed capacity = 10 MW)

	Weather Year 1			Weather Year 2		
Hour of Year	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	1	1	1	0	0	0
4	4	4	4	2	2	2
5	8	8	8	3	3	3
6	3	3	3	1	1	1
7	1	1	1	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	1	1	1	2	2	2
....	0	0	0	0	0	0
8757	5	5	5	6	6	6
8758	10	10	10	0	0	0
8759	6	6	6	6	6	6
8760	3	3	3	1	1	1

Figure 2-2: Illustrative DLOL accreditation calculation[5]

The following is a description of the calculation of accreditation using the DLOL method, including details of hour selections and weighting. Figure 2-3 provides a graphical representation of steps to calculate resource class-level

[4] A class-level percentage will be used for resources with insufficient data.
[5] Adapted from https://www.esig.energy/new-design-principles-for-capacity-accreditation/

UCAP and will be referenced throughout.

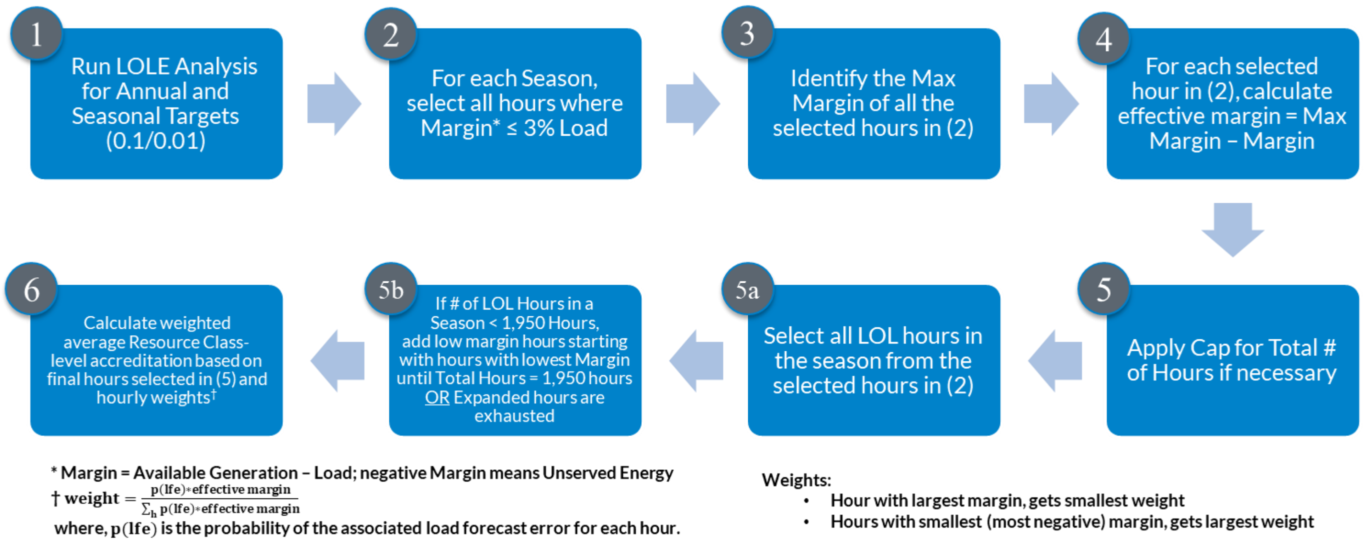


Figure 2-3 Flow chart of hour selection and weighing

The MISO LOLE analysis performs a Monte Carlo probabilistic simulation using 30 years of correlated load and weather data for each of five load forecasts. MISO determines the adjustment to capacity in the probabilistic model that would bring the MISO system to the 1 day in 10 years LOLE standard on an annual basis—however, the distribution of that annual LOLE of 0.1 across the four seasons determines for which seasons the annual adjustment to capacity can be used. If, on an annual basis, a season is not showing a minimum of 0.01 LOLE, we further reduce capacity in the model through a negative adjustment unit to find the point at which no risk becomes some risk for that season, which was defined in MISO's seasonal construct design as 0.01 LOLE. See the *Planning Year 2023-2024 Loss of Load Expectation Study Report* for more information about the LOLE study.

To calculate the Resource Class-level accreditation, the following steps are followed:

1) The Monte Carlo simulations are performed, ensuring that the model converges on the LOLE target,

2) For each season, select the hours where margin is below 3% of the load for the hours, where margin equals total available generation plus net imports minus load. This selection includes two subsets of hours: a loss of load hour, where there was a loss of load due to available generation being less than the required load (when margins are negative), and low-margin hours, where there was no loss of load, but the margin was less than 3% (positive margins).

$$margin = \sum generation - load + net\ imports$$

3) Within each season, the maximum margin is identified from the low-margin hours extracted in Step 2 above.

4) For each hour selected in Step 2, calculate "effective margin" for each hour as the maximum margin from Step 3 minus the margin in the hour. This creates a value that is positive for all hours, is largest for the hours with the smallest margin (or highest loss of load in the hour) and is zero for the hour with the largest margin (i.e., the least problematic hour).

$$effective\ margin = Max(margin) - margin$$

5) The number of hours used is capped within each season using the following procedure:

a. All LOL hours are used in the final calculation, regardless of the number of LOL hours.

b. Applying the logic of 65 Tier 2 RA hours per season from the current Schedule 53 calculations for each weather year used in the LOLE model, MISO selected 65 times 30 equals 1,950 hours per season as the cap for number of hours for the resource class-level UCAP calculations. If there are more than 1,950 LOL hours, no low-margin hours are used. If there are fewer than 1,950 LOL hours per season, hours will be selected from the low-margin hours, beginning with the smallest margin until the cap is reached or until all low-margin hours within the season have been selected. If there are fewer than 1,950 hours between the LOL and low-margin hours, then all LOL and low-margin hours are used, and the cap will not be reached. LOL hours will never be excluded, and hours with greater than a 3% margin will never be included. The complete set of hours selected in this step are called "critical hours."

6) The total generation by class is calculated for each hour selected in step 5. The generation across these hours is performed for each season using a weighted average. This represents the resource class-level UCAP megawatt, the megawatts that a resource class is expected to contribute during each season in the LOLE model. The weights are calculated as the product of two values: a) the probability associated with the load forecast error the hour belongs to (noted as *p(lfe)*), and b) the effective margin weight developed in step 4. The weights are normalized so that the sum equals one (1).

$$weight = \frac{p(lfe) \cdot effective\ margin}{\sum_h p(lfe) \cdot effective\ margin}$$

The load forecast error (LFE) values are included in the probabilistic analysis to account for economic load uncertainty and are documented in further detail in MISO's LOLE Study Report. By way of example, the probability associated with each load forecast error that was used in the Planning Year 2023-2024 LOLE Study can be found in Table 2-1 below.

LFE	-2	1	0	1	2
Probability	0.050	0.242	0.413	0.242	0.050

Table 2-1 Probability associated with each load forecast error

MISO considered alternative weighting schemes to that described above. The weighing scheme described in step 3 above was adopted as the best option evaluated. Other weighting options considered include:

1) Weighing by the max margin within the associated weather year

a. This weighing scheme suffers from the problem of potentially reordering the hours. Consider an hour with a 200 MW margin and another with a 150 MW margin. If the max margin in these years is 300 and 200, respectively, then the weight will assign a value of 100 MW and 50 MW, respectively. This reorders the hours so that the 150 MW margin receives a lower weight than the 200 MW margin.

2) Weighing each hour equally

a. This weighing scheme treats an hour with 5,000 MW Expected Unserved Energy (EUE) the same as an hour with a 50 MW positive margin. This would be inappropriate as an hour with 5,000 MW of EUE presents a much higher reliability risk than one with a low margin of 50 MW.

3) Weighing LOL hours with a flat percentage and low-margin hours with another flat percentage, such as 80%/20%.

a. This weighing scheme creates the issue where an hour with low margin may receive larger than their share of the weight. Consider a year in which there are 1,900 LOL hours and only 50 low margin hours. This weighing scheme would give 50 hours 20% of the weight, meaning each hour receives 0.4% weight, while the other 1,900 hours would receive 80% of the weight, meaning each hour receives roughly 0.04% of the weight. In the extreme a single low margin hour could account for 20% of the total weight of the final accreditation despite there being 1,949 LOL hours.

These issues are addressed by weighing by margin and normalizing this weight to a fixed value across all weather years.

2.3 Schedule 53 Methodology for Allocation of Class Level

This section summarizes the allocation of resource class-level UCAP megawatt to each resource in the class. MISO's resource-level accreditation proposal uses the Commission-approved seasonal accreditation methodology for Schedule 53 resources as a foundational block.

Tier 1 and Tier 2 RA hours over the previous three years of operations are used to determine resource availability for calculating seasonal accreditation. Tier 1 will determine each resource's real-time offered availability during normal operating condition hours, and Tier 2 will determine each resource's real-time offered availability during hours with the most difficult operating conditions, including declared maximum generation events. Tier 2 is more heavily weighted so that most of a resource's accreditation will be based on its availability during times of reliability need. The number of Tier 2 RA hours in a season could exceed the target, 65 hours when a high number of hours are accrued due to declared system or subregional emergencies.

Tier 1 and Tier 2 hours ensure that individual resources are compared to other resources within their resource class when the system experiences the highest operational risk. For instance, resources in the solar class may have no output during evening risk hours, but all resources would be affected in the same manner and the allocation within the class would not be impacted. Resources with better performance during Tier 1 and Tier 2 hours receive a larger slice of the overall class-level value. The proposed number of Tier 1 and Tier 2 hours is large enough to provide stability for calculations.

If there are less than 65 Tier 2 RA hours in a season (deficient hours), seasonal resource class-level UCAP as a percentage of resource class-level ICAP capacity is used for resource availability during those deficient hours. All other aspects of the current Schedule 53 design, including outage exemptions, tier weighting and lead time considerations, remained unchanged.[6]

Table 2-2: Example calculation of DLOL and the Schedule 53 Method for a provides a simplified example of how the class-level value determined by the DLOL method is allocated to individual resources in a five-resource class. First, the Intermediate Seasonal Accredited Capacity (ISAC) is calculated by weighing Tier 1 hours at 20% and Tier 2 hours at 80%. The Seasonal Accredited Capacity (SAC) for each unit is calculated by distributing the class-level value from the DLOL model, 50 MW, among the units, proportional to their class level ISAC value, which is the sum of SAC for all units equals the class-level value. Lastly, each unit's percentage credit is calculated by dividing the unit's SAC by its ICAP value.

[6] See Resource Adequacy BPM-011, Appendix Y for further details.

Resource	ICAP	Tier 1 Hour Availability	Tier 2 Hour Availability	Intermediate SAC (ISAC)	Final SAC	% Credit (SAC/ICAP)
Resource class-level UCAP megawatt determined by the DLOL method from LOLE analysis = 50 MW						
Unit 1	5	2	3	2.8	2.6	52%
Unit 2	10	7	8	7.8	7.3	73%
Unit 3	15	12	14	13.6	12.7	85%
Unit 4	20	10	16	14.8	13.9	69%
Unit 5	25	12	15	14.4	13.5	54%
Total	75	43	56	53.4	50	67%

ISAC = (Avg. Tier 1 Availability x 20%) + (Avg. Tier 2 Availability x 80%)

Final SAC = (Resource Class-Level UCAP Megawatt) * (Unit ISAC/Total Class ISAC Megawatt)

Table 2-2: Example calculation of DLOL and the Schedule 53 Method for a two-resource system

3 Overview of Current Accreditation Methodologies

MISO's current accreditation methodologies for thermal, wind and solar resources are shown in Figure 3-1.

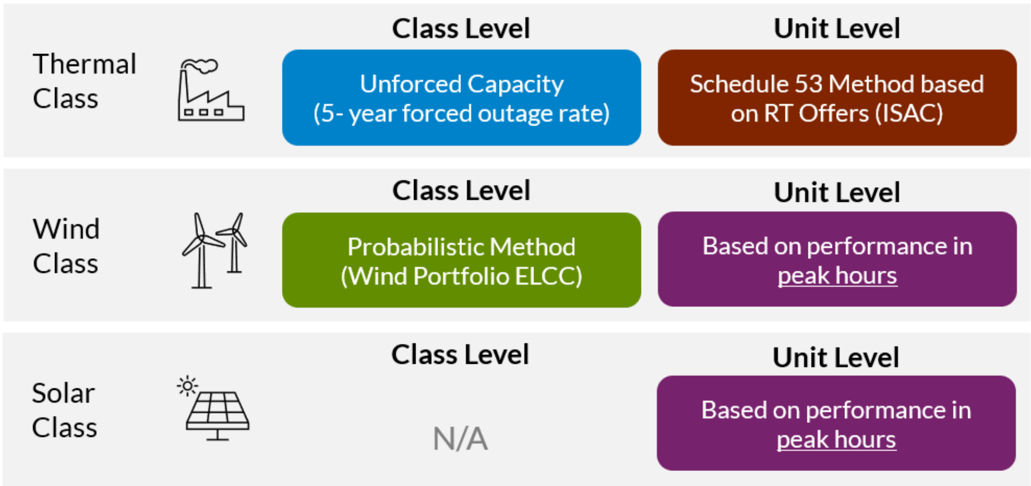


Figure 3-1: Summary of existing wind and solar accreditation methodologies

3.1 Thermal Resources (Current Methodology)

The current resource class-level accreditation for thermal resources, unforced capacity, is determined based on a resource's performance between January 1 and December 31 of the five years before the planning year. Market participants submit North American Electric Reliability Corporation (NERC) Generator Availability Data System (GADS) data to MISO every quarter. The resulting UCAP is the basis for the class-level value for most thermal resources.

Schedule 53 describes the process of determining a resource's ISAC value and how each resource derives its final SAC value. Schedule 53 allocates the total systemwide UCAP value to individual resources based on their performance during resource adequacy hours. The final ISAC for each resource in each season of the planning year becomes part of the systemwide conversion ratio for each season. The ratio is applied to each resource's ISAC to determine a resource's final SAC value for each season. SAC values are communicated to market participants by December 15, prior to the Planning Resource Auction.

Under Schedule 53, a two-tiered calculation determines individual resource accreditation by season. The Tier 1 will determine each resource's real-time offered availability during normal operating condition hours, and the Tier 2 will determine each resource's real-time offered availability during hours with the most difficult operating conditions, including declared maximum generation events. Tier 2 is more heavily weighted so that the majority of a resource's accreditation will be based on its availability during times of reliability need. Figure 3-2 shows the process of calculating Tier 1 and Tier 2 ISAC for a resource.

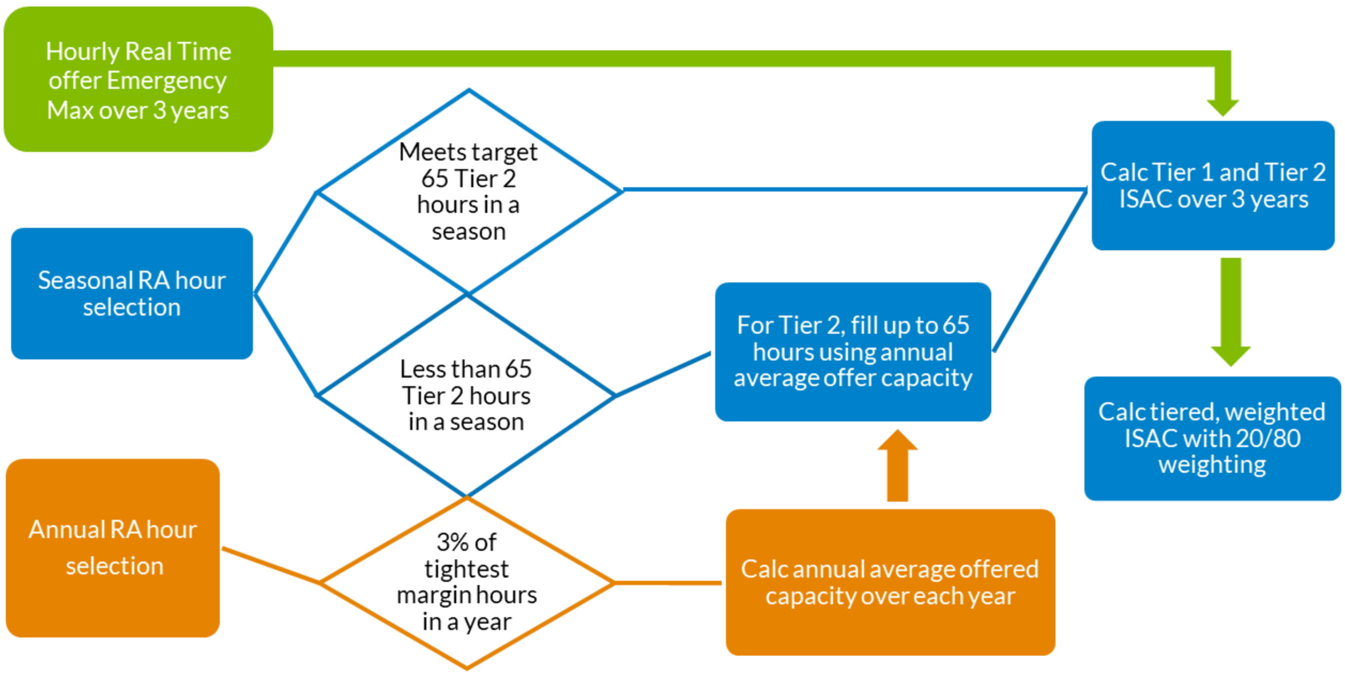
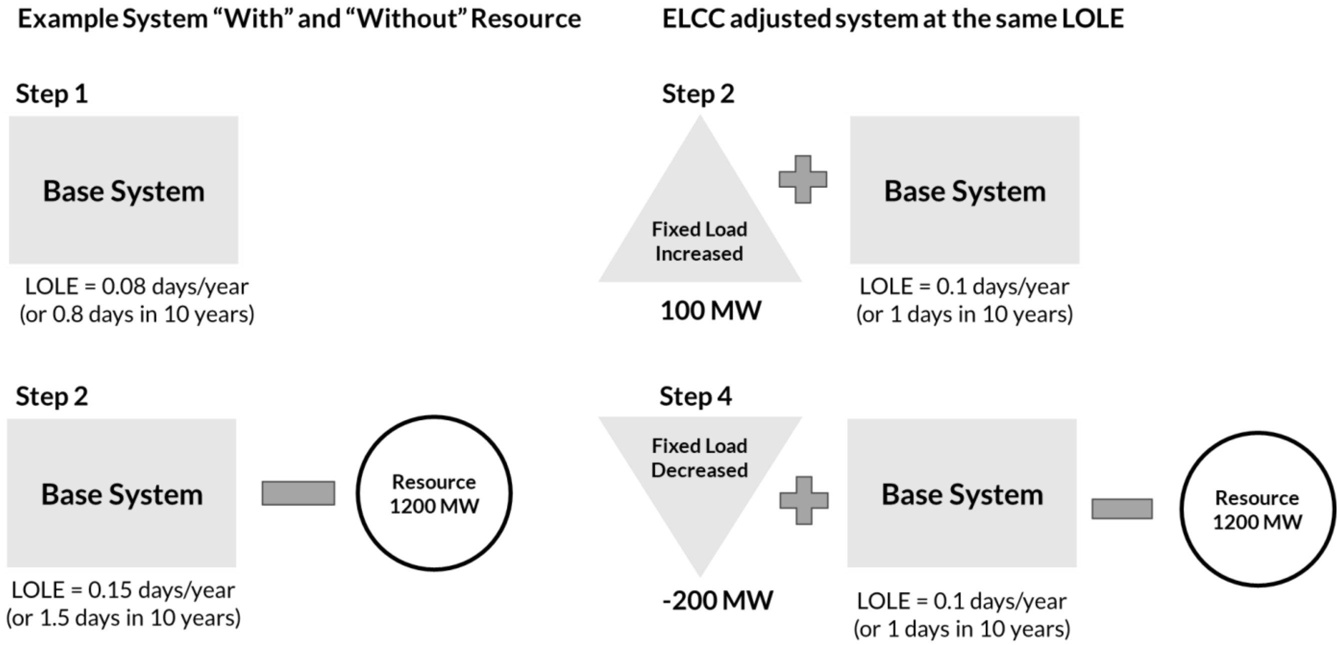


Figure 3-2: Process of calculating Tier 1 and Tier 2 Seasonal Accredited Capacity

3.2 Wind Resources (Current Methodology)

MISO uses the average Effective Load Carrying Capability (ELCC) method to capture the reliability contribution of the front-of-meter wind resource class in each season. The ELCC method relies on results from the LOLE model. This method first calculates a base system LOLE. Adjustments are made to the model until the average LOLE across all weather years reaches the seasonal LOLE criteria. When LOLE is less than the target seasonal criteria, a fixed load is added. When LOLE is greater than the target seasonal criteria, typical proxy generation is added. This process repeats until the target seasonal criteria is reached.

The same calculations repeat without the studied resource class. A new base-system LOLE is calculated for the base system without the resource class in question. Adjustments are made to that model until the average LOLE across all weather years used in the LOLE model reaches the seasonal LOLE criteria. Figure 3-3 illustrates the steps used to calculate the average ELCC. The average ELCC for the resource class in each season is the difference in load/generation adjustments between the two models (with and without the resource class resource, or Step 4 minus Step 2, respectively, in Figure 3-3) divided by the total registered maximum output of the resource class in question.



$$\text{Example Resource ELCC \%} = \frac{(-200\ MW - 100\ MW)}{1200\ MW} = 25\%$$

Figure 3-3: Illustrative average ELCC calculation[7]

The class-level seasonal accreditation value for wind that is determined by the average ELCC analysis is allocated to the individual in-service and front-of-meter wind resources based on the individual wind resource's historical performance during each season's top eight system coincident peak load hours over the most recent three planning years pertaining to each season. Where available, their offered availability is used for wind resources that are Dispatchable Intermittent Resources (DIR). MISO does not dispatch non-DIR wind resources and does not provide offers to the MISO energy markets. Subsequently, only its settled generation in the real-time energy market is used to measure availability.

3.3 Solar Resources (Current Methodology)

Solar resources have their class and unit level SAC values determined based on the three most recent planning years of the historical average output of the resource for hours ending 15, 16 and 17 EST for the summer, fall and spring months, and hours ending 8, 9, 19 and 20 EST for the most recent winter months.[8] Solar resources with less than 30 days of metered values for a given season will receive the seasonal class average for their initial planning year. The seasonal class average for a new solar resource for summer, fall and spring is 50%, while the seasonal class average is 5% for winter.

[7] Modeling of the ELCC adjusted system at the same LOLE is an iterative process.
[8] Resources with less than three years of data will have SAC values determined based on historical data if it has 30 days in each season.

4 Evaluation of Accreditation Methodologies

MISO approached the evaluation of accreditation reform by examining a wide range of possible methods to address the problem statement. The evaluated methodologies for accreditation can be broadly divided into two categories: 1) average accreditation approach (like average ELCC) and 2) marginal accreditation approach, which includes marginal ELCC, Marginal Reliability Impact (MRI) and DLOL. MISO developed an evaluation criteria and analysis framework to compare modeling results and help guide decisions on the best method for the MISO region. This section reviews alternative methodologies considered and compares these methodologies against the evaluation criteria.

4.1 Accreditation Options Considered

For evaluation, the following high-level accreditation options were considered as part of the qualitative evaluation (Table 4-1). MISO also examined how other jurisdictions are approaching accreditation.

Category	Method	Description
Accreditation for resource class	Deterministic: Resource adequacy hours	Based on the historical performance during the resource adequacy hours based on new RAN construct
	Deterministic: Peak or net-peak hours	Based on the historical performance during the peak or net-peak load hours
	ELCC: Marginal	ELCC determined based on marginal contribution to system needs
	ELCC: Class average	ELCC determined for each resource group either: (i) With the resource group in the system (ii) Without the resource group in the system
	ELCC: Adjusted class average	Class average ELCC adjusted to ensure that the ELCC of the entire portfolio (all resources) isn't exceeded
	ELCC: Delta method	Each resource's last-in ELCC is adjusted either up or down according to the difference between its last-in and first-in ELCC in a manner such that the sum of accredited ELCCs to all resources equals the ELCC of the portfolio [9]
	EFC (Effective Firm Capacity)	EFC (Effective Firm Capacity - Probabilistic; this method is similar to ELCC)
Allocation of accreditation for generation within a resource group	Resource adequacy hours only	Each resource receives accreditation proportional to its contribution during the RA hours determined based on the new RAN construct
	Peak hours or net-peak hours	Each resource receives accreditation based on the historical performance during the peak, or net peak load hours
	ELCC (each unit)	Estimate ELCC for each generation unit individually

Table 4-1: Considered resource accreditation options

MISO examined a broad range of solutions from prospective/probabilistic to retrospective/deterministic. Prospective methods refer to a solution that examines many potential system conditions and risks that may happen but haven't necessarily been observed. Retrospective methods refer to a solution based on actual operations experience and observed risk. Blended methods attempt to merge these two perspectives into a single view. Figure 4-1 illustrates how the considered methods fit in the continuum from probabilistic to deterministic. At least one option was considered that fit within each of the probabilistic and deterministic perspectives.

[9] https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf

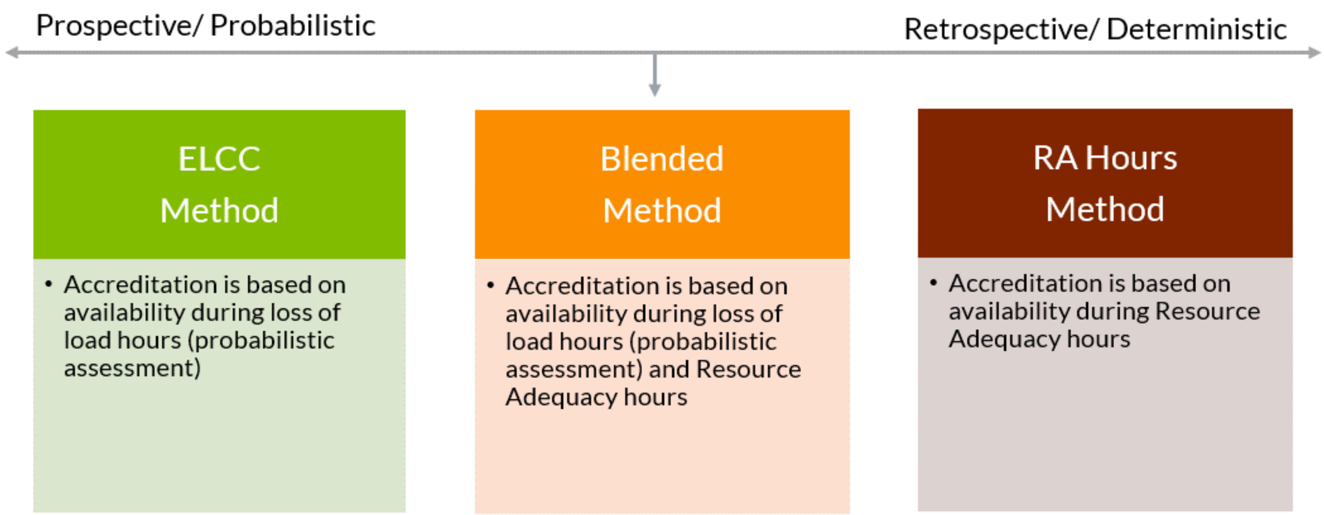


Figure 4-1: Spectrum of prospective and retrospective evaluation options

These options were reduced to a smaller set of options to be examined in quantitative analysis and discussed with MISO stakeholders. Figure 4-2 provides further description and rationale for each option evaluated.

Method	Description	Rational for Inclusion
ELCC Class Average (Average)	Effective Load Carrying Capability (ELCC) for a resource class is determined by measuring the amount of perfectly available capacity added to the model to maintain the same reliability target from the base system to the system with the resource class removed, then dividing by the total rated maximum capability of the resources in that class.	This option is currently being used at MISO and will serve as the reference case, though MISO anticipates the approach's accuracy will be challenged by multiple technology types (e.g., wind and solar)
ELCC Class Average (Marginal)	Same as Average ELCC except that a single resource is removed rather than the entire resource class.	This option could demonstrate a method for addressing technology diversity effects that are ignored in class average option
Blended (Retrospective/prospective)	Composite of prospective and retrospective approaches. Accreditation is based on historical performance during RA hours and projected loss of load expectation (LOLE) risk periods.	This option could draw from the beneficial aspects of both the prospective and retrospective risk assessments.
RA Hours (Resource Adequacy Hours)	Accreditation is based on the historical performance during the RA hours.	This option aligns with the thermal accreditation filing.

Figure 4-2: Detailed description of evaluation options

4.2 Alternative Marginal Approaches to Direct-LOL

4.2.1 Marginal ELCC Methodology

While the average ELCC methodology captures the overall capacity contribution of each resource class, the marginal method captures the capacity contribution of an incremental resource. In general, marginal ELCC calculation follows the steps in the average ELCC calculation (Figure 3-3). First, a base system LOLE is calculated, then adjustments are made to the model until the average base system LOLE across all weather years reaches 0.1 days/year. In the case of marginal ELCC, the same calculations are then done, adding an incremental resource. A new base system LOLE is calculated with the incremental resource. The adjustments are made to the model until the average base system LOLE across all weather years reaches 0.1 days/year. The marginal ELCC for the incremental resource is the difference in load/generation adjustments divided by the ICAP of the incremental resource in question. The marginal ELCC calculation requires a series of iterations until the LOLE goal is reached.

4.2.2 Marginal Reliability Impact (MRI) Methodology

The MRI method is an alternative to capture the marginal capacity contribution of a resource type that is less computationally intensive than the marginal ELCC method. Instead of determining a difference in fixed load adjustment values, the MRI method compares the impact of the marginal unit to the system's LOLE and that of adding a perfect unit of the same capacity. This process relies on a fixed, determined number of LOLE simulations. In contrast, the ELCC-base method requires an iterative process to calculate the fixed load adjustments that lead to the target LOLE value.

The MRI calculations rely on a starting point for the base system. This can be an "as-is" model of the system or the system with adjustments so that the average base system LOLE across all weather years reaches 0.1 days/year. Starting with the base system, the LOLE is recorded with two independent modifications: adding the incremental resource and adding a perfect unit of the same capacity. The capacity contribution of the resource is calculated as the change in LOLE when the incremental resource is added and the delta when the perfect unit is added. The following equation shows the mathematical definition of capacity contribution calculated through the MRI method:

$$CC_{MRI} = \frac{LOLE_{Base} - LOLE_{Marginal\ Capacity\ Change}}{LOLE_{Base} - LOLE_{Perfect\ Unit}}$$

4.3 Average Versus Marginal Accreditation Approaches

One of the most significant differences between the current and considered accreditation methods is the linkage of resource contributions and system risk under each method. Average approaches accredit the entire resource class based on the entire fleet's contribution. In contrast, marginal approaches measure the contribution of the next incremental addition to the resource class. This section discusses the implications of each method in a large system like MISO.

MISO's current accreditation methodology for wind resources is average ELCC, which aligns availability with need but not actual risk, meaning a wind resource's average ELCC does not align with the availability during modeled LOL periods. Average ELCC uses the entire resource class contribution to accredit the resource. This methodology's goal is to understand how much of the total system output is attributable to the resource class.

This methodology was sufficient when the wind on the MISO system was small and only wind resources were being evaluated. However, a significant drawback of this methodology is that, by removing an entire resource class, the risk profile of the aggregate system changes. Therefore, results obtained from this methodology measure how the risk profile changes in the system instead of the actual goal, which is to measure the resource class's contribution to the system. In other words, average ELCC calculations performed under this method demonstrate the resource class's impact on overall system risk rather than the value the resource class has to the aggregate system.

Marginal approaches focus on the contribution of incremental changes to the resource type, which results in an analysis and accreditation more aligned with expected and actual risk, as small changes do not substantially alter the risk distribution of the system. To maintain a reliable system, a marginal approach more closely aligns resource availability to the need of the system being examined for the resource. This closer alignment with actual risk provides a clear investment signal for the most efficient new resource in the prompt year. Similarly, it can better inform retirement and investment decisions by accurately accrediting resources based on their contribution to reliability.

Another important consideration between average and marginal accreditation is the ability to capture interdependencies between resource types. Because average accreditation of large resource classes can measure the difference between systems with very different risk distributions, it is very difficult to measure the interaction between resource types accurately. This leads to an inability to add the accreditation values of separate resource types together to measure the total accredited capacity of an entire fleet and distorts the Planning Reserve Requirement. This issue gets persistently worse as ELCC measures more resource types. There are some proposals to correct these so-called "portfolio" effects. Still, they require a significant number of time-consuming calculations, and there is no industry-accepted standard way to resolve this issue. Because the incremental amount of the resource class is small, marginal accreditation maintains consistency between the risk distribution across all cases. Consequently, this method can include the interactive effects and add the accredited capacities of resource types.

The marginal accreditation methods, calculated on a marginal basis, more closely link resource planning to operations because the accredited capacity of a resource is determined based on its most likely contribution during times of need and accounts for the real-time availability of the resource. Using a marginal approach for accreditation in the capacity market sends a price signal for the next increment of investment and helps to bridge planning to operations. In addition to the pricing effects, marginal accreditation also helps ensure that the values assigned in the prompt year match those that will be reflected in the operating horizon.

4.4 Evaluation Criteria

In addition to referencing MISO's Market Design Guiding Principles, MISO evaluated accreditation methodologies for conceptual design against five general criteria: impact, feasibility, flexibility, stability, and after stakeholder feedback, comparability, Figure 4-3. These were developed based on criteria previously used for the RAN initiative, presented at the October 2020 RASC, and modified based on stakeholder input. MISO considered "non-discriminatory" as a criterion but opted to place it as a part of the flexibility criterion.

Figure 4-3: Evaluation criteria

4.4.1 Impact

A method's impact is identifying and sufficiently mitigating actual risk under current and future portfolios and grid conditions in conjunction with markets and operations. Impact ensures sufficient capacity in the planning horizon when it's needed to maintain reliability. The method should measure performance in scarcity conditions and link planning to operations. This criterion is complemented by one of the "pillars of accreditation" identified by the Energy Systems Integration Group (ESIG), which states that the accreditation method should support resource adequacy and consider energy sufficiency requirements, not just capacity availability. Another impact to consider is whether the methodology is probabilistic, deterministic, or both, and how it aligns with the LOLE risk model.

4.4.2 Flexibility

Flexibility is accommodating the evolving resource portfolio and technologies to help mitigate shifting risk across all periods. Additionally, all resource classes must be treated comparably regarding their accreditation methodology. In other words, an accreditation methodology that is non-discriminatory amongst resource classes.

4.4.3 Feasibility

Feasibility is the practicality, scalability and administrative feasibility of implementation for both MISO and its market participants, as well as clarity and transparency of the process. Market participants need to be able to forecast future capacity values to attract investment, and complicated processes can be impossible to replicate.

4.4.4 Stability

Stability is reasonably informing state and utility resource planning processes that rely on accreditation information as an input to long-term decision-making. The method should not only remain robust under changing conditions but should also be able to reflect changing conditions as the system resource mix and load profiles evolve.

4.5 Evaluation Results

The evaluation results were presented at the August 2022 RASC (summarized in Figure 4-4). Green indicates the most favorable rating, while red indicates the least favorable rating. MISO's proposed approach is to use an approximation[10] method for resource class-level accreditation for all capacity resources, except external, which aligns with the DLOL method proposal.

[10] ELCC approximations could include other simplified LOLE based methods (e.g., NYISO's marginal reliability improvement or other LOLE study processing) pending further investigation of accuracy and feasibility implications.

		Unit Level	Class Level	Impact	Flexibility	Feasibility	Stability
	MISO's Current Wind Method	Performance during *eight peak hours*	Average Individual-ELCC				
Recommendation	**ELCC Approximation Adjusted by RA Hours**	Performance during *seasonal RA Hours*	Seasonal, Marginal Portfolio-ELCC				
	RA Hours Only	Unit Performance During Seasonal RA Hours					
	Blended Option A	Average between actual unit performance during seasonal RA Hours and modeled class-level seasonal average portfolio-ELCC					
	Blended Option B	Sum of unit actual performance during RA hours; seasonal and unit actual performance during simulated loss-off-load hours					
	MISO's Thermal Proposal (Reference)	Seasonal RA Hours	Unforced Capacity (UCAP)				

Figure 4-4: Results of evaluation (green is better, red is worse)

4.6 Evaluation Conclusion

Based on the evaluation of accreditation options against the evaluation criteria and the problem statement, MISO proposes using the DLOL methodology ELCC approximation adjusted by RA to determine class-level accreditation for all non-emergency resources with unit-level performance accredited based on MISO's approved Schedule 53 methodology. This proposal aligns with the principal concept developed for thermal accreditation — accredit each unit based on availability during times of need. A Schedule 53 methodology is used for unit-level allocation based on performance during times of need while accounting for unique long-term risks by incorporating the probabilistic DLOL approach. Figure 4-5 summarizes how the proposed accreditation methodology and currently used methods compare across MISO's evaluation criteria.

Method	*Class & Unit Levels*	Impact	Flexibility	Feasibility	Stability
MISO's current Wind method	**Class:** Average Individual-Load Carrying Capability (ELCC) **Unit:** Performance during peak hours	Aligns availability with current risk but is disconnected from future risk	Extending to many other resource types misses synergistic effects	Computationally difficult and hard to understand as method scales	Results averaged over a range; doesn't inform the future as well
MISO's current Solar method	**Class:** N/A **Unit:** Performance during peak hours	Doesn't align changing needs with availability	Easily extendable to other resource types	Computationally efficient and easy to administer	Easy to predict but doesn't reflect changing conditions
Direct-LOL method	**Class:** Availability during critical hours **Unit:** Seasonal Tier 1 and Tier 2 RA hours	Direct alignment between availability and reserve requirements: Account of probabilistic and realized risk, compensation for desired behavior	Easily extendable to other resource types, accounts for synergistic effects	Computationally efficient and easy to administer	Results dependent on resource mix; informs the future well

Figure 4-5: Evaluation Criteria Comparison of DLOL to Current Methods

The DLOL approach provides a direct alignment between accreditation and planning reserve requirements. The availability during LOL hours sets accreditation and reliability contribution during periods of highest risk, and the LOL hours are determined by applying the 0.1 day/year LOLE reliability criteria. Additionally, the sum of the accreditation values is directly aligned with the LOLE process used to determine the PRMR value. The current approach for wind can align availability and need for that class, but the actual need within the model is when the LOL hours occur, i.e., when reliability risk is the highest. The DLOL approach also better accounts for the balance between probabilistic risk and operational risk and compensates resources based on performance when those resources are needed most. For these reasons, the DLOL best meets the impact criterion.

As for the flexibility criterion, the DLOL approach can be applied to all non-emergency resource classes, which provides comparable treatment for all resource types. MISO has different methodologies for accrediting resources, and the DLOL approach will bring all non-emergency resources under one umbrella regarding accreditation. This is non-discriminatory amongst resource classes, which stakeholders have voiced as needed.

The DLOL approach uses one LOLE model run for the feasibility criterion to determine the accreditation value of resources and the PRMR. The current wind approach needs at least three LOLE runs to determine accreditation and requirements. If the approach currently used for wind was extended to other resource classes, it would become very complex as the analysis would require many more LOLE runs.

Lastly, it is important to have stability in the metrics and the ability to forecast. Both methods, current wind and the DLOL, can provide stability. However, given the expected shift in risk, the DLOL method provides better signals for the future and can evolve with the modeled resource mix. DLOL also captures the synergistic effects amongst resource classes because all resource classes are within the model when measuring availability, accreditation and setting the requirements. The current approach for wind may miss the synergistic effects between resources because of the need to remove a certain resource class from the modeling to determine the ELCC.

5 PRMR Calculation

The principle to determine the Planning Reserve Margin Requirements (PRMR) remains unchanged with the proposed accreditation change. PRMR is still determined as the sum of accredited values within the LOLE model for all capacity resources, including LMRs and firm external support, plus the megawatt adjustment to drive the probabilistic model to criteria. That is, within each season, the resource class-level UCAP megawatts, LMRs and firm external support are added together with the adjustment to bring the model to the criteria applicable for the season[11]. This summed value is the PRMR and precisely follows the procedure currently used. The only difference is that the capacity accreditation for all capacity resources, except external resources, are being derived from the total megawatts by resource class, as calculated from the DLOL method, instead of relying on a combination of Schedule 53-based, for thermal resources, average ELCC, for wind resources, or pre-determined values, for solar resources. Therefore, the proposed methodology achieves perfect alignment between accreditation and the PRMR.

Table 5-1 summarizes the estimated PRMR requirements for planning year 2023-2024. The lower total accreditation values for resources under the DLOL method result in an equally lower PRMR. The lower PRMR will continue to be socialized among all LSEs. Once the DLOL accreditation is fully implemented, the PRMR could go up or down, in line with accredited values and measured system risk, depending on the planning year and resource mix being modeled. The approach to PRMR allocation remains unchanged and is based on the contribution of each LSE to the MISO systemwide peak load. However, MISO plans to consider future updates to the PRMR allocation method based on other factors, including the contribution of LSE load to risk periods.

PY 23/24 - PRMR	Summer		Fall		Winter		Spring		Formula Key
Resource Class	Current	Proposed	Current	Proposed	Current	Proposed	Current	Proposed	
Gas	30,251	29,541	28,595	29,745	28,582	23,605	28,962	23,657	[A]
Combined Cycle	27,558	27,326	28,635	27,015	28,552	23,650	27,929	22,997	[B]
Coal	40,545	39,955	39,888	38,812	39,914	32,539	39,280	32,641	[C]
Hydro (includes diversity contracts)	2,120	2,122	2,104	2,118	926	916	1,350	1,287	[D]
Nuclear	11,410	10,850	11,522	10,304	11,627	10,493	11,063	9,640	[E]
Pumped Storage	2,530	2,523	2,345	2,504	2,299	1,216	2,359	1,763	[F]
Storage	28	28	28	28	54	52	55	55	[G]
Solar	2,151	1,700	1,603	1,937	698	188	1,824	2,221	[H]
Wind	4,639	2,731	5,993	3,859	11,389	4,477	6,500	4,601	[I]
Run-of-River	966	966	966	966	966	966	966	966	[J]
BTMG	4,196	4,196	4,218	4,218	4,163	4,163	4,240	4,240	[K]
Demand Response	7,397	7,397	7,041	7,041	5,388	5,388	6,280	6,280	[L]
Firm External Support	1,707	1,707	1,714	1,714	1,857	1,857	1,778	1,778	[M]
Adj. {1d in 10yr}	(4,000)	(4,000)	(10,000)	(10,000)	(6,200)	(6,200)	(12,750)	(12,750)	[N]
PRMR	**131,498**	**127,042**	**124,652**	**120,261**	**130,215**	**103,310**	**119,836**	**99,376**	[O]= sum of [A] through [N]

Table 5-1: Calculation of PRMR with DLOL accreditation values

[11] For PY23-24 and PY24-25, MISO used a LOLE of 0.1 days/season for the summer season, and 0.01 days/season for the fall, winter, and spring seasons.

6 Local Reliability Requirement (LRR)

Like PRMR, Local Reliability Requirements (LRRs) are updated to utilize the resource class-level accreditation values derived from the same probabilistic model using the DLOL method. The overall approach remains unchanged. The LRR for each LRZ is determined by aggregating the capacity accreditation of the resources in the Zone, plus a megawatt adjustment used to bring the probabilistic model of the isolated LRZ to criteria.[12]

As with the PRMR, the main difference introduced in this proposal is the capacity accreditation for all capacity resources, except external. Ideally, LRR would be determined by aggregating the final SAC values of all resources in a zone. These two values are determined at different times for a given planning year, as LRR values need to be finalized in November before the planning year commences, and final SAC values are not determined until the following February 15 before the planning year. Given these temporal challenges, MISO will calculate LRR with an approximation to the final unit SAC by combining data from the current and previous planning years, as follows:

1. The total class accreditation megawatts are determined for the current planning year (same values used to determine the current planning rear PRMR)
2. For each resource class, the resource class-level UCAP megawatts are allocated amongst the resources in the resource class using the Schedule 53 allocation method described in section 2.3, utilizing the hour information in Tier 1 and Tier 2 from the previous planning year. This provides estimated SAC values for individual resources to calculate LRRs[13].
3. The estimated SAC values are aggregated to the LRZ level. Those values are used as an input into the LRR calculations, similar to the current method which utilizes Schedule 53-based, average ELCC, or pre-determined values for thermal, wind and solar resources, respectively.

Because the Schedule 53 process uses the previous three years to determine Tier 1 and Tier 2 hours, the current and previous planning years should overlap two-thirds of the hours. These should ensure a reasonable alignment between final and estimated SAC values at the unit (and LRZ) level.

A simple example to illustrate the calculation is presented in Table 6-1. In this example, four units belong to two zones and classes. The middle portion of the table shows how, in the previous planning year, the resource class-level UCAP values were allocated by unit. On the right side, the "class-level megawatt" results from the LOLE model for the current planning year. The "Estimated SAC" column results from allocating that year's "class-level MW" with the ratios from the previous year. For instance, the Estimated SAC for Unit A results from taking one-third of 360 MW.

<table>
<tr><th rowspan="2">Unit</th><th rowspan="2">Zone</th><th rowspan="2">Class</th><th colspan="3">Planning Year N-1</th><th colspan="2">Planning Year N</th></tr>
<tr><th>Class-level MW</th><th>Unit ISAC to Class ISAC ratio</th><th>Final SAC</th><th>Class level MW</th><th>Estimated SAC</th></tr>
<tr><td>Unit A</td><td>LRZ1</td><td rowspan="2">Gas</td><td rowspan="2">300</td><td>1/3</td><td>200</td><td rowspan="2">360</td><td>240</td></tr>
<tr><td>Unit B</td><td>LRZ2</td><td>2/3</td><td>100</td><td>120</td></tr>
<tr><td>Unit C</td><td>LRZ1</td><td rowspan="2">Solar</td><td rowspan="2">200</td><td>3/4</td><td>150</td><td rowspan="2">220</td><td>165</td></tr>
<tr><td>Unit D</td><td>LRZ2</td><td>1/4</td><td>50</td><td>55</td></tr>
</table>

Table 6-1. Example of calculation of estimated SAC values

[12] Please refer to section 68A.5 Module E.1 in the MISO Tariff for a description of how the isolated model is created and is adjusted to criteria.

[13] The estimated SAC values are only used to determine the LRR in the Planning Year. Final SAC value for individual Resources will be calculated once Tier 1 and Tier 2 information is available for the current Planning Year.

Table 6-2 shows how these estimated SAC values are used to calculate the LRR for both zones. The resource accreditation is added, along with the megawatt adjustment necessary to bring the respective isolated models to criteria. The last column in the table shows the formula for the calculation.

Resource class	LRZ1 LRR	LRZ 2 LRR	Formula key
Gas	240	120	[A]
Solar	165	55	[B]
Adjustment to reach criteria (MW)	-30	-25	[C]
Total requirement (MW)	375	150	[D] = sum [A] through [C]

Table 6-2. Example of calculation of LRR, based on components

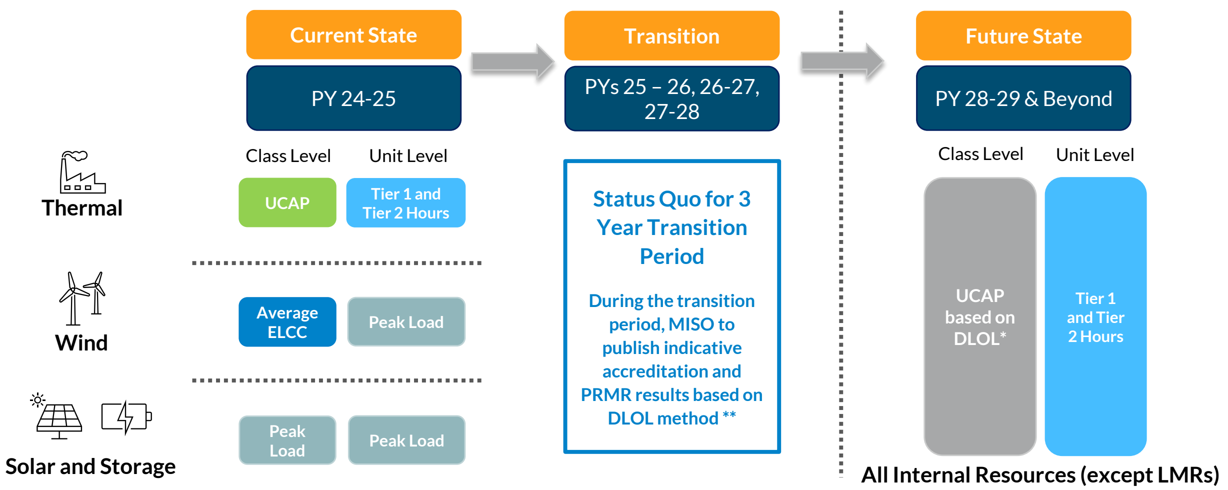
7 Transition

MISO proposes a three-year transition period to implement DLOL for all non-external, non-emergency resources. The transition proposal includes keeping the status quo accreditation methodologies for all resources in the interim. During the transition period, MISO plans to provide indicative results based on the DLOL/Schedule 53 method to preview the coming methodology change. Following the transition period, MISO intends to apply the DLOL/Schedule 53 method to all capacity resources except external.

Any accreditation methodology is only as good as the input data used. LOLE modeling using SERVM has been performed by MISO for the past 9 years and improvements to the model and its inputs are continuously occurring. LOLE model improvements in recent years include:

1) Hourly profiles for renewable generation
2) A probabilistic distribution of seasonal non-firm external support
3) Use-limited modeling of battery storage resources
4) Seasonal dispatch durations and number of calls for demand response resources
5) Seasonal forced outage rates

Given the increasing prominence to the role the LOLE model plays in the accreditation efforts, MISO recognizes that continued improvements and refinements are necessary and that stakeholders desire to participate in these improvements. Beginning with the February 2024 RASC, MISO will work with stakeholders to identify modeling enhancements that will further support MISO's Reliability Imperative. [14]



*Definition of Unforced Capacity (UCAP) is changing with the Accreditation Filing and will account for resource's availability in the LOLE analysis that will be computed based on DLOL method.

**MISO also plans to use the Regional Resource Assessment (RRA) to publish forward looking accreditation and planning reserve margin requirement estimates starting with the 2024 RRA

Figure 7-1 Transition Plan for implementation of the proposed Accreditation methodology

[14] MISO will have continued emphasis and improvements on the probabilistic modeling (i.e., generator capabilities, correlated outages, fuel supply limitations, severe weather, Demand Response and Storage characteristics) that is used in the MISO RA processes.

8 Conclusion

MISO began the Resource Accreditation Reform by working with stakeholders to identify the following problem statement:

> Resource accreditation should reflect the availability of resources when they are most needed. Significant growth of variable, energy-limited resources in the MISO footprint, along with changing weather impacts and operational practices, are shifting risk profiles in highly dynamic ways with implications for resource adequacy and planning. MISO's existing accreditation methods for non-thermal resources require further evaluation to ensure that the accredited capacity value reflects the capability and availability of the resource during the periods of highest reliability risk. Availability correlation within and across resource types

To address this question, MISO considered the following design criteria:

- All high-risk periods should be considered throughout the year
- Ensure comparability across resource types
- Ability to change availability as needed
- Volatility of reliability contribution over time
- Ability to continuously be available (energy limitations)

The design considerations that went into this effort included calculating the operating margin, which hours to use, what threshold to consider, how to address seasons with missing data, regional effects, resource differences, operational characteristics of the units, and outage exemptions.

MISO and its stakeholders have worked together to address these considerations. These goals have been achieved under the DLOL method. All high-risk periods are considered regardless of when they occur. This is achieved by accrediting resources using the DLOL method wherein expected performance during LOL hours and low-margin (margin <= 3% of the load) hours are used to accredit resources. All capacity resources, except external, will be accredited under the same methodology, ensuring comparability across resource types. Using the DLOL methodology, resource volatility, availability, and energy limitations are also properly and fairly accounted for. No class's accreditation is impacted differently by the chosen methodology or the considered timeframe. Using the Schedule 53 framework to allocate resource class-level accreditation values to the individual resources within the resource class ensures the appropriate accounting of seasons with missing or deficient RA hours, regional effects, resource differences, operational characteristics of the units, and outage exemptions.

MISO has developed a complete design that aligns with system planning reserve margin requirements, risk, availability, and accreditation. Elements outside of the scope of the current accreditation design will be the focus of the next phase of the Reliability Imperative, including LOLE modeling improvements, load forecasting, planned and forced outage rates patterns, and correlated outages.

9 Acronyms and Definitions

DIR = Dispatchable Intermittent Resource

DLOL = Direct Loss of Load

EFC = Effective Firm Capacity

ELCC = Effective Load Carrying Capability

ESIG = The Energy Systems Integration Group

GADS = Generator Availability Data System

ISAC = Intermediate Seasonal Accredited Capacity

ICAP = Installed Capacity

LMR = Load Modifying Resource

LOL = Loss of Load

LOLE = Loss-of-Load Expectation

LSE = Load Serving Entity

MRI = Marginal Reliability Impact

NERC = North American Electric Reliability Corporation

PRM = Planning Reserve Margin

PRMR = Planning Reserve Margin Requirement

PV = Photovoltaic

RA = Resource Adequacy

RAN = Resource Availability and Need

RASC = Resource Adequacy Subcommittee

RRA = Regional Resource Assessment

SAC = Seasonal Accredited Capacity

UCAP = Unforced Capacity