Resource Modeling under RCA

Review of proposed Resource Adequacy Assessment (RAA) Resource Modeling changes for the Resource Capacity Accreditation (RCA) project

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Resource Capacity Accreditation in the Forward Capacity Market | WMPP ID: 157

Proposed Effective Date: FCA 19 (with a one-year delay)

- The Resource Capacity Accreditation (RCA) project proposes improvements to the accreditation processes used for the Forward Capacity Market (FCM) by implementing methodologies that will more appropriately accredit resource contributions to resource adequacy as the resource mix transforms supporting a reliable transition to clean energy technologies
  - See the Key Project page for links to prior presentations
- Improvements are required to the Resource Adequacy Assessment (RAA) used currently to calculate capacity requirements (demand) and develop resource-specific accreditation values
- Focus of today is on changes being proposed to Resource Modeling

Proposed Effective Date: FCA 19 (with a one-year delay)

Outline of today's discussion:

- RCA RAA Background (Slides 4-9)
- Overall RAA Resource Modeling (Slides 10-18)
- Active Demand Capacity Resource (ADCR) modeling (Slides 19-30)
- Passive Demand Resource (DR) modeling (Slides 31-32)
- Distributed Energy Capacity Resources (DECR) modeling (Slides 33-34)
- Co-located resource modeling (Slides 35-39)
- Future modeling enhancement for DECR and Co-located resources (Slides 40-41)
- February discussions (Slides 42-44)
- Conclusion (Slides 45-46)

RCA RAA BACKGROUND

Review of motivation for changes to the RAA under the RCA project

RAA is used to establish capacity requirements and demand curves and, under RCA, resource accreditation

- RAA is currently used as the basis for determining the system and local capacity requirements and demand curves
  - Determines the system's ability to meet the one-in-ten ("1-in-10") loss-of-load expectation (LOLE) reliability criterion
- Under RCA, the RAA is also being used as the basis for the development of resource-specific accreditation
  - Much more focus on an individual resource's seasonal performance rather than the aggregate impacts to reliability of load and resource performance

Improvements to RAA modeling are required for more accurate MRI-based accreditation

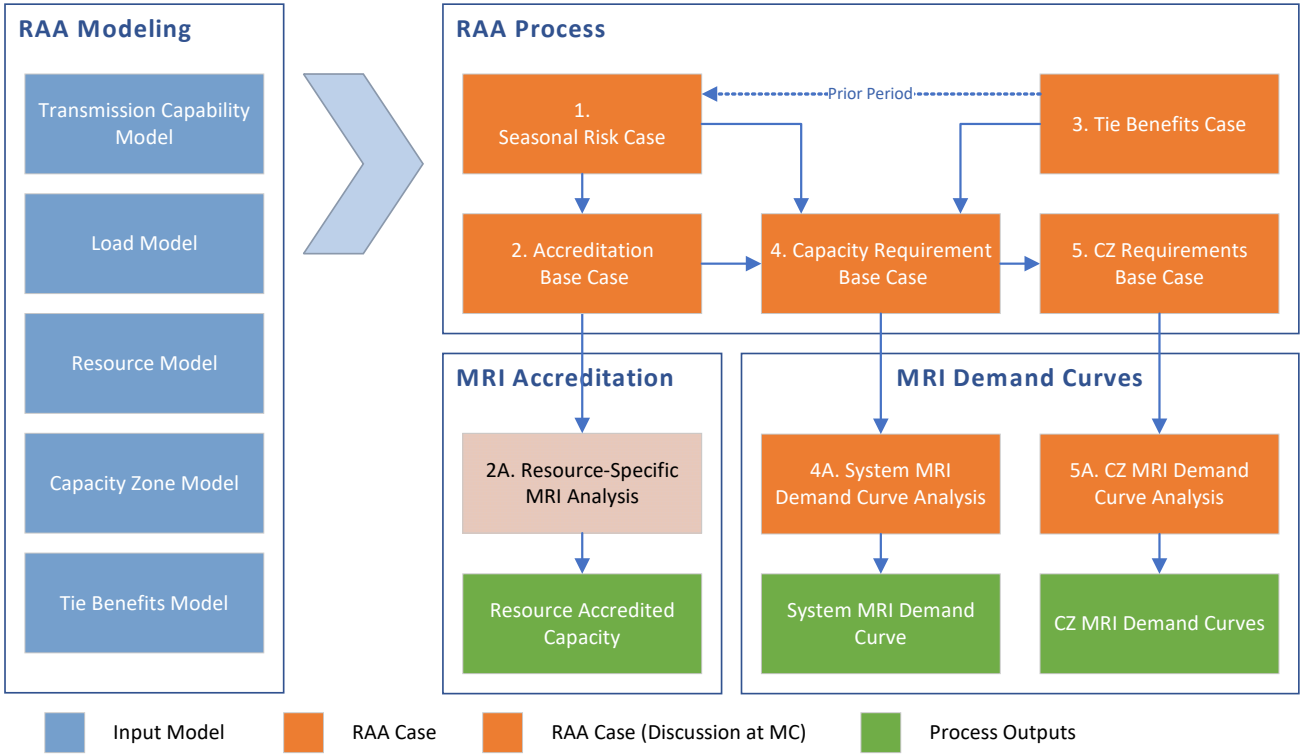
- A marginal approach to accreditation is conceptually a measure of the expected performance of resources during hours of reliability risk (*e.g.*, system is experiencing loss of load)
- Improvements to the RAA will better identify when loss-of-load (LOL) events occur and their duration, and will improve how individual resource performance is reflected during these events
- There are four broad drivers of changes being considered in the RAA:
  - Model system conditions with greater accuracy and granularity
  - Better capture resources' performance and interactions among different resources
  - Better reflect the correlation between resources' performance and system loading conditions and weather
  - Improve modeling consistency among different types of resources

All aspects of the RAA are impacted by the proposed RCA improvements

- **RAA Process.** Defines the modeling approach and input assumptions for each RAA case:
  - Seasonal Risk Case
  - Accreditation Base Case
  - FCA System Capacity Requirement Base Case
  - FCA Zonal Capacity Requirement Base Cases*
  - ARA-related cases*
- **Load Model.** Defines how the expected load is represented in the RAA cases:
  - Seasonal Load Shape and Peak Uncertainty Factors
  - Energy Uncertainty Factors
  - Passive Demand Resource Treatment
  - Behind-the-Meter Solar and other Load Modifiers
- **Resource Model.** Defines the modeling approach and input assumptions associated with each resource type:
  - Generation Capacity Resource
  - Demand Capacity Resource
  - Import Capacity Resource
  - Distributed Energy Capacity Resource
- **Tie Benefits Model.** Defines how the seasonal tie benefits are established
- **Transmission Interface Model.** Defines expected capacity transfer capability (CTC) for the external and internal interfaces*

* Items that will be discussed in RCA Phase II filing for FCA19

Conceptual RAA Process Flow



Initial Discussions are Focused on Resource Modeling Enhancements

Topic	Sub Areas	Meeting

Resource Model	• Generation Capacity Resources
	  ▪ Intermittent Power Resources (IPR)
	  ▪ Energy Storage Resources (ESR)
	  ▪ Non-ESR/Non-IPR Generation Resources
	• Import Capacity Resources
	• Tie Benefits
		December 18, 2023

Resource Model	• Demand Capacity Resources
	  ▪ Active Demand Capacity Resources
	  ▪ Seasonal Peak and On-Peak Demand Resources
	• Distributed Energy Capacity Resources
	• Generation Capacity Resources
	  ▪ Co-Located (Generation) Technologies
	  ▪ Gas and oil resources (for Peak Winter Period), included in separate material
		January 16, 2024

RESOURCE MODELING IN THE RAA

Review proposed changes to Resource Modeling in the RAA under RCA

Changes to the RAA Resource Model are focused on improving how expected performance is reflected

- Conceptually, the accredited capacity (*i.e.,* qualified marginal reliability impact capacity [QMRIC]) reflects a resource's expected output in the hours experiencing loss of load simulated in the RAA or where additional available capacity would reduce load shed in another hour (*i.e.,* RAA MRI Hours)
- RCA related changes are focused on improving how the expected output of all resources is determined by simulating the system condition dynamically on an hourly basis:
  - Random unplanned outages
  - Planned outages
  - Output variations due to weather and fuel constraint
  - Correlation of resources' performance to weather/load
  - Interaction among different resources

Different types of resources will be reflected in the RAA using different models

- RAA Resources are modeled in the RAA as either an:
  - Aggregated RAA Resource, which is a grouping of like Capacity Resources or other supply capacity
    - Shared fuel supply (e.g., gas or oil resources in the Peak Winter Period of Dec-Feb)
    - Small, similar performing technologies (e.g., IPR)
  - Individual RAA Resource, which is associated with an individual Capacity Resource or other supply capacity
  - Certain Capacity Resources may be modeled as different RAA Resources by time period
- There are four modeling options for how RAA Resources are treated:*
  - Thermal Model: Modeled at its Seasonal Qualified Capacity (QC) with an outage rate
  - Profile Model: Modeled based upon an hourly expected performance profile
  - Storage Model: Modeled based upon its energy limitations
  - Perfect Capacity (PC) Model: Modeled as thermal resource at its Seasonal QC with no outage rate or as profile resource with constant output at its Seasonal QC
- RAA Resources are modeled using one of these models to capture their reliability contribution by reflecting their physical characteristics

- Reference 2023 Dec RC presentation: https://www.iso-ne.com/static-assets/documents/100006/a03_a_rca_raa.pdf

SUMMARY OF PROPOSED RAA RESOURCE MODELS FOR DIFFERENT TYPES OF CAPACITY

Review of proposed RAA Resource Model that is used to reflect Capacity Resource and other supply capability in the RAA

Many generation technologies use the Thermal Model in the RAA

Capacity Resource/ Supply Capability	Proposed RAA Resource Model
Nuclear/Coal/Fuel Cell/Non-IPR Hydro Resources	Thermal Model based upon Seasonal QC
Gas-only/Gas Dual-Fuel/Oil Resources (for months of non-Peak Winter Period of Mar to Nov)	Thermal Model based upon Seasonal QC
Import Resources Pool-backed and Resource-backed Imports	Thermal Model based upon seasonal cleared MW from a prior FCA
Tie Benefits	Thermal Model based upon seasonal tie benefits value

IPR and Demand Resources use the Profile Model

Capacity Resource	Proposed RAA Resource Model
Intermittent Power Resources Solar (fixed and tracking)/Hydro/ Biomass/Waste/Landfill Gas/Wind/ others	Profile Model (a change from current modeling of using Thermal Model) based upon expected performance • IPR with a Nameplate Capacity (NC) < 10 MW are included in an Aggregated RAA Resource • IPR with a NC >= 10 MW are included in an Individual RAA Resource
Active Demand Capacity Resources	Profile Model based upon expected performance (a change from current modeling of using Thermal Model)
Passive Demand Resources Seasonal Peak and On-Peak Resources	Profile Model based upon expected performance (a change from current modeling of using Perfect Capacity Model)

ESR and DECR use the Storage and Perfect Capacity Models respectively in the RAA

Capacity Resource	Proposed RAA Resource Model
Energy Storage Resource Battery Storage/Pumped Storage Hydro (PSH)	Storage Model based upon Seasonal QC (a change for PSH from current modeling of using Thermal Model)
Distributed Energy Capacity Resources	Perfect Capacity Model based upon Seasonal QC (not currently modeled because Order 2222 is effective starting for Capacity Commitment Period [CCP] 19)

Co-Located Generation Technologies are modeled differently depending upon how they participate

Co-Located (Generation) Technologies	Proposed RAA Resource Model
Single Capacity Resource IPR, ESR, Non-IPR/Non-ESR	Perfect Capacity Model based upon Seasonal QC
Multiple Capacity Resources • IPR • ESR • Non-IPR/Non-ESR	Based upon Seasonal QC assignment • Profile Model (same as other IPR) • Storage Model (same as other ESR) • Thermal Model (same as other Non-IPR/Non-ESR)

Modeling of Gas and Oil Resources for Peak Winter Period depends upon the RAA Case

Capacity Resource	Proposed RAA Resource Model	RAA Case
Gas Resources	Profile (a change from current Thermal Model) based upon Winter QC	• Seasonal Risk • Accreditation • Capacity Requirement
Distillate Fuel Oil (DFO) Resources DFO-Only and Dual-Fuel using DFO	Storage (a change from current Thermal Model) based upon Winter QC (or back-up fuel capability)	• Seasonal Risk
DFO Resources DFO-Only and Dual-Fuel using DFO	Thermal based upon a derated Winter QC (or back-up fuel capability)	• Accreditation • Capacity Requirement
Residual Fuel Oil (RFO) Resources RFO-Only and Dual-Fuel using RFO	Thermal based upon a derated Winter QC (or back-up fuel capability)	• Seasonal Risk • Accreditation • Capacity Requirement

ADCR MODELING

Review of proposed modeling improvements for RAA Resources associated with Active Demand Capacity Resource

ADCR are currently modeled as Aggregated Thermal RAA Resources

- In the current RAA model, ADCR are modeled as Aggregated Thermal RAA Resources for each Load Zone
  - Summer QC ratings are used for all months of the year
  - Outage rate is based on the weighted average of all resources in the Load Zone
- Current approach does not reflect the variation in hourly (seasonal) capability of many ADCR or their individual resource performance

Under RCA, all ADCR are treated as Individual Profiled RAA Resources in the RAA

- Using the Individual Profiled RAA Resource model allows for ADCR expected hourly performance in each season reflecting the variability based upon historic capability and performance
  - Offer behavior for many of these resources shows a shape being offered across the operating day (generally higher in the peak hours and lower in other hours)
  - Approach dynamically changes the accreditation of these resources as the hours and seasons in which risk is observed changes
- These changes improve the ability for the RAA to identify the hours with loss-of-load risk and the associated event duration and better reflect the expected performance of ADCR

RAA Resources associated with ADCR have profiles established for them based upon historical capability

- Only existing ADCR (i.e., cleared in the FCA and not terminated/retired) are included in the RAA
  - Commercial and non-commercial profiles are developed differently
- Two hourly normalized profiles are developed for each DR Season based upon the day type (weekday and weekend/holiday) using the three most recent calendar years' real-time information
  - Three years, rather than five years, worth of information is used reflecting the potential for the mix of Demand Response Resources (DRR) and associated assets and associated performance to evolve over time
  - Days included are filtered based upon temperature thresholds, weighted temperature humidity index (WTHI) in the DR Summer Period and heating degree day (HDD) in the DR Winter Period

Hourly normalized profiles are developed for RAA Resources associated with commercial ADCR

- Each RAA Resource associated with a commercial ADCR has profiles developed based upon its historical real-time maximum reduction in effect for the hour
  - DRR maximum reduction is based upon the real-time offer and reflects any adjustments for any real-time redeclarations and/or outages
  - Historical seasonal performance factor is used to calculate an expected maximum reduction
- Expected maximum reduction is the real-time maximum reduction for the hour adjusted for the seasonal performance factor divided by the days in the period that meet the temperature threshold associated with the day type:

$$Expected\ Maximum\ Reduction_{ADCR,DRSeason,DayType,HE} = \frac{\sum_{DRR \in ADCR}\left(Realtime\ Maximum\ Reduction_{DRR,DayType,HE} \times Performance\ Factor_{DRR,DR\ Season}\right)}{Number\ of\ Eligible\ Days_{DR\ Season,DayType}}$$

DRR seasonal performance factors

- DRR seasonal performance factors measure its performance relative to its offered quantities when dispatched, and are calculated based on its actual performance and its target Desired Dispatch Point (DDP) during the time intervals when it was being audited or dispatched for each season
- $$Performac\ Factor_{DRR,Interval} = \frac{Gross{-}up\ performance}{Expected\ DDP}$$

  $$= \frac{capacity\ load\ reduction * 1.08 + capacity\ net\ supply}{Expected\ DDP}$$
- Seasonal performance factors are the average across all intervals of the performance factor for each season, excluding intervals when the DDP is zero
  - Winter: Dec – Mar
  - Summer: Apr – Nov

Temperature thresholds are used to align profiles with days which loss of load is observed in the RAA

- Temperature thresholds by DR Season are used to filter the days included in the development of the profiles providing a correlation between weather and capability
  - Comparable to the application of temperature in thermal generation Summer Claim Capability (SCC) which is used across all hours in the Summer and Winter Season in the RAA
- Temperature thresholds for the development of profiles will be set balancing when loss of load is observed in the RAA and the availability of data in the historical period
  - ISO will provide proposed temperature thresholds at a future meeting

Each RAA Resource associated with a commercial ADCR has a normalized profile established

- Normalized profiles are developed for each commercial ADCR by DR Season and day type.
  - Seasonal QC is the value associated with that hour from the corresponding CCP for the historical period

$$Normalized\ Profile_{ADCR,DRSeason,DayType,HE} = \frac{Expected\ Maximum\ Reduction_{ADCR,DRSeason,DayType,HE}}{Seasonal\ \mathrm{QC}_{ADCR,CCP}}$$

- The profiles for each DR Season are weighted by the Seasonal QC associated with the associated prior CCP to establish a profile for each DR Season and day type for each RAA Resource and capped at 100%:

$$MIN\left(\frac{\sum\left(Normalized\ Profile_{ADCR,DRSeason,DayType,HE} \times Seasonal\ \mathrm{QC}_{ADCR,DRSeason}\right)}{Seasonal\ \mathrm{QC}_{ADCR,CCP}}, 100\%\right)$$

RAA Resource's expected capability is based upon its Seasonal QC and its normalized profile

- Hourly expected capability of an RAA Resource associated with an ADCR is based upon its normalized profile and the Seasonal QC for that commitment period
  - There are two expected maximum reduction profiles for each ADCR for each DR season; one for each day type

$$Expected\ Capability_{ADCR,DRSeason,DayType,HE} = Normalized\ Profile_{ADCR,DRSeason,DayType,HE} \times Seasonal\ \mathrm{QC}_{ADCR,CCP}$$

Commercial normalized profiles for ADCR RAA Resources are calculated for DRR and then ADCR (example)

- ADCR A is comprised of DRR 1 and DRR 2
  - Two eligible weekdays in the DR Summer Period for CCPX-2
  - Max Reduction is adjusted for a DRR specific performance factor for that period
- ADCR A's Expected Maximum Reduction reflects the average Expected Maximum Reduction for each hour from the DRR for DR Summer Period for CCPX-2

ADCR A: DR Summer Period (CCPX-2)						
HE	Expected Max Reduction (MWh)	Summer QC (MW)	Normalized Profile (%)			
13	4.8	10.0	48.0%			
14	7.3	10.0	73.0%			
15	9.4	10.0	94.0%			
16	9.9	10.0	98.5%			
17	5.9	10.0	59.0%			
	DRR 1			DRR 2		
	Summer Performance Factor (%)	Max Reduction (MWh)	Expected Max Reduction (MWh)	Summer Performance Factor (%)	Max Reduction (MWh)	Expected Max Reduction (MWh)
DR Summer Period (CCPX-2), Weekday 1: High Temperature 90 degrees						
13	90.0%	5.0	4.5	80.0%	3.0	2.4
14	90.0%	6.0	5.4	80.0%	4.0	3.2
15	90.0%	7.0	6.3	80.0%	5.0	4.0
16	90.0%	7.0	6.3	80.0%	5.0	4.0
17	90.0%	6.0	5.4	80.0%	5.0	4.0
DR Summer Period (CCPX-2), Weekday 2: High Temperature 80 degrees						
13	90.0%	3.0	2.7	80%	-	-
14	90.0%	4.0	3.6	80%	3.0	2.4
15	90.0%	5.0	4.5	80%	5.0	4.0
16	90.0%	6.0	5.4	80%	5.0	4.0
17	90.0%	-	-	80%	3.0	2.4

RAA Resource A's profile is based upon combining ADCR A profiles from CCPX-1 and CCPX-2 (example)

- ADCR A's normalized profiles from CCPX-1 and CCPX-2 are weighted by the Summer QC from those DR Seasons to obtain a normalized profile for RAA Resource A
- RAA Resource A's Expected Maximum Reduction is based upon the Summer QC for FCAX and its normalized profile

RAA Resource A: DR Summer Period (CCPX)						
				Normalized Profile (%)	Summer QC (MW)	Expected Max Reduction (MWh)
13				35.8%	12.0	4.3
14				62.9%	12.0	7.5
15				86.2%	12.0	10.3
16				94.3%	12.0	11.3
17				52.2%	12.0	6.3
ADCR A: DR Summer Period (CCPX-2)				ADCR A: DR Summer Period (CCPX-1)		
	Expected Max Reduction (MWh)	Summer QC (MW)	Normalized Profile (%)	Expected Max Reduction (MWh)	Summer QC (MW)	Normalized Profile (%)
13	4.8	10.0	48.0%	3.1	12.0	25.7%
14	7.3	10.0	73.0%	6.5	12.0	54.5%
15	9.4	10.0	94.0%	9.6	12.0	79.7%
16	9.9	10.0	98.5%	10.9	12.0	90.8%
17	5.9	10.0	59.0%	5.6	12.0	46.6%

Non-commercial profiles are developed based upon existing ADCR information

- For any “non-commercial” Seasonal QC associated with an existing commercial ADCR, the normalized hourly profile from the existing ADCR is applied to both the commercial and non-commercial capability
- For a new, fully non-commercial ACDR, the normalized hourly profile uses proxy profile developed based upon:
  - Seasonal QC-weighted average of the normalized hourly profiles from other RAA Resources associated with ADCR within the Load Zone
    - If there are less than four Individual RAA Resources associated with ADCR, then RAA Resources associated with ADCR from adjacent Load Zones are included as well

PASSIVE DEMAND RESOURCE MODELING

Review of proposed modeling improvements for RAA Resources associated with On-Peak and Seasonal-Peak Demand Resources

Passive Demand Resource modeling is being revised to reflect expected hourly capability

- In the current RAA, Passive Demand Resources (including both On-Peak and Seasonal-Peak) are modeled as an Aggregated Perfect Capacity RAA Resource by Load Zone at their Summer QC for all hours in DR Summer Period and at their Winter QC in the DR Winter Period
- Under RCA, Passive Demand Resources will no longer be modeled as a supply resource, but will be moved to the demand side of the market adjusting the expected demand
  - Further details on this will be covered with other Load Model changes at the February NEPOOL Reliability Committee (RC)

DECR MODELING

Review of proposed modeling improvements for RAA Resources associated with Distributed Energy Capacity Resources

DECR are a new resource type introduced to the market under Order 2222 for CCP19

- DECR are comprised of aggregations of different capacity resource types including generation and demand resources into a single capacity resource
- Under RCA, the DECR are proposed to be modeled as Aggregated Perfect Capacity RAA Resources (by Load Zone) based upon their Seasonal QC
  - There are not expected to be many existing DECR for CCP19, so modeling these resources in this manner should have minimal/no impact on reliability outcomes
- Accreditation approach for CCP19 will not be based upon the RAA
  - This will be discussed further at the February NEPOOL Markets Committee (MC)

CO-LOCATED GENERATION TECHNOLOGY MODELING

Review of proposed modeling improvements for RAA Resources associated with co-located generation technologies

Co-Located (generation) technologies have unique operating characteristics and participation in the FCM

- Co-located technologies are a set of heterogeneous technologies that are behind the same point of interconnection (POI)
- Some co-located technologies have no operating constraints (appear like a stand alone technology) while others may have facility limitations or operational dependencies/constraints between the technologies that impact the individual technology's performance

Co-Located technologies can currently participate in the FCM in multiple ways

- Co-located generation technologies that participate as a single capacity resource are modeled in the RAA as Perfect Capacity RAA Resources today
- Co-located generation technologies that participate as multiple capacity resources are:
  - Modeled based upon their capacity resource type (focus on IPR and ESR case) today
    - IPR: Individual or Aggregated Perfect Capacity RAA Resource
    - ESR: Individual Storage RAA Resource
  - Required to apportion the total QC for the facility between the capacity resources when facility limit or Capacity Network Resource Capability (CNRC) is limiting

RCA is not proposing significant changes to the modeling of co-located generation technologies

- Co-located technologies participating as single capacity resource will continue to be modeled as Individual or Aggregated PC RAA Resources based on their Seasonal QC
  - At this time there are not a significant quantity of these resources, so this modeling approach is not expected to have any significant impact on reliability outcomes
- Co-located technologies that participate as multiple capacity resources are:
  - Modeled based upon their capacity resource type today
    - IPR: Individual or Aggregated Profiled RAA Resource
    - ESR: Individual Storage RAA Resource
    - Non-ESR/Non-IPR: Individual Thermal RAA Resource
  - Required to apportion the total QC for the facility between the capacity resources when the facility limit or CNRC is limiting

Modeling limitation will result in not all co-located technologies being accredited from the RAA result directly

- Accreditation for co-located resources are not directly based on how they are modeled in RAA, and will be discussed further at the February NEPOOL MC

FURTHER MODELING IMPROVEMENTS FOR DECR AND CO-LOCATED GENERATION TECHNOLOGIES

DECR and co-located generation technologies have similar modeling challenges

- Both can participate as a single capacity resource comprised of heterogeneous technologies:
  - DECR can include co-located technologies
  - Co-located technologies may have additional facility limitations or operational dependencies/constraints between the technologies
- Conceptually, modeling requires metering for each technology and the ability to reflect each of the technologies individually in the RAA based upon their physical characteristics (and possibly interaction between technologies)
  - The different technologies would either need to be associated to a single capacity resource or would required to participate as different capacity resources
  - The concept of having multiple RAA Assets associated to a single Capacity Resource is not currently something that can be easily supported
- ISO will evaluate when/how to more fully address the modeling of co-located generation technologies and DECR for a future period

SUMMARY AND NEXT STEPS

Review of the Resource Modeling topics discussed today and topics for future Reliability Committee meetings

Summary and Next Steps

- In this presentation, we have reviewed:
  - Proposed RAA resource models for different types of Capacity
  - Detailed treatment of Active Demand Capacity Resources and Co-located Resources
- Discussion at February RC will transition to Load and Capacity Requirements of the RAA Process

Future discussions focus on other aspects of the RAA

Topic	Sub Areas	Projected Meeting
Load Model	• Seasonal Load Shape and Peak Uncertainty Factors • Energy Uncertainty Factors • Passive Demand Resource Treatment • Behind-the-Meter Solar and other Load Modifiers	February 13-14, 2024
Transmission Interface Model	• Seasonal Capacity Transfer Capability	February 13-14, 2024
Capacity Requirements	• Installed Capacity Requirement • Capacity Transfer Limit	March 19, 2024
RAA Process	• Seasonal Risk Case • Accreditation Base Case • System Capacity Requirement Base Case	March 19, 2024

CONCLUSION

Improvements to RAA modeling are required for more accurate MRI-based accreditation

- A marginal approach to accreditation is conceptually a measure of the expected performance of resources during hours of reliability risk (e.g., system is experiencing loss of load)
- Improvements to the RAA will better identify when LOL events occur and their duration and will improve how individual resource performance is reflected during these events
- There are four broad drivers of changes being considered in the RAA:
  - Model system conditions with greater accuracy and granularity
  - Better capture resources' performance and interactions among different resources
  - Better reflect the correlation between resources' performance and system loading conditions and weather
  - Improve modeling consistency among different types of resources

Questions