Revision 1

Resource Capacity Accreditation in the Forward Capacity Market

Detailed Design

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Resource Capacity Accreditation (RCA) in the Forward Capacity Market (FCM)

WMPP ID: 157

Proposed Effective Date: Forward Capacity Auction 19 (FCA19) with a one-year delay

- The RCA project proposes improvements to the ISO's accreditation processes in the FCM to further support a reliable, clean-energy transition by implementing methodologies that will more appropriately accredit resource contributions to resource adequacy as the resource mix transforms
- This material continues discussion on the RCA detailed design, including:
  - Refresher on the conceptual framework for FCA qualified marginal reliability impact (QMRIC) calculations (Appendix 1)
  - Follow-up on questions from the March NEPOOL Markets Committee (MC) detailed design discussion
  - FCA activity flows and detailed design discussion for active and passive demand resources
  - FCA activity flow for energy storage resources (ESR) including pumped-storage hydro and batteries
- In response to feedback from the March MC, Appendix 2 includes a numerical example of the MRI calculations for Configuration 3 and 4 co-located resources

RESPONSES TO QUESTIONS AND FEEDBACK FROM MARCH MC

Question: How are weekly pondage resources modeled?

- Weekly pondage hydro resources can be registered as either intermittent power resources (IPR) or non-IPR
- IPR weekly pondage hydro resources will be modeled as a Profiled RAA Resource with an hourly energy profile based upon their historical performance
- Non-IPR weekly pondage hydro resources will be modeled as Thermal RAA Resources at their seasonal qualified capacity (QC) with an XEFORd (equivalent forced outage rate on demand excluding outside management control events)
  - Non-IPR weekly pondage hydro resources will not be modeled as a Storage RAA Resource (i.e., like pumped-storage hydro) for FCA19
- December 2023 NEPOOL Reliability Committee (RC) material discusses the different modeling options associated with RAA Resources

Question: Can the ISO model some small (<10 MW) IPR individually?

- Under RCA, small (<10 MW of nameplate capacity) IPR will be grouped together and have their MRIs calculated from this Aggregated Profiled Resource Adequacy Assessment (RAA) resource
  - Administrative and computational challenges with modeling the hundreds of small resources resulted in the need to aggregate these small resources together for purposes of the RAA and MRI calculations
  - See the March MC material for an activity flow summary for small IPRs, the January 2023 MC material for a detailed walkthrough of the MRI calculations, and the December 2023 RC material for details on how these resources will be aggregated
- Given the many hundreds of small IPR, offering exemptions for some is not practical and is inconsistent with the reason why these resources need to be aggregated
- An aggregation approach does not result in all resources in an aggregation being valued the same, there is a resource-specific performance adjustment related to each resource's QC
  - The next two slides provide a simple numerical example that demonstrates that resources that perform better in the pre-defined reliability hours used to set an IPR's QC will have greater FCA QMRIC than those that perform worse, all else equal

Example: Three IPRs within an Aggregated RAA Resource have identical adjusted NC, but differing QC

- Consider three, Aggregated Profiled RAA Resources with a total of 5 MW adjusted nameplate capacity (NC) and a QC established based upon the reliability hours
  - For simplicity, assume FCA QC, summer QC, winter QC are equal
  - R1 has the lowest QC at 1 MW
  - R2 has the highest QC at 2 MW
  - R3 has a QC of 1.5 MW
- Assume perfect capacity's annual MRI is 1 hour/year, and the Aggregated RAA Resource's summer MRI is 0.5 hours/year and winter MRI is 0.3 hours/year
- The next slide provides the FCA QMRIC calculation for R1, R2, and R3, and shows that R2 has the highest FCA QMRIC and R1 the lowest, despite all three resources having the same adjusted NC

Example: IPRs that perform better in the context of QC relative to the aggregation's QC will receive higher FCA QMRIC

- MRIs of the Aggregated RAA Resource are calculated in the context of the total seasonal QC of the IPRs associated with it
  - MRI can be thought of as the total performance of all the individual IPR in the context of this total seasonal QC
- IPR that are part of the aggregation with a higher QC (relative to their adjusted NC) receive more QMRIC than those with lower QC (relative to their adjusted NC)

Parameter	Variable/Calculation	R1	R2	R3
Adjusted Nameplate Capacity$_{IPR}$	[1]	5.0 MW	5.0 MW	5.0 MW
Qualified Capacity$_{IPR}$	[2]	1.0 MW	2.0 MW	1.5 MW
Summer MRI$_{Aggregated\ RAA\ Resource}$	[3]	0.5 hours/year		
Winter MRI$_{Aggregated\ RAA\ Resource}$	[4]	0.3 hours/year		
Annual MRI$_{Perfect\ Capacity}$	[5]	1.0 hours/year		
FCA QMRIC$_{IPR}$	[6] = ([3]/[5]) x [2] + ([4]/[5]) x [2]	0.8 MW	1.6 MW	1.2 MW

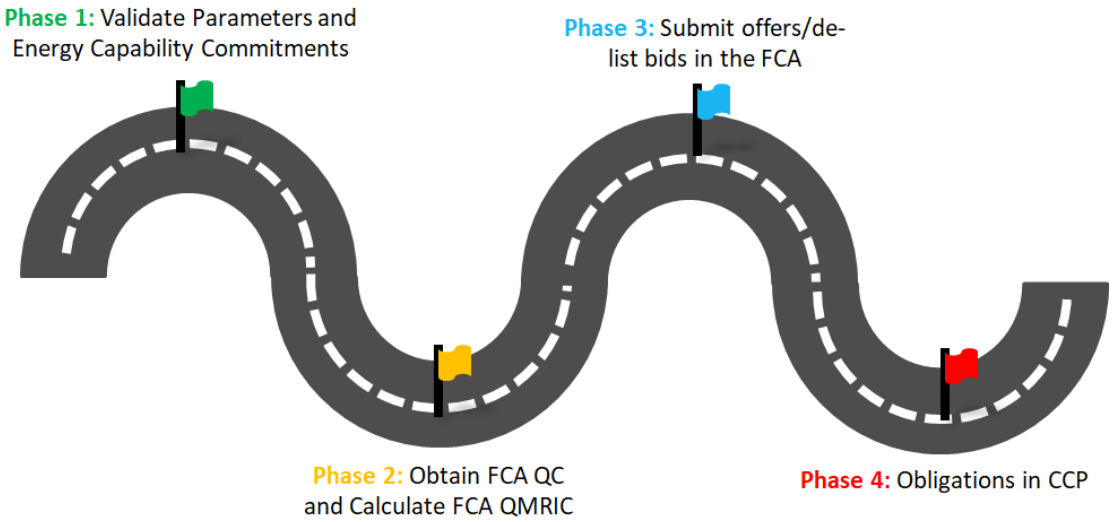
Question: How does the ISO model a solar resource with 0 MW of winter network resource capability (NRC)?

- Solar resources cannot have a winter NRC of zero as these resources are capable of producing power in the winter months and a winter NRC of zero would imply they were not allowed to supply electricity to the grid in the winter months
- **Concept Recap:** Winter NRC is a value that reflects the nameplate capacity adjusted for losses to the point of interconnection (POI) and thus the maximum output the resource could produce
  - Normalized profiles are developed in the context of this value based upon historical performance data

Question: Can the ISO provide summary statistics on the four configurations of co-located generation technologies?

- Based upon the FCA18 results, the approximate total FCA QC of co-located technologies is 495 MW
  - Configuration 1/2: 250 MW
  - Configuration 3: 125 MW
  - Configuration 4: 120 MW
- Co-Located Generation Technology Configuration Summary
  - Configuration 1: Two separate capacity resources that are not subject to a binding facility limit
    - A facility limit is the maximum output a facility can put onto the grid
  - Configuration 2: Two separate capacity resources that are subject to a binding facility limit
  - Configuration 3: Co-located technologies are registered as a single non-IPR
    - Modeled as perfect capacity in the accreditation base case (see January RC material)
    - Accreditation is discussed in Appendix 2 and March MC material
  - Configuration 4: Co-located technologies are registered as a single IPR
    - Modeled as perfect capacity in the accreditation base case (see January RC material)
    - Accreditation is discussed in Appendix 2 and March MC material

WALKTHROUGH OF FCA QMRIC CALCULATION PROCESS FOR DEMAND RESOURCES (DR)



Phase 1: Demand Resources will not have One-Time Challengeable Parameters

- In advance of FCA19, DR will not have one-time challengeable parameters
  - There will be annually challengeable parameters, discussed on the next slide

Phase 1: Active Demand Capacity Resources (ADCR) can Challenge their Energy Profile and Performance Factor Annually

- Each ADCR will have a seasonal energy profile that represents their historical hourly availability over the last three years' real-time offer data in the energy market
  - Hourly normalized profiles will be developed for each DR Season and day type (weekday and weekend/holiday)
  - Energy profiles will be used to determine how much demand the ADCRs are expected to reduce during the hours important for system reliability
  - See the January RC material for details on how the ADCR profiles are created
- Each FCA cycle, the ISO will report to the Lead Market Participant their energy profile and supporting data for the last three complete capacity commitment periods (CCP)
- The supporting data used to construct the hourly energy profiles will be challengeable on an annual basis

Phase 1: Passive Demand Resources will not have Annually Challengeable Parameters

- Passive demand resources (PDR) include all On-Peak Demand and Seasonal Peak Demand Resources
- A single, common system-wide profile (different for each month) that represents the demand reduction associated with a given hour will be used for all passive demand resources
  - See the February RC material for details on how this profile will be calculated
- Common hourly profile for all PDR will not be challengeable and resource-specific profiles will not be allowed for FCA19

Phase 2: FCA QMRICs will be calculated for each existing ADCR

- Seasonal MRIs will be calculated using the same seasonal definitions as the other resources
  - Summer Period: June-September
  - Winter Period: October-May
- Seasonal MRIs will be calculated for each existing ADCR
- FCA QMRICs will be calculated for each ADCR using the ADCR's seasonal QC and seasonal MRI
  - FCA QMRIC represents each resource's probability-weighted expected performance in the hours that are important for system reliability

Phase 2: FCA QMRICs will be calculated for each PDR

- Seasonal MRIs will be calculated using the same seasonal definitions as the other resources
  - Summer Period: June-September
  - Winter Period: October-May
- Seasonal MRIs will be calculated for a single proxy PDR (not for each PDR)
- FCA QMRIC for each PDR will be calculated using the proxy PDR's seasonal MRI and the PDR's seasonal QC
  - FCA QMRIC conceptually represents the demand reduction in the hours that are important for system reliability

Phase 3: Demand Resources will Submit Offers or De-list Bids in the FCA in terms of FCA QMRIC

- Each ADCR and PDR will submit offers or de-list bids into the FCA in terms of FCA QMRIC (i.e., the most CSO a resource can sell or de-list is their FCA QMRIC)

Phase 4: Demand Resources with CSO will have Obligations for the CCP

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- ADCRs will have seasonal pay-for-performance (PFP) obligations based on the portion of their FCA QMRIC that they are awarded as CSO
- Energy market must-offer obligations for ADCRs will be based on their seasonal QC
  - Specifically, their must-offer obligation will be based on their effective CSO (ECSO), which represents the physical capability of the portion of the resource that received a CSO award
    - For each month, ECSO will be calculated using CSO and QMRIC values that correspond with the RAA base case season and QC that correspond with the DR season
    - RAA base case summer is June through September, RAA base case winter is October through May
    - DR summer is April through November, DR winter is December through March
- PDR comprised of Distributed Generation and Load Management will have seasonal PFP obligations based on the portion of their FCA QMRIC that they are awarded as CSO
  - PDR comprised of Energy Efficiency does not have a seasonal PFP obligation
- PDRs do not have an energy market must-offer obligation

DETAILED DESIGN ON ADCR'S FCA QMRIC CALCULATIONS IN PHASE 2

Hourly Profiles will be developed for Existing, Commercial ADCRs using Historical Data

- All existing ADCRs will be modeled in the accreditation base case with an hourly profile that reflects an ADCR's historical availability, adjusted for performance
  - Normalized hourly profiles will be developed based on their last three years' real-time offer data and their performance factor to reflect the ADCR's expected hourly performance for each day type (weekday and weekend/holiday)
  - Hourly profiles (MW) will be based upon the normalized profile and the most recent seasonal QC available for the FCA
  - Additional details on hourly profile construction for ADCRs are available in the January RC material
- Seasonal MRIs for existing ADCRs, will be established by their hourly profile in a similar manner to large IPR

Seasonal MRIs for Existing, Commercial ADCRs will be calculated using Hourly Profiles

- Step 1: Calculate the total amount of expected unserved energy (EUE) in the summer (June to September) and winter (October to May) seasons from the accreditation base case
- Step 2: In the accreditation base case, increase the size of ADCR by a small amount
  - Currently, in accordance with other resources, the summer QC is increased by 0.5 MW in the summer season and a proportional quantity of winter QC is increased in the winter season

$$Proportional\ increase\ in\ Winter\ QC = 0.5\ MW \times \frac{Winter\ QC}{Summer\ QC}$$

  - ADCR's normalized hourly profile will be scaled by the small amount of increase in Summer QC, 0.5 MW, to determine the amount of increase in ADCR demand reduction in the accreditation base case
    - For the winter, the increase in the size of ADCR demand reduction will be obtained by scaling the ADCR's normalized hourly profile with the proportional increase in Winter QC calculated above
- Step 3: After increasing the ADCR's size by a small amount, re-run the accreditation base case to calculate new EUE values in the summer and winter seasons
- Step 4: Calculate seasonal MRI
  - Resource's summer MRI will be the difference between the summer season EUE in Steps 1 and 3, divided by the change in summer QC (e.g., 0.5 MW).
  - Resource's winter MRI will be the difference between the winter season EUE in Steps 1 and 3, divided by the change in winter QC (e.g., 0.5 MW x Winter QC/Summer QC)

Seasonal MRIs for Non-Commercial ADCRs will be calculated using a Load Zone Class Average Approach

- For a non-commercial ADCR, the seasonal MRI will be based upon seasonal QC-weighted average of the MRI from other ADCRs in the Load Zone
  - See January RC material for additional details for modeling existing, non-commercial ADCR

DETAILED DESIGN ON PDR'S FCA QMRIC CALCULATIONS IN PHASE 2

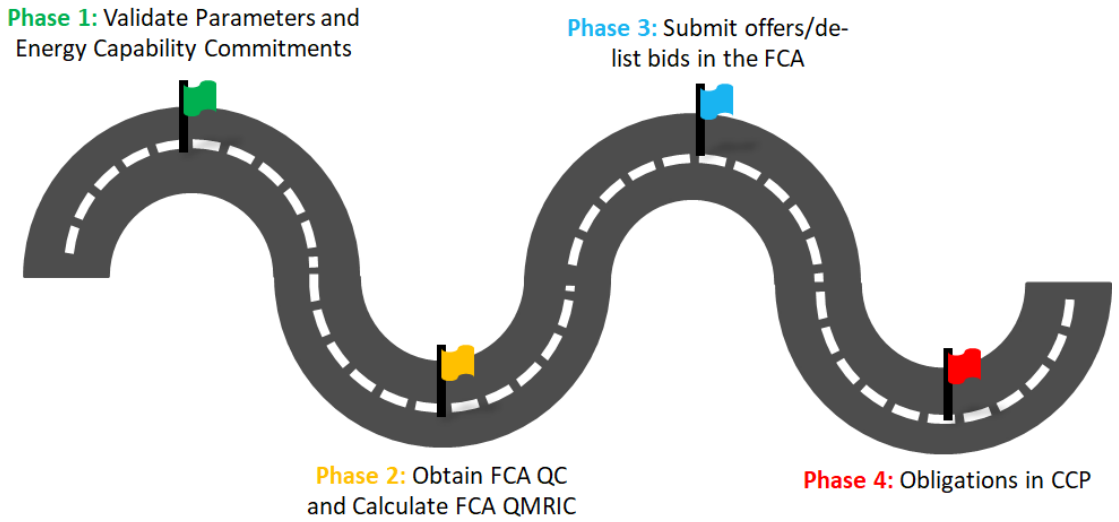
Common Hourly Profile will be used for all PDR (commercial and non-commercial)

- Because PDR will not be included in the accreditation base case as a supply resource, a proxy resource approach will be used to calculate their seasonal MRIs
- Monthly hourly profiles will be developed based on the profiles used in the PDR reconstitution in the last five years' load forecast cycles
  - Additional details on hourly profile construction for PDRs are available in the February RC material
- The proxy resource approach adds a small proxy PDR (0.5 MW) to the accreditation base case and compares the resulting EUE with the EUE from to the original accreditation base case
- The four steps to the proxy resource approach for PDR are provided on the next slide

Seasonal MRIs for PDRs will be Calculated using a Proxy Resource Approach which is applied to all PDR to determine their QMRIC

- Step 1: Calculate the total amount of EUE in the summer (June to September) and winter (October to May) seasons from the accreditation base case
- Step 2: In the accreditation base case, add a small proxy PDR with a 0.5 MW of summer and winter QC
  - PDR's normalized hourly profile will be scaled by the seasonal QC, 0.5 MW, to determine the amount of proxy resource's hourly demand reduction
  - The seasonal definition used in the RAA modeling corresponds with the RAA base case season (i.e., summer is June-September, winter is October-May)
- Step 3: After adding the small proxy PDR, re-run the accreditation base case to calculate new EUE values in the summer and winter seasons
- Step 4: Calculate seasonal MRI
  - Proxy resource's summer MRI will be the difference between the summer season EUE in Steps 1 and 3, divided by the change in summer QC (e.g., 0.5 MW).
  - Proxy resource's winter MRI will be the difference between the winter season EUE in Steps 1 and 3, divided by the change in winter QC (e.g., 0.5 MW)

WALKTHROUGH OF FCA QMRIC CALCULATION PROCESS FOR ENERGY STORAGE CAPACITY RESOURCES (ESR)



Phase 1: ESR can Challenge their Storage Capacity and Round-trip Efficiency once

- Round-trip efficiency and storage capacity (which includes pond size for pumped-storage hydro) will be able to be challenged once by the Lead Market Participant
- ISO will report to the Lead Market Participant the current values by September 27, 2024 for the FCA19 cycle

Phase 1: ESR do not have any Annually Challengeable Parameters

- No XEFORd will be applied to ESR
  - Aligns accreditation process for pumped-storage hydro and battery storage resources
  - See the December 2023 RC material for more information

Phase 2: FCA QMRICs Calculated for ESR

- FCA QMRIC will be calculated for each ESR
- FCA QMRIC represents each resource's probability-weighted expected performance in the hours that are important for system reliability
  - For ESR, expected performance partially depends on their ability to charge before critical reliability hours
- Resources that are expected to perform better, on average, during the hours that are important for system reliability will be able to sell more capacity in the FCA (i.e., higher QMRIC)
- Detailed description of this process is available in the January MC material

Phase 3: Resources will Submit Offers or De-list Bids in the FCA in terms of FCA QMRIC

- Each ESR will submit offers or de-list bids in the FCA in terms of their FCA QMRIC (i.e., the most CSO a resource can sell or de-list is their FCA QMRIC)

Phase 4: ESR with CSO will have Obligations for the CCP

- ESR will take on seasonal PFP obligations based on the portion of their FCA QMRIC that they are awarded as CSO
  - See the March and April 2023 MC material for additional details
- ESR energy market must-offer obligations will be based on their seasonal QC
  - Specifically, their must-offer obligations will be based on their ECSO, which represents the physical capability of the portion of the resource that received a CSO
  - For example, if a resource is awarded 50% of their FCA QMRIC as CSO, their must offer obligation will be 50% of their seasonal QC

APPENDIX 1: CONCEPTUAL FRAMEWORK FOR FCA QMRIC CALCULATIONS

Walkthrough of conceptual framework for FCA QMRIC calculations discussed at prior committee meetings

RCA Reforms will Improve Resources' Capacity Market Compensation to Better Reflect Reliability Contributions

Previously presented at February 2024 MC Meeting

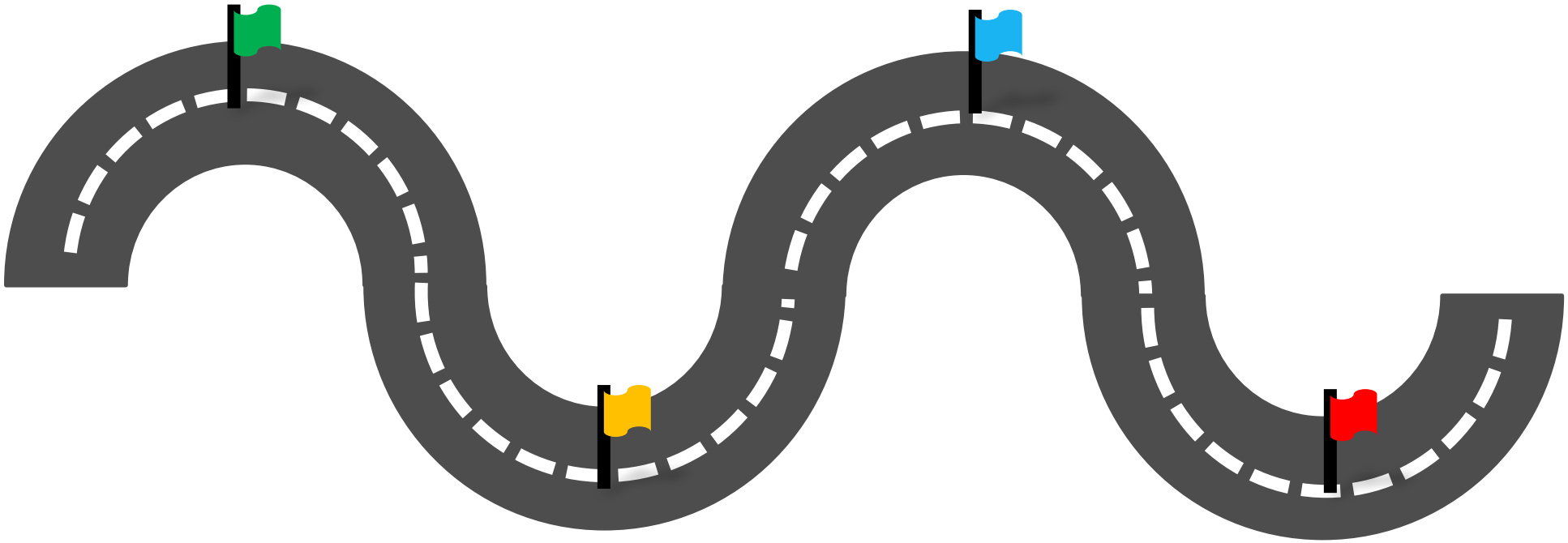
- For the FCM to procure capacity cost-effectively, resources must be compensated in a manner commensurate with their reliability contributions
  - Resources that contribute more to reliability should be paid more than resources that contribute less, all else equal
- The RCA reforms will improve capacity market compensation by implementing a new accredited capacity, **FCA QMRIC**, which represents resources' probability-weighted expected performance in hours that are important for system reliability

Four Phases to Obtain Accredited Capacity Values and Participate in Capacity Market

Previously presented at February 2024 MC Meeting

Phase 1: Validate Parameters and Energy Capability Commitments

Phase 3: Submit offers/de-list bids in the FCA



Phase 2: Obtain FCA QC and Calculate FCA QMRIC

Phase 4: Obligations in CCP

Phase 1: To Calculate FCA QMRIC, the ISO needs Resource-specific Parameters

Previously presented at February 2024 MC Meeting

- Resource-specific information/parameters will be used to establish the expected hourly performance profiles which will form the basis of the new accredited capacity value (FCA QMRIC)
  - e.g., dual fuel capability, XEFORd, etc.
- The ISO plans to collect/validate some parameters only once for FCA19, while the ISO plans to validate others annually ahead of each FCA
- The parameters the ISO plans to collect for each resource type will be provided in their detailed walkthrough

Phase 1: Resources can Optionally Submit Energy Capability Commitments to Increase their FCA QMRIC

Previously presented at February 2024 MC Meeting

- Some resource types may have the option to submit energy capability (EC) commitments to improve their probability-weighted expected performance in hours important for system reliability
- ISO plans to validate and approve these commitments, and report the result of that process back to the Lead Market Participant
- Different resource types will be able to make different EC commitments, where specifics will be provided as part of each resource type's detailed walkthrough
- Validation of one-time and annual parameters planned to conclude on March 7, 2025 for FCA19
  - Additional details on the proposed timeline are available in the December 2023 MC material

Phase 2: Resources' FCA QC is Finalized and FCA QMRIC is Calculated

Previously presented at February 2024 MC Meeting

- In Phase 2, resources will receive their final FCA QC value for the forthcoming FCA
- With their FCA QC and the collected and validated parameters in Phase 1, the ISO will calculate and report each resource's accredited capacity value, FCA QMRIC
  - ISO plans to report FCA QMRIC to Lead Market Participants by March 28, 2025 for the FCA19 cycle. Additional details available in the December 2023 MC material
- FCA QMRIC represents a resource's probability-weighted expected performance during the hours that are important for system reliability
  - Established through calculating the resources' impact on expected unserved energy (EUE) using the MRI-based approach to accreditation which has been discussed in previous material
    - See the November and December 2022 MC/RC material, and the March 2023 MC material)

Phase 3: Given their FCA QMRIC, Resources Submit Offers/De-list Bids in the FCA

Previously presented at February 2024 MC Meeting

- FCA QMRIC will represent the maximum amount of capacity a resource can sell in the FCA
- The FCA will be conducted with respect to resources' FCA QMRIC, not their FCA QC
- As such, resources will submit offers or de-list bids in the FCA with respect to their FCA QMRIC
  - Existing FCA QMRIC will be available ahead of the submission of de-list bids
  - Information to determine new FCA QMRIC will be available ahead of the show of interest (SOI) window

Phase 4: Resources take on Obligations in the CCP Consistent with the Amount of CSO Sold

Previously presented at February 2024 MC Meeting

- Resources that sell CSO in the FCA will take on obligations for the corresponding Capacity Commitment Period (CCP)
  - CSO is in terms of FCA QMRIC, not FCA QC, and is the same value in all twelve months
- With RCA, resources' pay-for-performance (PFP) obligations will be seasonal, so that resources will have their obligations more closely match their expected performance in the summer and winter seasons
- CSO also comes with an energy market must-offer obligation consistent with its winter or summer physical capabilities (effective CSO) as required by resource type
  - See the January 2023 MC material for additional details

APPENDIX 2: CO-LOCATED RESOURCE EXAMPLE

Numerical example of Configuration 3 and 4 co-located resources' MRI calculation

FCA QMRIC calculations for configuration 3 and 4 co-located resources will employ a class average approach

Previously presented at March 2024 MC Meeting

- The ISO does not have information on how the individual components of configuration 3 and 4 co-located resources perform
- As a result, configuration 3 and 4 resources will be modeled as perfect capacity (PC) RAA resources in the accreditation base case (see January RC material)
- Given these resources will be modeled as perfect capacity in the RAA, their modeled performance likely does not reflect what their probability-weighted expected performance during the hours that matter for system reliability requiring an alternative approach from the modeled capability to accredit them
- Instead, configuration 3 and 4 co-located resources will be accredited using a class average approach discussed on the next slide

Configuration 3 and 4 resources' with solar components seasonal MRIs calculated using a class average

Previously presented at March 2024 MC Meeting

- Configuration 3 and 4 resources with a solar component will have their summer MRI calculated as the mean of the class average solar and battery summer MRIs, while the winter MRI will be calculated based only on the class average battery winter MRI:

$$MRI_{Summer} = \frac{MRI_{Solar,Summer} + MRI_{Battery,Summer}}{2}$$

$$MRI_{Winter} = MRI_{Battery,Winter}$$

- $MRI_{Solar,Summer}$ will be the class average solar summer MRI for the co-located resource's Load Zone
  - See the January MC material for details on the calculation of solar resource class average MRI
- $MRI_{Battery,Seasonal}$ will be calculated using the proxy resource approach based on the duration of the battery component
  - See the January MC material for additional discussion on the proxy resource MRI approach for ESR

Numerical example of seasonal MRI and FCA QMRIC calculation for Configuration 3 and 4 co-located resources

- Assume for resource (i) and perfect capacity (PC) and classes for solar and battery technologies:

  $QC_{i,Summer} = QC_{Winter} = FCA\ QC = 10\ MW$
  $MRI_{Solar,Summer} = 0.33\ hours/year$
  $MRI_{Battery,Summer} = 0.2\ hours/year$
  $MRI_{Battery,Winter} = 0.05\ hours/year$
  $MRI_{PC,Annual} = 1\ hour/year$

- Summer MRI for the configuration 3 and 4 co-located resource would be:

$$MRI_{i,Summer} = \frac{MRI_{Solar,Summer} + MRI_{Battery,Summer}}{2} = \frac{0.33\ hr/yr + 0.2\ hr/yr}{2} = 0.265\ hr/yr$$

- Winter MRI for the configuration 3 and 4 co-located resource would be:

$$MRI_{i,Winter} = MRI_{Battery,Winter} = 0.05\ hr/yr$$

- FCA QMRIC for the configuration 3 and 4 co-located resource would be:

$$FCA\ QMRIC_i = \left(\frac{MRI_{i,Summer}}{MRI_{PC,Annual}} \times QC_{i,Summer}\right) + \left(\frac{MRI_{i,Winter}}{MRI_{PC,Annual}} \times QC_{i,Winter}\right)$$

$$3.15\ MW = \left(\frac{0.265\ hr/yr}{1\ hr/yr} \times 10\ MW\right) + \left(\frac{0.05\ hr/yr}{1\ hr/yr} \times 10\ MW\right)$$

APPENDIX 3: ACRONYMS

Summary of acronyms used within this material

Acronyms

ADCR	Active Demand Capacity Resources
CCP	Capacity Commitment Period
CSO	Capacity Supply Obligation
EC	Energy Capability
ECSO	Effective CSO
ESR	Energy Storage Resource
EUE	Expected Unserved Energy
FCA	Forward Capacity Auction
FCM	Forward Capacity Market
IPR	Intermittent Power Resource
MC	NEPOOL Markets Committee
MRI	Marginal Reliability Impact
NC	Nameplate Capacity

PDR	Passive Demand Resources
PFP	Pay-for-Performance
PC	Perfect Capacity
POI	Point of Interconnection
QC	Qualified Capacity
QMRIC	Qualified MRI Capacity
RAA	Resource Adequacy Assessment
RC	NEPOOL Reliability Committee
RCA	Resource Capacity Accreditation
XEFORd	Equivalent forced outage rate on demand excluding outside management control events