Refresher Training: Flexible Ramping Product (FRP) Refinements – Deliverability

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Customer Readiness

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Housekeeping

- Keep yourself muted to minimize background noise
- Unmute to ask verbal questions or write questions in the chat pod
- Raise your hand using WebEx interactivity tools
Agenda

• This training covers the following topics:
  – Review of project changes
  – Key points
  – Application-specific changes
  – Settlement charge code changes
### Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
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<td>BAA</td>
<td>Balancing Authority Area</td>
<td>LMCP</td>
<td>Locational Marginal Capacity Price</td>
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<td>BAAOP</td>
<td>Balancing Authority Area Operations Portal</td>
<td>MRI-S</td>
<td>Market Results Interface - Settlements</td>
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<td>CLAP</td>
<td>Custom Load Aggregation Point</td>
<td>OASIS</td>
<td>Open Access Same-Time Information System</td>
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<td>Flexible Ramping Down</td>
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<td>Real-Time Dispatch</td>
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<td>Load Aggregation Point</td>
<td>WEIM</td>
<td>Western Energy Imbalance Market</td>
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FRP Problem Statement

WHAT WAS THE CHALLENGE?
What challenge is this project addressing?

- To improve deliverability of flexible ramping product through nodal procurement

- Addresses concerns where flexible ramp capacity is awarded behind transmission constraints which are binding
  - *Binding transmission constraint prevents the flexible ramp capacity from being deployable if uncertainty materializes*
  - *Reliability concern because system is relying on capacity which is potentially undeliverable*
WHAT IS CHANGING?
Pricing of FRP

• FRP will be modeled by location of the nodes that are in the ISO market’s network model to ensure that FRP awards are feasible to deliver and appropriately priced
  – Flexible Ramping Nodal Prices
  – Flexible Ramping Scheduling Point/Tie Nodal Prices

• Locational modeling consists of:
  – the RTM considering transmission constraints
  – the energy flows that would occur when the RTM dispatches energy from capacity scheduled to provide FRP
Procurement of FRP in WEIM

- ISO will maintain current RSE rules that limit WEIM energy transfers, when a BAA fails the RSE, to the amount scheduled in the market interval preceding the failure.
- The RTM will only procure FRP from a failing BAA’s own resources.
- Procurement target will be the amount calculated to meet the BAA’s individual uncertainty and forecasted ramping needs and would be feasible to deliver.
- Target would not include the benefit of pooling uncertainty of all BAAs across the WEIM footprint; This prevents a BAA with insufficient resources to meet its FRP needs from leaning on the capacity of other BAAs.
- When WEIM BAA is in contingency, the BAA will be removed from FLEX UP and FLEX DOWN passing group definition; There will be no FRU/FRD procurement for that BAA.
Key Points: Flexible Ramping Up (FRU) & Flexible Ramping Down (FRD)

• There are **no** capacity bids for FRU/FRD; they are priced at opportunity costs

• **Only** 5-min dispatchable resources are eligible for FRU/FRD awards

• Variable Energy Resources (VERs) are scheduled up to their forecast and they may be awarded FRU/FRD; VER FRU/FRD awards are deployed in the FRU/FRD deployment scenarios

• **All** physical transmission/transfer constraints that are enforced in the original market calculation (including base case and contingency constraints) are also enforced in the FRU/FRD deployment scenarios

**Note:** Upon go-live only flowgates apply. Other constraints will be introduced over time.
Key Points: Flexible Ramping Up (FRU) & Flexible Ramping Down (FRD)

• Distribution of FRU/FRD requirements in FRU/FRD deployment scenarios in each BAA is divided among load, solar, and wind resources
  – Allocation factors are derived from historical data that reflect the relative contributions of these resource classes to the overall uncertainty

• FRU/FRD demand elasticity is achieved with FRU/FRD surplus variables with cost curves that reflect the expected cost of foregoing FRU/FRD procurement
  – Ensures that FRU/FRD is not procured at a higher cost than the benefit it provides

• FRU/FRD surplus variables are modeled as independent controls in each FRP surplus zone, effectively relaxing the distributed FRU/FRD requirements in the respective zone
Flexible Ramping Up Deployment Scenario

- All FRU awards are deployed
- Demand/wind/solar forecast for each BAA that failed FRU sufficiency test is adjusted by FRU requirement for that BAA
- Demand/wind/solar forecast for group of BAAs that passed FRU sufficiency test is adjusted by FRU requirement for BAA group
- FRU surplus in each BAA that failed FRU sufficiency test is fully deployed
- FRU surplus in group of BAAs that passed FRU sufficiency test is fully deployed
Flexible Ramping Down Deployment Scenario

- All FRD awards are deployed
- Demand/wind/solar forecast for each BAA that failed FRD sufficiency test is adjusted by FRD requirement for that BAA
- Demand/wind/solar forecast for group of BAAs that passed FRD sufficiency test is adjusted by FRD requirement for BAA group
- FRD surplus in each BAA that failed FRD sufficiency test is fully deployed
- FRD surplus in group of BAAs that passed FRD sufficiency test is fully deployed
Configuration of FRP Surplus Zones

• Define and maintain FRP surplus zones in each BAA in the WEIM area

• FRP surplus zones shall include generation and load nodes so that every generation and load in a BAA shall belong to only one FRP surplus zone
  – In the case of CAISO, this will include CAISO scheduling points

• FRP surplus zones shall be used in the market to distribute FRP surplus variables
  – Four FRP surplus zones for CAISO align with the four TAC areas
  – For WEIM BAAs, one FRP surplus zone for the entire BAA, except for BAAs with CLAPs (e.g., BANC, PSCO) where the FRP surplus zones shall align with the CLAPs
Questions
FRP Deliverability Enhancements

KEY POINTS
As of 2/1/23, the calculations that determine FRP pricing will use a nodal pricing model requiring reporting changes in CMRI.

Reports will no longer contain data:
- Fifteen-Minute Market (FMM) Flexible Ramp Price Breakdown
- Real-Time Dispatch (RTD) Flexible Ramp Price Breakdown

Reports will provide FRP pricing:
- Fifteen-Minute Market (FMM) Schedule Prices
- Real-Time Dispatch (RTD) Schedule Prices
FRP: Requirement calculation changing to provide greater accuracy prior to each operating hour

Currently

As of 2/1/23

- 24 hour requirements published once daily
- Most recent net load forecast incorporated into hourly flex ramp calculation provided at T-75 & T-55
Multiple Threshold Layers with New FRP

• Threshold 1: Seasonal (Current capped thresholds will remain)
  – 1 Up value for all hours, 1 Down value for all hours
  – Calculated based on the past 90 days, however this may be adjusted
  – 99th percentile calculated for each hour; largest value used for Up Cap for all hours
  – 1st percentile calculated for each hour; largest value used for Down Cap for all hours

• Threshold 2: 180 Day Thresholds (New)
  – Values differ by hour
  – Calculated based on the past 180 days
  – 99th percentile for each hour used as Up Cap for respective hour
  – 1st percentile for each hour used as Down Cap for respective hour

• Market Operations BPM updates are in PRR 1473: Flexible Ramping Product Deliverability
For Histogram type (new 180 day thresholds)
- High value is used to cap FRU
- Low value is used to cap FRD
- Updated daily at 6:00am PPT

For Mosaic type (existing seasonal thresholds)
- High value is used as cap
  - Ramp type UP shows cap for FRU
  - Ramp type DOWN shows cap for FRD (think of this as negative value when comparing to FRD)
- Low value is used as floor – currently set to 0.1 MW for all entities
- Updated quarterly
Hourly Flex Requirement Available in BAAOP

- If an entity passes the flex ramp sufficiency tests, it will be included in the FRU/FRD Pass Group
- If an entity fails the flex ramp sufficiency tests, it will be listed individually
- This data is updated hourly

Note: Flex ramp requirement will always be the lesser of the following numbers:
- Flex requirement
- Histogram threshold
- Mosaic threshold
Application Review

APPLICATION-SPECIFIC DETAILS
Change to existing display – Market: Real-time Binding Transmission Constraints

Path: EIM > Transmission > Binding Transmission Constraints - Flowgates > RTD/RTPD/STUC

Additional column to indicate the constraint is binding and in which scenarios:
- BASE, FRU is FRU deployment scenario
- FRD is for FRD deployment scenario
Real-time Binding Transmission Constraints: What does the Operator need to consider?

**Example 1:** All three types (BASE, FRD, FRU) exist in the same interval – same flowgate

- Since the Base type exists and the Cleared Value exceeds the Binding Limit, this should be considered exactly like today - the market sees an overload.
- The inclusion of the FRU and FRD indicates that FRP awards, if dispatched, would also be affected, as expected.
Real-time Binding Transmission Constraints: What does the Operator need to consider?

Example 2: Only an FRU or FRD record exists for a given flowgate and time interval

- If only an FRU or FRD record exists and the cleared value is still under the binding limit, this may likely not require manual action.
- FRU or FRD congestion is projected congestion that would occur if the uncertainty is realized and the FRP awards are dispatched.
- The market will strive to resolve this constraint and even make space for additional ramping capacity.
Real-time Binding Transmission Constraints: What does the Operator need to consider?

Example 3: Only Base exists for the given Flowgate and time interval

- If only Base exists, there are no uncertainty scenarios in which the congestion occurs as a result of dispatch of all available FRU/FRD for the given contingency.
- Either all the FRP ramping capacity is able to be dispatched without congestion or possibility the counter-flows of the FRP awards are contributing to the solution.
New display – Market: Real-time
BAAOP Flex Ramp Sufficiency Schedules, BAA Factors

New UI to show:

- FRP requirement for individual BAA’s requirement (when they fail the test in that direction)
- FRU/FRD_Pass group requirement for the remaining BAAs which pass the test in that direction

Path: EIM > System > Flex Ramp Sufficiency Schedules > BAA Factors > RTD/RTPD/STUC
New display – Market: Real-time: Flex Ramp LMP

- New UI to show nodal FRP prices

What does the Operator need to know?

- FRP LMPs are associated to P-nodes/AP-Nodes (like today’s energy LMPs) and like ancillary services are settled separately.

- FRP LMP’s are not decomposed into multiple components (Energy, Loss, Congestion), there is only a final Flex Ramp Up and Flex Ramp Down LMP, per location and time interval calculated in RTD/RTPD/STUC.

- Left side displays Resources, right-side by Interties. (Pricing Run only)
How will FRP Deliverability enhancements impact load biasing (aka imbalance conformance)

• With market uncertainty now deliverable based upon nodal constraints, Load Biasing should be more responsive
CMRI Real-Time Menu: Flexible Ramp Price Breakdown Reports – no new data after 2/1/23

- The following reports will **not** contain future data as of 2/1/23:
  - Fifteen-Minute Market (FMM) Flexible Ramp Price Breakdown
  - Real-Time Dispatch (RTD) Flexible Ramp Price Breakdown

- Reports will remain available for prior trade dates
CMRI Real-Time menu: Reports containing updated FRP data as of 2/1/23

FRP awards data will be available in these existing reports
CMRI Real-Time menu: Reports containing FRP prices

- Report columns and layout are the same
- Calculation of FRP pricing changes as of 2/1/23
CMRI Real-Time menu: Reports containing FRP schedules

- FMM Schedules
- RTD Schedules

- Report columns and layout are the same
OASIS Prices Menu > Energy Prices list: New Reports

- Flexible Ramping Nodal Prices
- Flexible Ramping Scheduling Point/Tie Nodal Prices
OASIS: Flexible Ramping Nodal Prices

- FRU/FRD Nodal prices at the Pnode level for all:
  - P-nodes,
  - SP-ties
  - AP-nodes

- Calculated by the RTD and RTPD binding market run
OASIS: Flexible Ramping Scheduling Point/Tie Nodal Prices
OASIS Prices Menu > Shadow Prices list: New Reports

Existing report

New reports
- FRU/FRD shadow price and requirement for BAAs that fail the RSE and for the FRU/FRD passing group
- Calculated by market runs
OASIS: Flexible Ramping Constraint Shadow Prices

- Transmission constraint shadow prices for FRU/FRD deployment scenarios in RTPD/RTD
OASIS: Flexible Ramping Scheduling Constraint Shadow Prices

- Scheduling constraint shadow prices for FRU/FRD deployment scenarios in RTPD/RTD
The following report will **not** contain future data as of 2/1/23:
- Flexible Ramp Requirements

Reports will remain available for prior trade dates.
The following reports provide data that can be used to calculate flex ramp requirements:

- Flexible Ramp Requirement Thresholds
- Flexible Ramp Requirements Uncertainty Histograms

**Note:** In order to calculate FRP requirement, entity will also need forecast data for each 15 minute interval of the trade date (for solar, wind, demand)
RTPD/RTD passing group ID & failing entities:

- Report provides the ability to determine which entities are part of the WEIM area requirement
OASIS: Flexible Ramp Forecasts

- Total RTD/RTPD binding & advisory resource forecast grouped by WEIM entity by tech type for solar/wind
- Report will also have a demand forecast component
• Threshold value for FRU/FRD requirement for each BAA/WEIM area
OASIS: Flexible Ramp Requirement Input Polynomials

- 5- & 15- minute, low and high, polynomial coefficients for these forecasts:
  - Mosaic
  - Wind
  - Solar
  - Demand

- Forecast by WEIM entity/area
OASIS: Flexible Ramp Requirements Input Uncertainty Histograms

- 5- & 15- minute, low and high, uncertainty histogram values for these forecasts:
  - Mosaic
  - Wind
  - Solar
  - Demand

- Forecast by WEIM entity/area
### Flexible Ramp Requirements Inputs and Outputs (WEIM RSE Flexible Ramping Tests)

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- Note that you can see the 15-min net load uncertainty on this report along with other information.
Settlements

**CHARGE CODE UPDATES**

- \( PU \): set of BAA\( s \) that pass the FRU sufficiency test
- \( PD \): set of BAA\( s \) that pass the FRD sufficiency test
- \( FRU_i/FRD_i \): FRU/FRD demand elasticity

\[
\sum_{j \in PU} \sum_{i \in \text{BA}_i} FRU_i + FRUS_{PU} = FRUR_{PU}
\]

\[
\sum_{i \in \text{BA}_i} FRU_i + FRUS_j = FRUR_j, \forall j \notin PU
\]

\[
\tau_j \geq \bar{\tau}_j
\]

\[
\sum_{i \in PD} \sum_{j \in \text{BA}_i} FRD_i + FRDS_{PD} = FRDR_{PD}
\]

\[
\sum_{j \in \text{BA}_j} FRD_i + FRDS_j = FRDR_j, \forall j \notin PD
\]

\[
\tau_j \leq \bar{\tau}_j
\]
The shift to FRP nodal pricing requires the mechanics for cost allocation pricing to change

- For all WEIM entities that pass either FRU or FRD settlements will derive the total quantity of each category
- CMRI, OASIS and BAAOP provide reports and data that result in settlement statements located in MRI-S
- Processes are not changing, however the charge code calculations that feed into settlement results will have slight modifications
Which charge codes will be impacted?

**Movement**
- 7070 Settlement
- 7076 Allocation

**Uncertainty**
- 7071/7081 Settlement
- 7077/7087 Daily Allocation
- 7077/7087 Monthly Allocation
What will be **settled** for both Movement and Uncertainty?

**Movement**

- 7070 Settlement
  - Use nodal FRUMP & FRDMP
  - Distinguish between Up and Down Awards
  - Incorporate Passing Group Indication (Q’’) in Movement amounts in preparation for allocation through the use of the Flex Ramp Test Results Flag

**Uncertainty**

- 7071/7081 Settlement (Up/Down)
  - FMM FRU/FRD Uncertainty Award settlement is at the resource specific FRUMP/FRDMP
  - RTD FRU/FRD Uncertainty Award settlement is a deviation settlement from FMM at the resource specific FRUMP/FRDMP
  - Prices no longer carry Q” or constraint ID
    - Updated formulas to reflect above change
  - Q” will now be introduced using the Flex Ramp Test Results Flag instead
What will be allocated for Movement?

7076 Allocation

- Apply new allocation methodology (Pass vs Fail Flex Ramp Sufficiency Test)
  - If BAA Passes, allocation of movement award costs will be across all WEIM entities that belong to PASS group
  - If BAA Fails, allocation of movement award costs will be isolated to the metered demand of the respective BAA
What will be **allocated** for Uncertainty?

### Uncertainty (daily)

7077/7087 DAILY Allocation (Up/Down)
- Remains a 2-Tier Cost Allocation by resource category methodology
- Allocation based on passed group:
  - **PASS**
    - Triggered across all BAAs that Pass
  - **FAIL**
    - Allocated to metered demand of isolated BAA

### Uncertainty (monthly)

7078/7088 Allocation (Up/Down)
- **Allocation based on Peak and Off-Peak Hours**
- Remains a 2-Tier Cost Allocation by resource category methodology
- Allocation based on passed group:
  - **PASS**
    - Triggered across all BAAs that Pass
  - **FAIL**
    - Allocated to metered demand of isolated BAA
EXAMPLES: SETTLEMENT OF FRP FORECASTED MOVEMENT
Forecasted Movement Settlement – Example 1:
BAA Passes both FRU and FRD RSE Tests

• Forecasted Movement Settlement is product of resource’s forecasted movement and the difference between nodal FRUMP – FRDMP

• The BAA total Forecasted Movement Costs shall be allocated across to that BAA Group Metered Demand
  – Prorate BAA Metered Demand / Total BAA Group Metered Demand
Forecasted Movement Settlement – Example 2: BAA Failed both FRU and FRD RSE Tests

- Forecasted Movement Settlement is product of resource’s forecasted movement and the difference between nodal FRUMP – FRDMP

- The BAA total Forecasted Movement Costs shall be allocated locally to that BAA Metered Demand
  - Prorate BAA Metered Demand / Total BAA Metered Demand
Forecasted Movement Settlement – Example 3: Passed FRU RSE Test/Failed FRD RSE Test

- All resources within that BAA are paid/charge their forecasted movement and the difference between nodal FRUMP – FRDMP

- Forecasted Movement Allocation is split:
  - Forecasted Movement costs/revenue associated with FRUMP shall be allocated to BAA Group Metered Demand because the BAA Passed FRU RSE
  - Forecasted Movement costs/revenue associated with FRDMP shall be allocated to BAA Metered Demand because the BAA Failed FRD RSE
Forecasted Movement Settlement – Example 4: Failed FRU RSE Test/Passed FRD RSE Test

- All resources within that BAA are paid/charge their forecasted movement and the difference between nodal FRUMP – FRDMP

- Forecasted Movement Allocation is split:
  - Forecasted Movement costs/revenue associated with FRUMP shall be allocated to BAA Metered Demand because the BAA Failed FRU RSE
  - Forecasted Movement costs/revenue associated with FRDMP shall be allocated to BAA Group Metered Demand because the BAA Passed FRD RSE
Final Questions
Thank you for your participation!

For more detailed information on anything presented, please visit our website at:

www.caiso.com

Or send an email to:
CustomerReadiness@caiso.com
Reference Material: September Training Session

Flexible Ramping Product (FRP) Refinements – Deliverability Training – September 7, 2022

• Presentation:  

• Video:  
  https://youtu.be/kIVPJNo5ww0
Reference Material: Project Documentation

• Business Practice Manual changes:
  – **BPM Change Management** – look for changes to Market Instruments and Market Operations BPMs

• Business Requirements Specification:

• Initiative webpage:
Reference Material: Project Documentation

• Market Simulation Structured Scenarios:

• Tariff amendment to refine FRP:

• Technical Specifications – located on the ISO’s Developer Site which provides detailed descriptions of the API changes for:
  – CMRI
  – OASIS