Flexible Ramping Product (FRP) Refinements – Deliverability

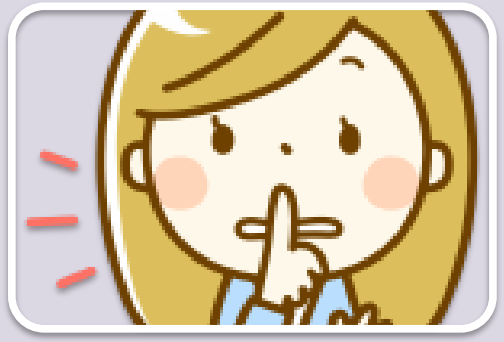
September 7, 2022

Radha Madrigal
Customer Readiness

Updated to include BAAOP screens; slides 21-23

Updated: 11/29/2022

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 will cover the following topics:
  - Background of FRP
  - High-level review of changes
  - Application-specific details
  - Market simulation activities

Objectives: Flexible Ramping Product Refinements

- Enforce transmission constraints and transfer limits in FRP deployment scenarios
- Procure FRP collectively for the group of BAAs that pass the flex test
- Procure FRP separately for BAAs that fail the flex test
- Establish Locational Marginal Capacity Prices (LMCP) for FRP
- Enhance current approach by adopting quantile regression method to adjust current FRP up/down requirement
- Distribute uncertainty requirement in each BAA load and Variable Energy Resource (VER) locations versus just load
- Enhance calculation of demand curve by adopting quantile regression method
- Distribute demand curve surplus variable as a decision variable at load aggregation points (LAP) versus Balancing Authority Areas (BAA)

Acronyms

Abbreviation	Term	Abbreviation	Term
BAA	Balancing Authority Area	MRI-S	Market Results Interface - Settlements
BAAOP	Balancing Authority Area Operations Portal	OASIS	Open Access Same-Time Information System
CLAP	Custom Load Aggregation Point	RSE	Resource Sufficiency Evaluation
CMRI	Customer Market Results Interface	RTD	Real-Time Dispatch
FRD	Flexible Ramping Down	RTM	Real-Time Market
FRP	Flexible Ramping Product	RTPD	Real-Time Pre Dispatch
FRU	Flexible Ramping Up	TAC	Transmission Access Charge
LAP	Load Aggregation Point	VER	Variable Energy Resource
LMCP	Locational Marginal Capacity Price	WEIM	Western Energy Imbalance Market

FRP REFINEMENTS - DELIVERABILITY

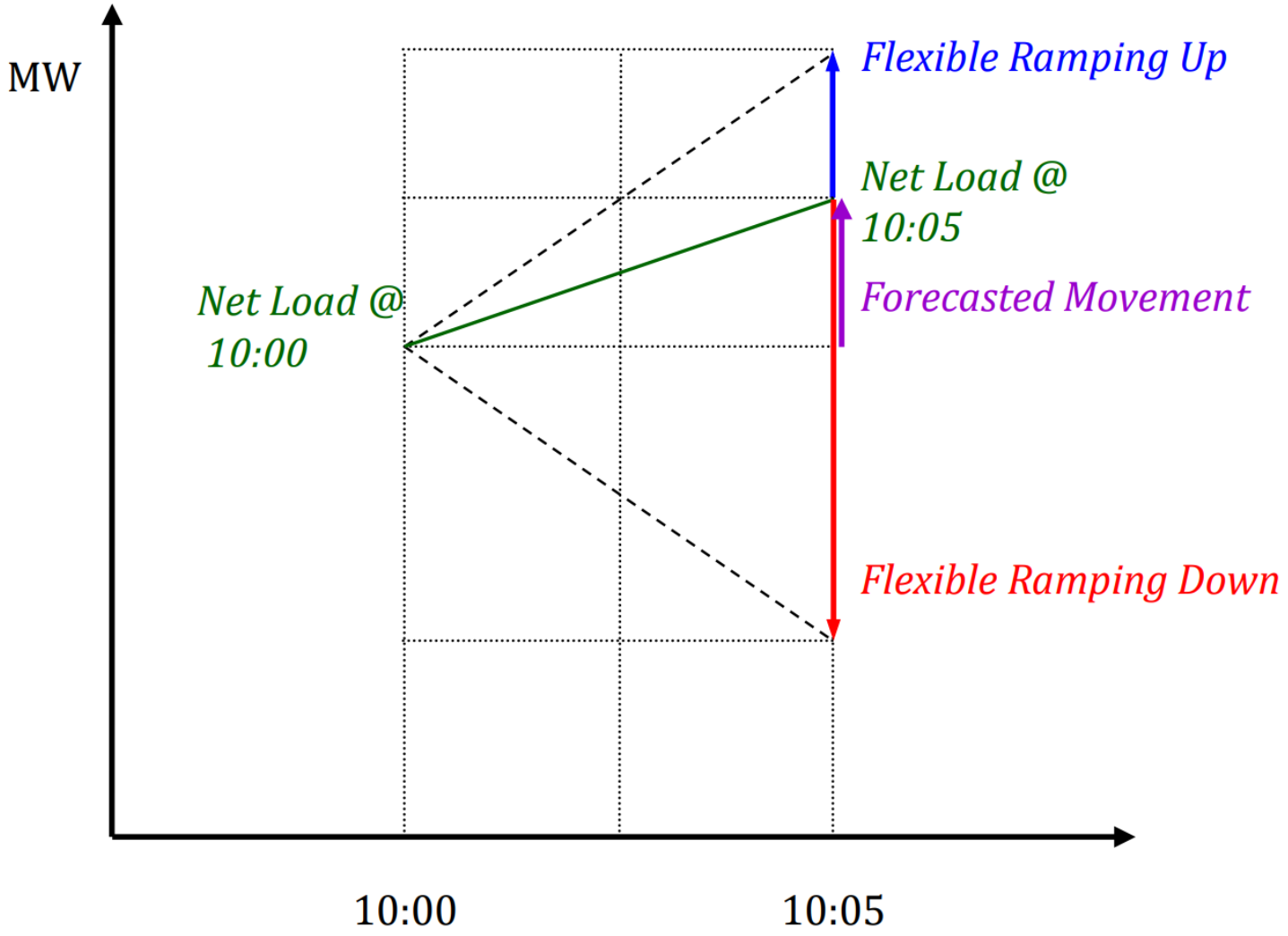
Implementation timeline

- Tariff amendment filed with FERC: August 15, 2022
  - FERC approval requested by October 17, 2022
- Market simulation: September 15 – October 14, 2022
- Production activation date: TBD

BACKGROUND: HIGH-LEVEL REVIEW OF CHANGES

Flexible Ramping Product

Flexible ramping product secures additional ramping capability that can be dispatched in the subsequent market runs to cover uncertainty in forecasted net load



Background: FRP Refinements – Deliverability Initiative Problem Statement

- Analyses showed energy from a large portion of scheduled FRP capacity is actually not deliverable because of congested transmission
  - Real-time market (RTM) currently does not consider transmission constraints within BAAs when scheduling FRP

- In addition to reducing FRP's effectiveness in addressing load uncertainty, this situation:
  - tends to make flexible ramping prices artificially low
  - is not reflective of the value of capacity that can provide flexible ramping capability

Background: FRP Refinements – Deliverability Initiative Solution

- Most significant enhancement is to **model FRP by location of the nodes** that are in the ISO market's network model
  - 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
  - Ensures FRP awards are *feasible to deliver* and *appropriately priced*

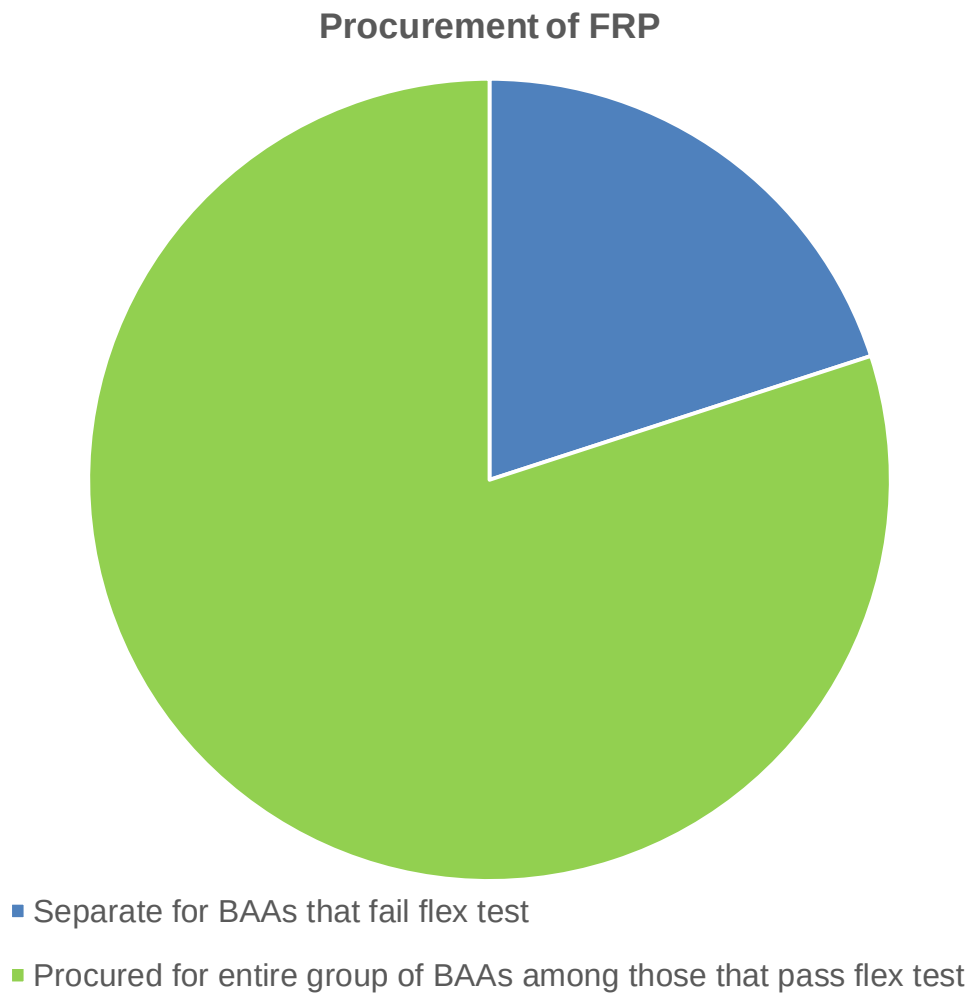
Background: Western Energy Imbalance Market (WEIM) Resource Sufficiency Evaluation (RSE)

- In the original proposal (2020), there was a technical element that would have limited WEIM transfers to zero as a consequence of failing the RSE; That was a proposal to change the status quo of holding transfers constant at the level prior to the hour in which the entity fails the RSE

- Significant stakeholder dialogue since that time concluded that *limiting WEIM transfers to zero in the event of an RSE failure would exacerbate reliability issues* during stressed system conditions and create unacceptable risks to reliability

- ISO modified this element of the original proposal, *effectively retaining the existing consequences for failing the RSE* while the ISO works to establish a framework of financial consequences for RSE failure
  - This modification will allow the ISO to implement this initiative <u>without causing any adverse reliability impacts</u>

Implementation: Western Energy Imbalance Market (WEIM) Resource Sufficiency Evaluation (RSE)



- 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)

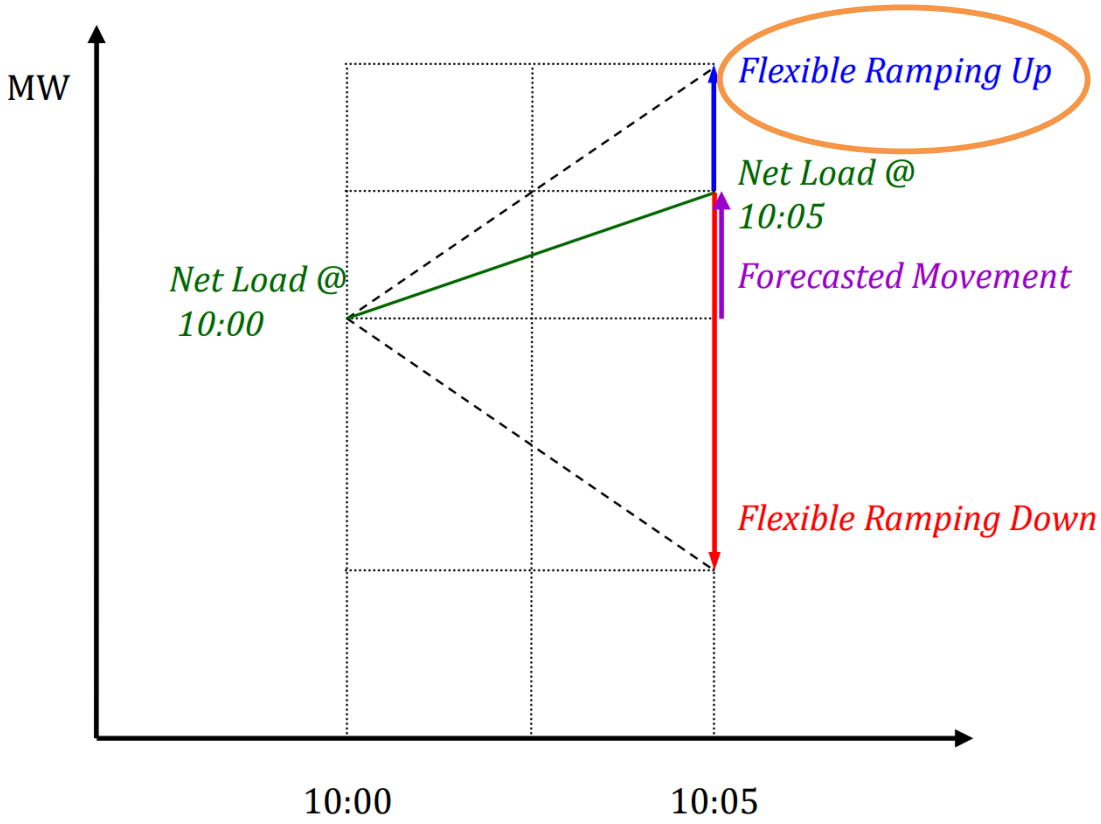
- There are **no** capacity bids for FRU/FRD; they are priced at opportunity costs
- Only 5-min dispatchable resources are eligible for FRU/FRD awards
- Variable Energy Resources (VERs) are scheduled up to their forecast and they may be awarded FRU/FRD; VER FRU/FRD awards are deployed in the FRU/FRD 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

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

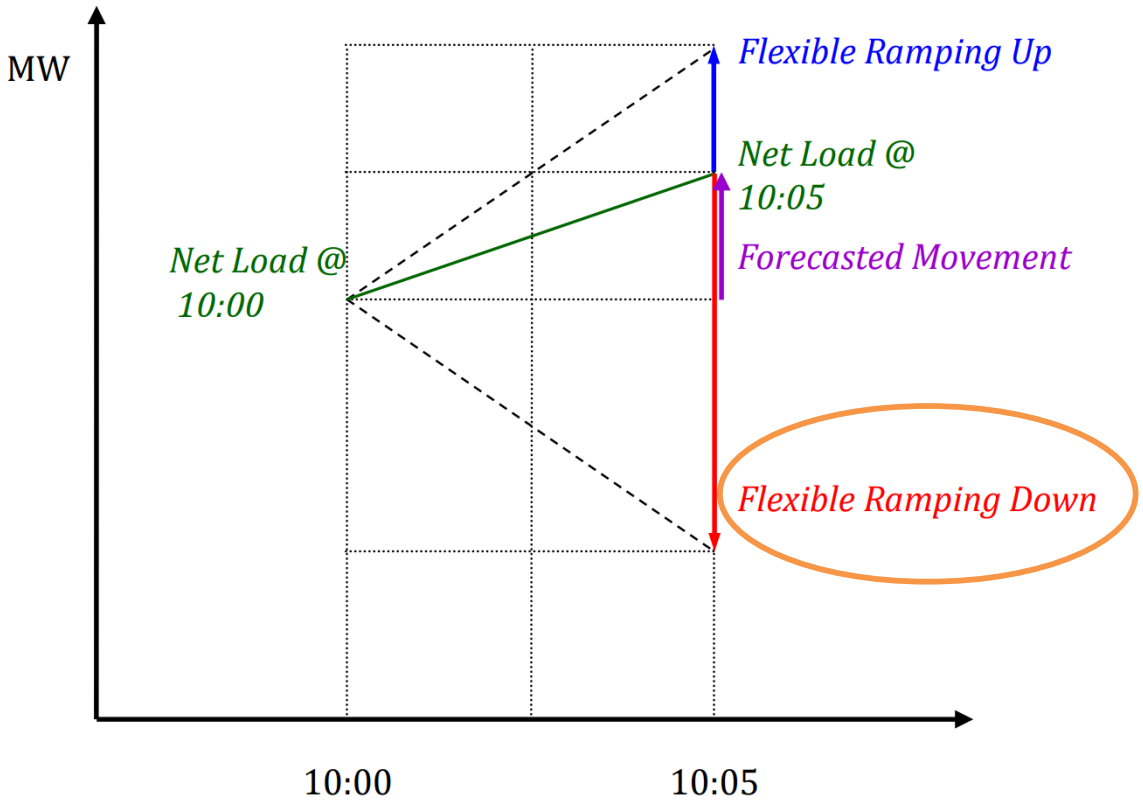
Flexible Ramping Up Deployment Scenario

- 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

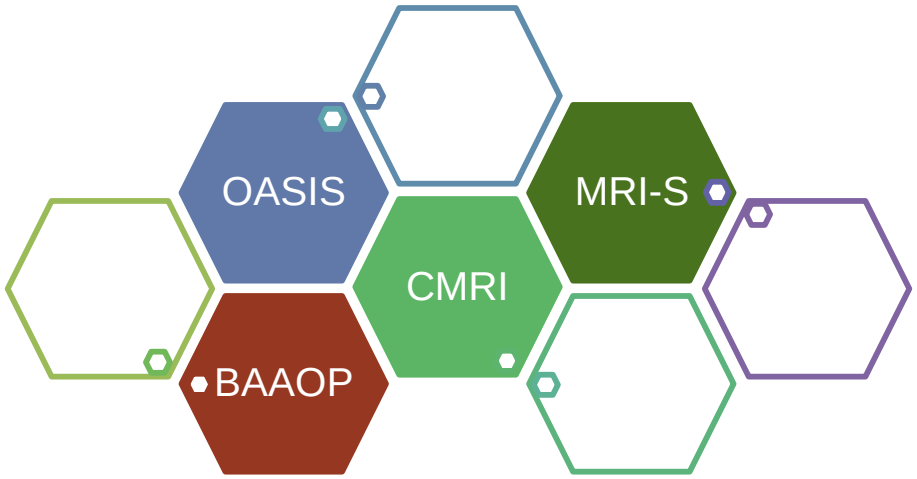
- All FRD awards are deployed
- Demand/wind/solar forecast for each BAA that failed FRD sufficiency test is adjusted by FRD requirement for that BAA
- Demand/wind/solar forecast for group of BAAs that passed FRD sufficiency test is adjusted by FRD requirement for BAA group
- FRD surplus in each BAA that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

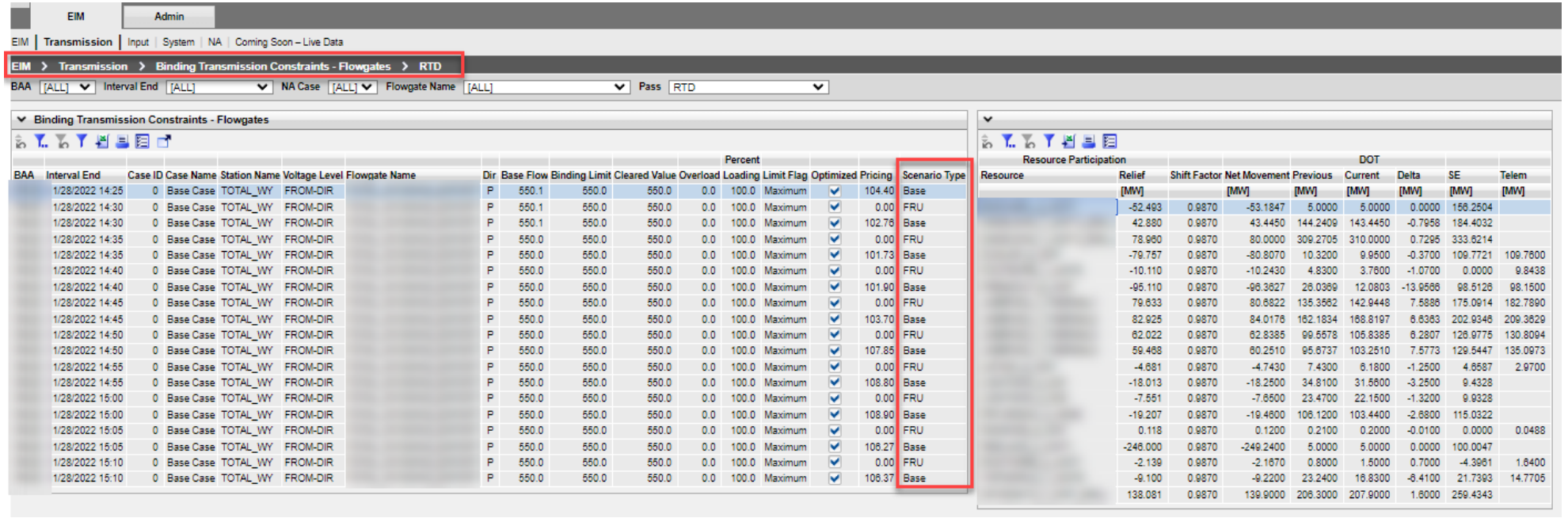


REVIEW APPLICATION-SPECIFIC DETAILS

Change to existing display – Market: Real-time

BAAOP

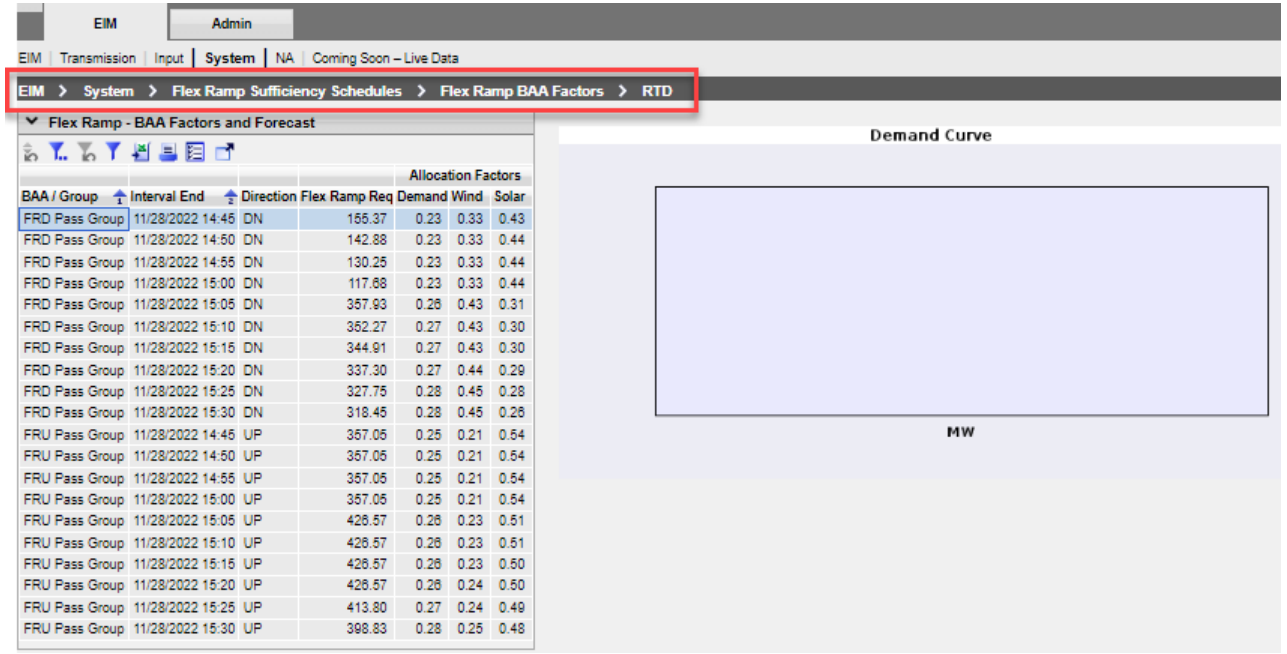
- Path: EIM > Transmission > Binding Transmission Constraints - Flowgates > RTD/RTPD/STUC
- Existing UI has a slight change; there is an additional column to indicate the constraint is binding and in which scenarios (BASE, FRU is FRU deployment scenario, FRD is for FRD deployment scenario)



New display – Market: Real-time
BAAOP Flex Ramp Sufficiency Schedules, BAA Factors

BAAOP

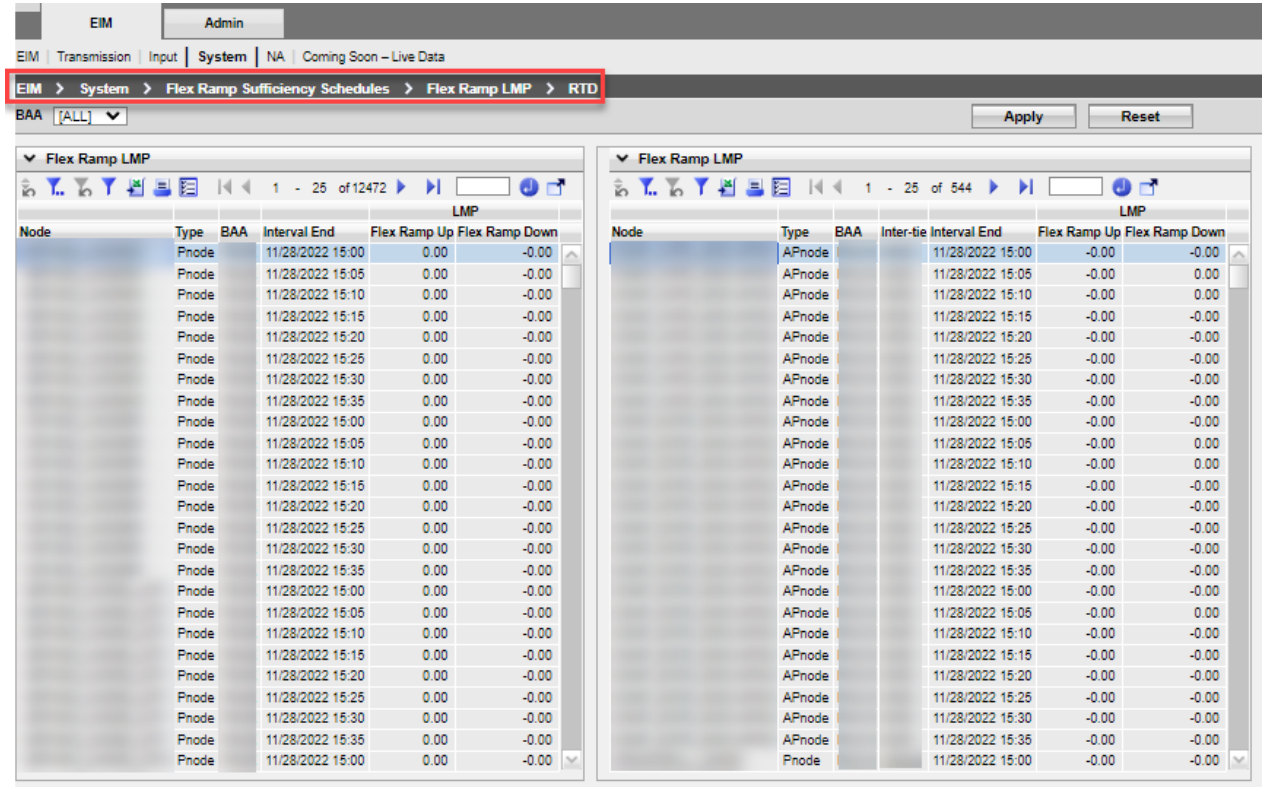
- Path: EIM > System > Flex Ramp Sufficiency Schedules > BAA Factors > RTD/RTPD/STUC
- New UI to show the FRP requirement for individual BAA's requirement (when they fail the test in that direction) and FRU/FRD_pass group requirement for the remaining BAAs which pass the test in that direction



New display – Market: Real-time
BAAOP Flex Ramp Sufficiency Schedules, Flex Ramp LMP

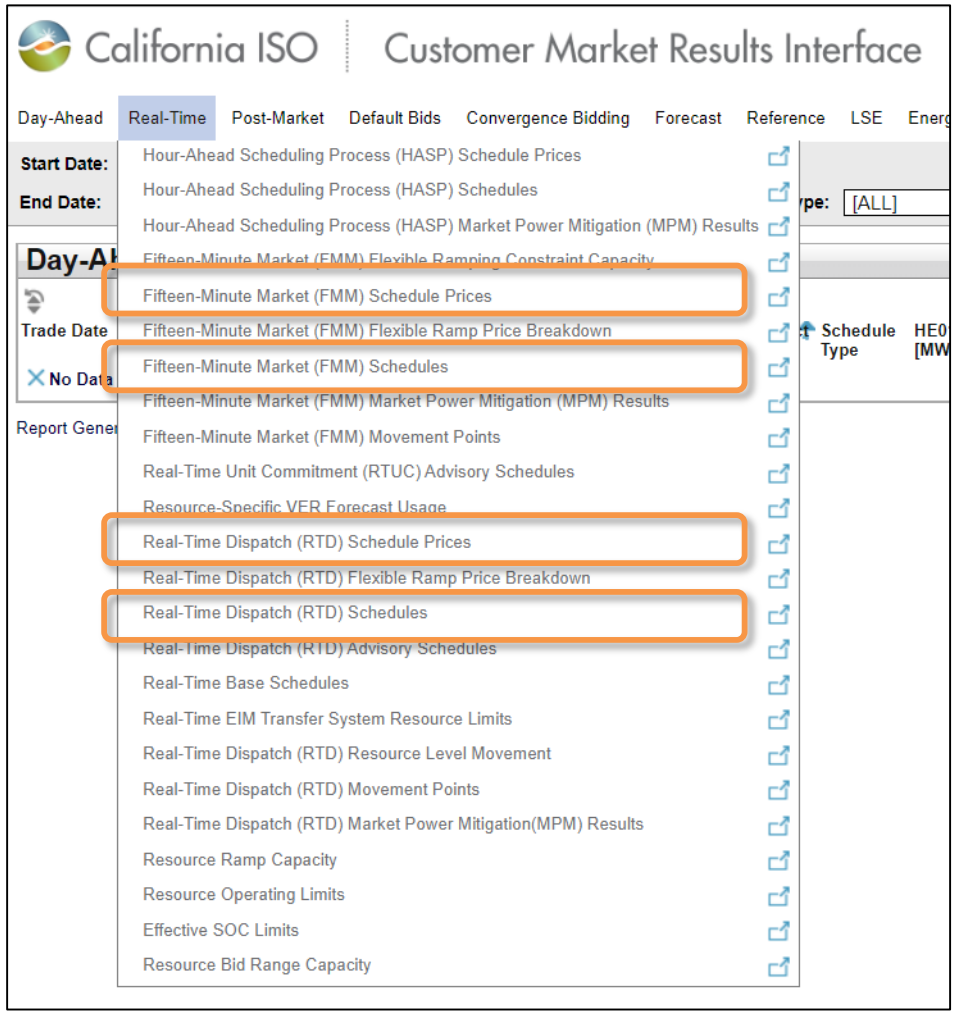
BAAOP

- PATH: EIM > System > Flex Ramp Sufficiency Schedules > Flex Ramp LMP > RTD/RTPD/STUC
- New UI to show nodal FRP prices



Existing CMRI reports will contain updated FRP data

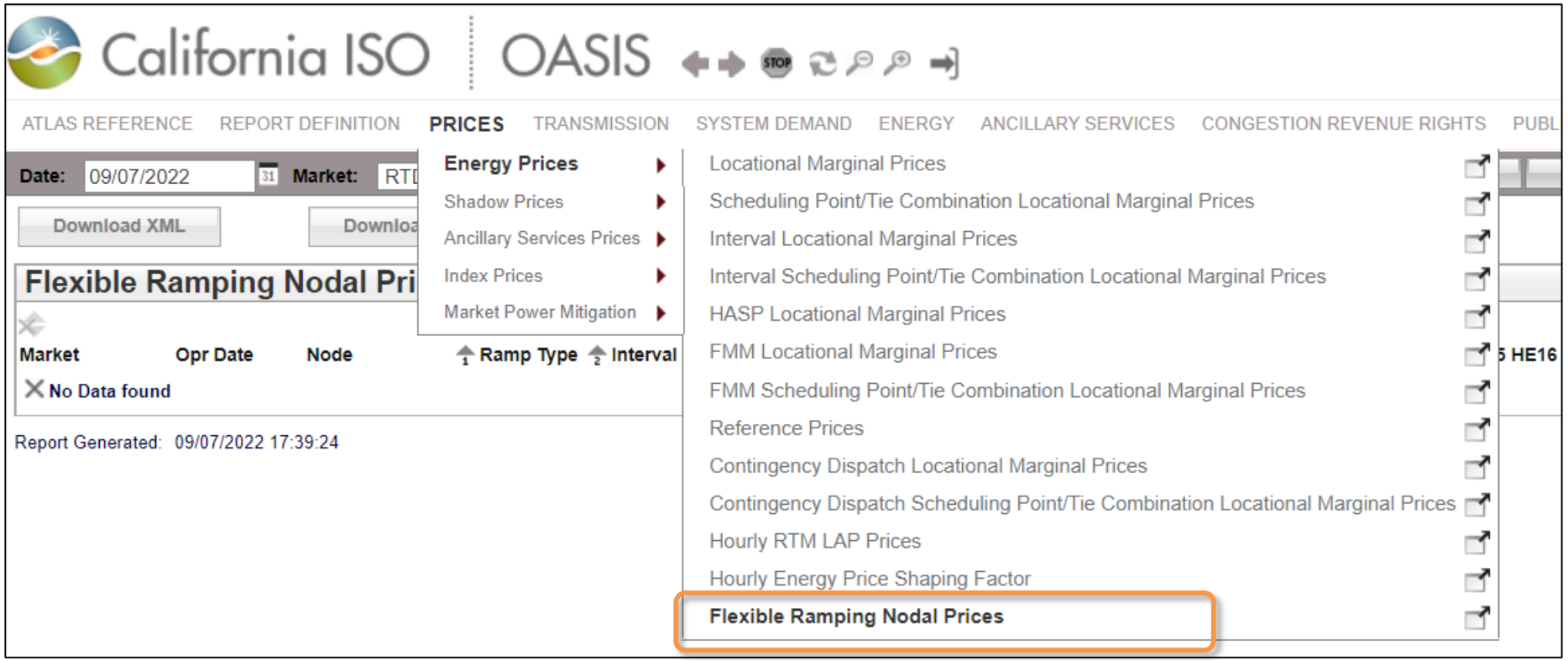
CMRI



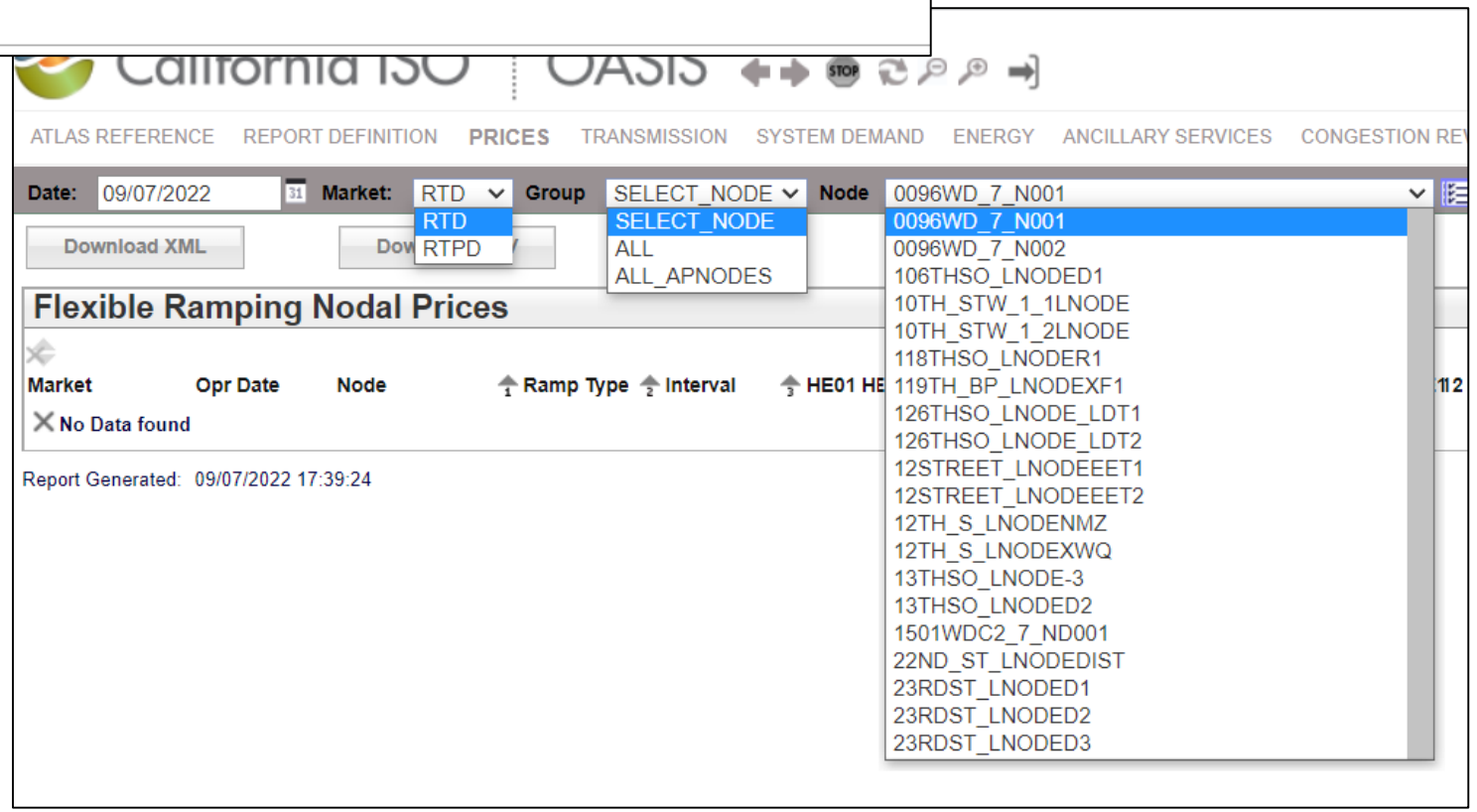
Additional FRP awards data will be incorporated into these existing reports

New OASIS Report Accessible From Prices Menu

OASIS



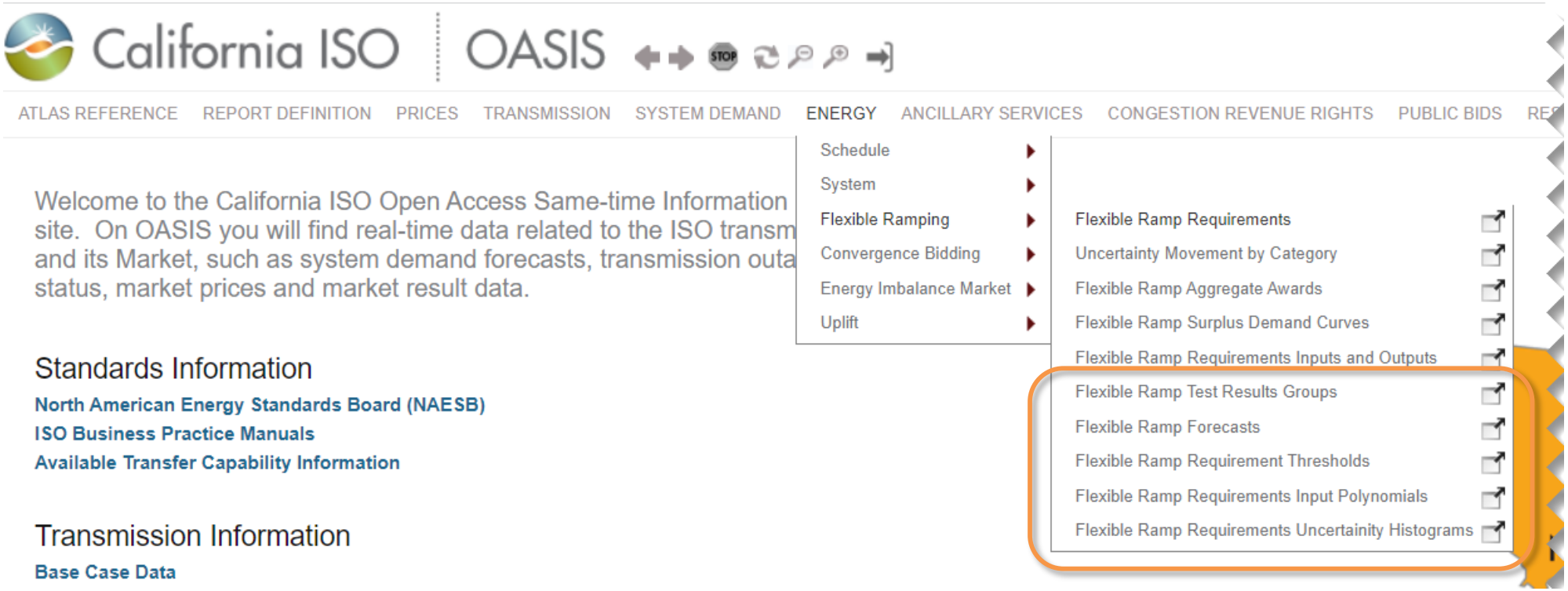
Flexible Ramping Nodal Prices



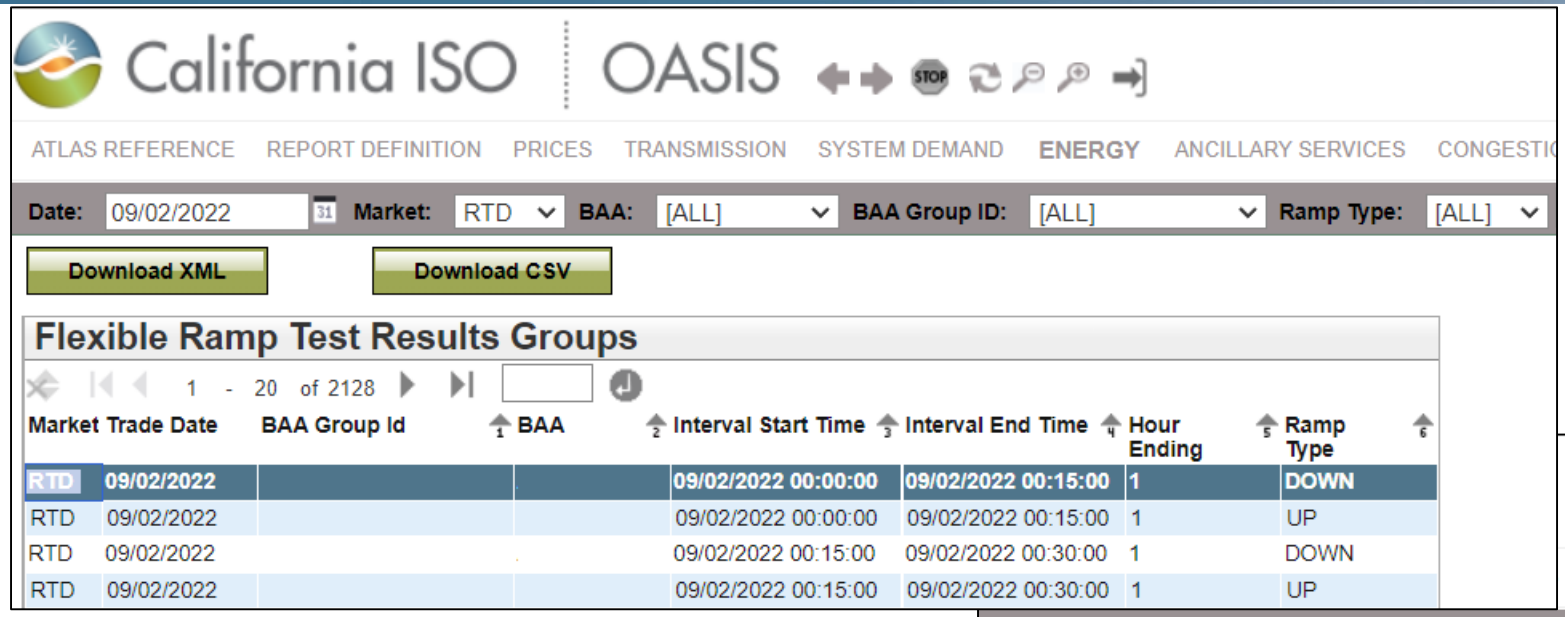
FRU/FRD Nodal prices at the Pnode level for all P-nodes, SP-ties and AP-nodes calculated by the RTD and RTPD binding market run

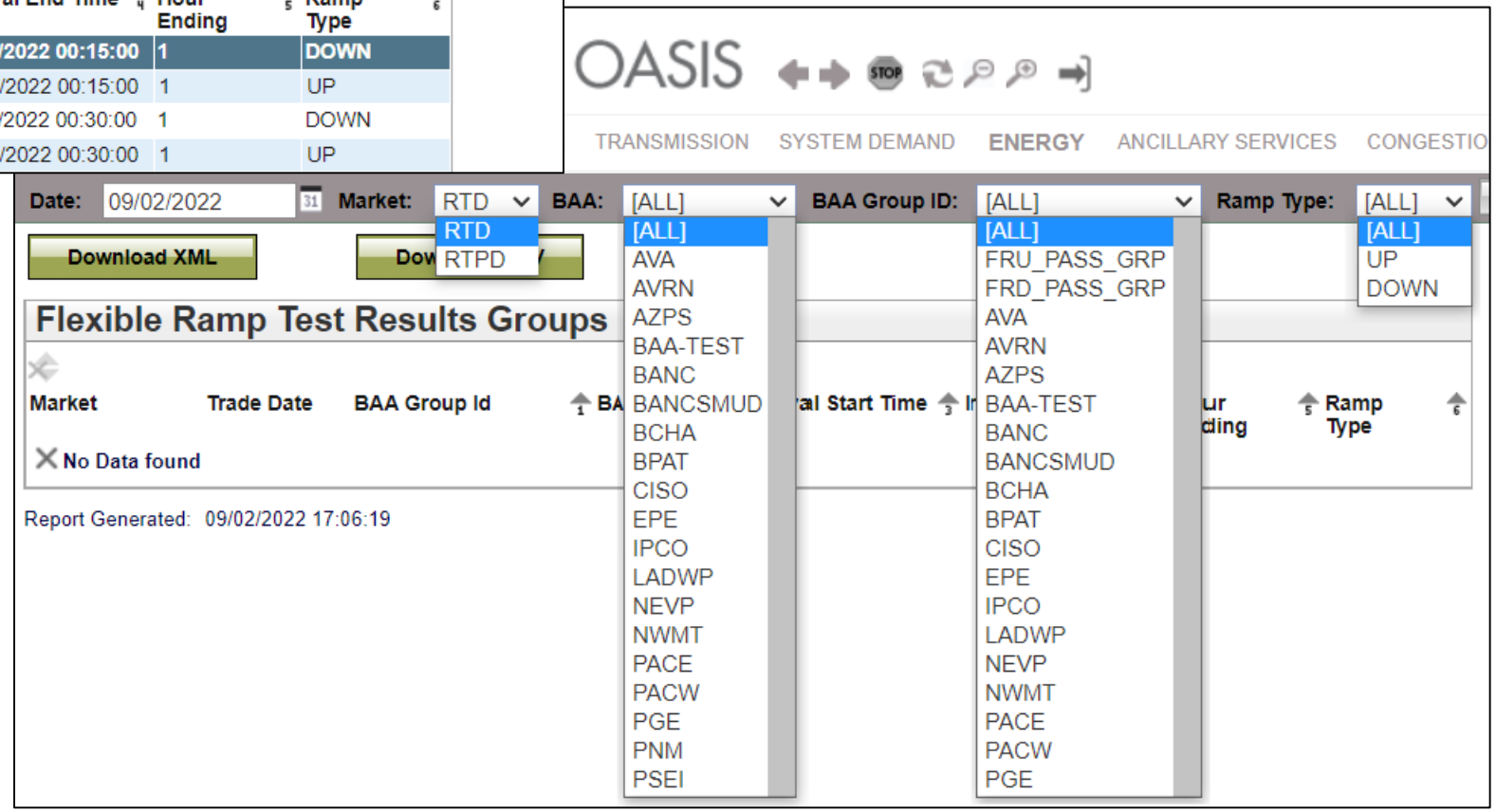
New OASIS Reports Accessible From Energy Menu

OASIS



Flexible Ramp Test Results Groups

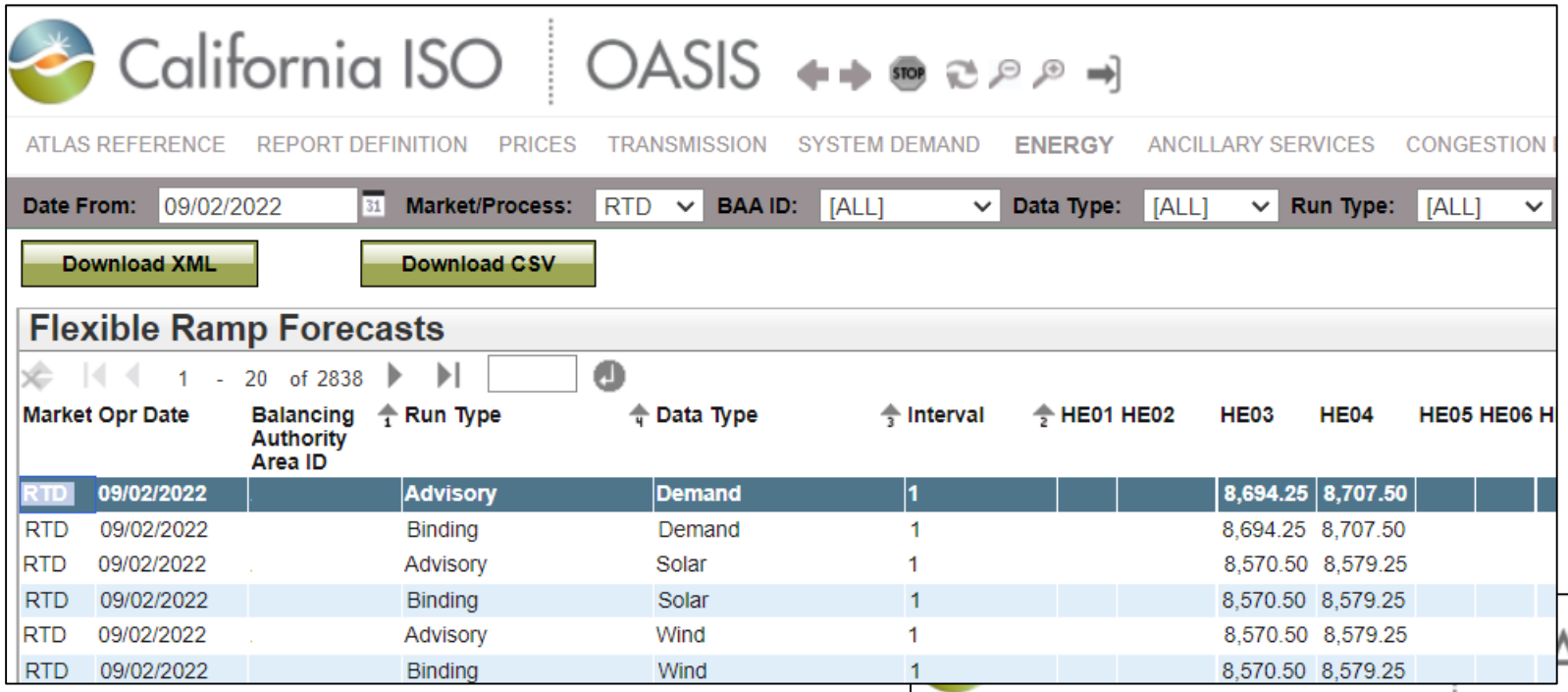


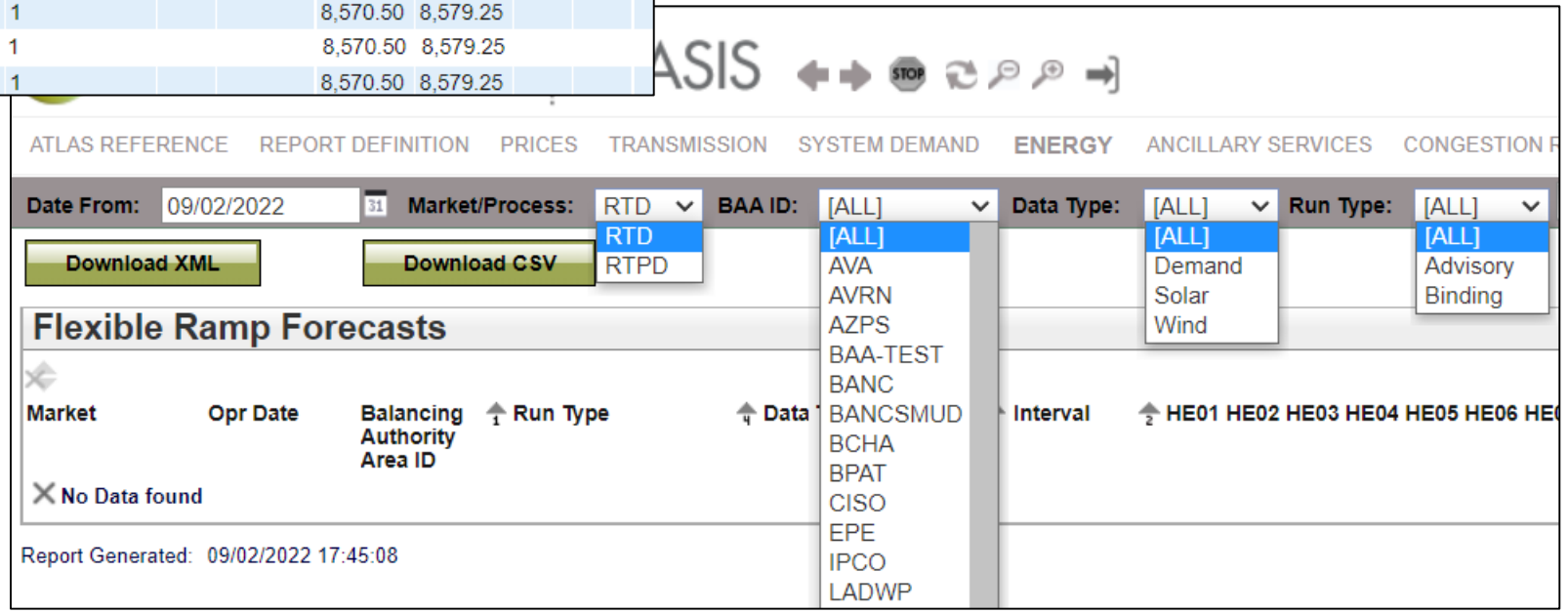


RTPD/RTD passing group ID & failing entities; Report provides the ability to determine which entities are part of the WEIM area requirement

OASIS

Flexible Ramp Forecasts

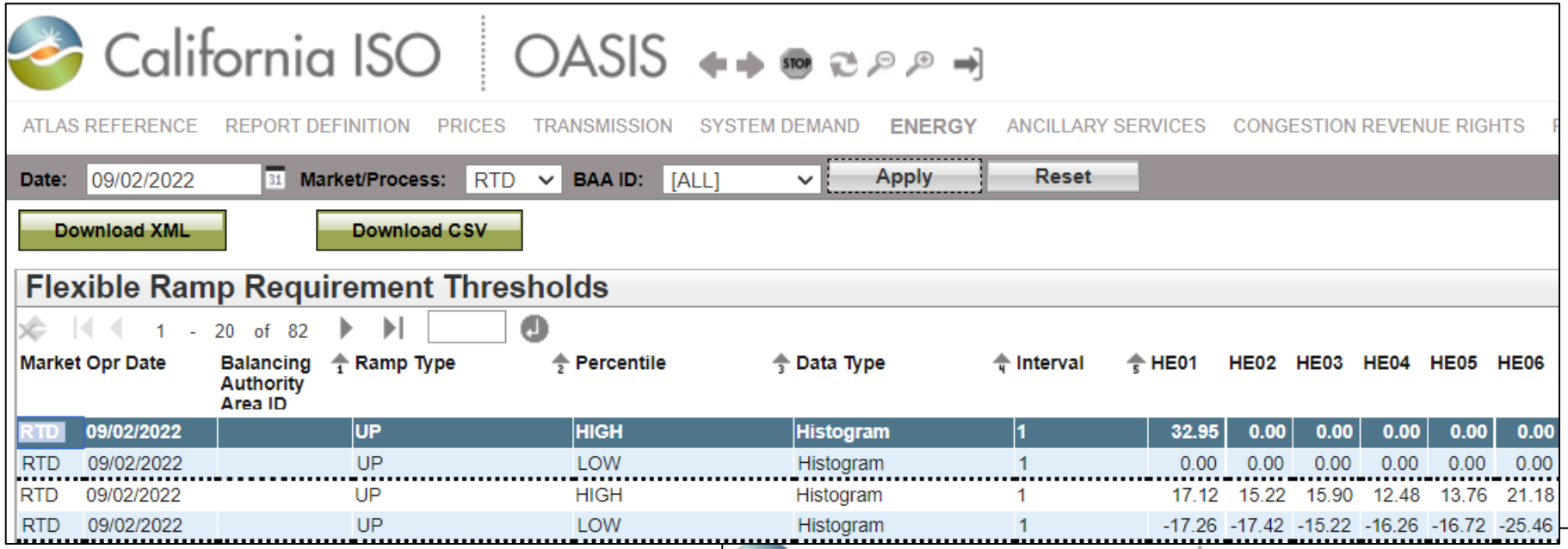




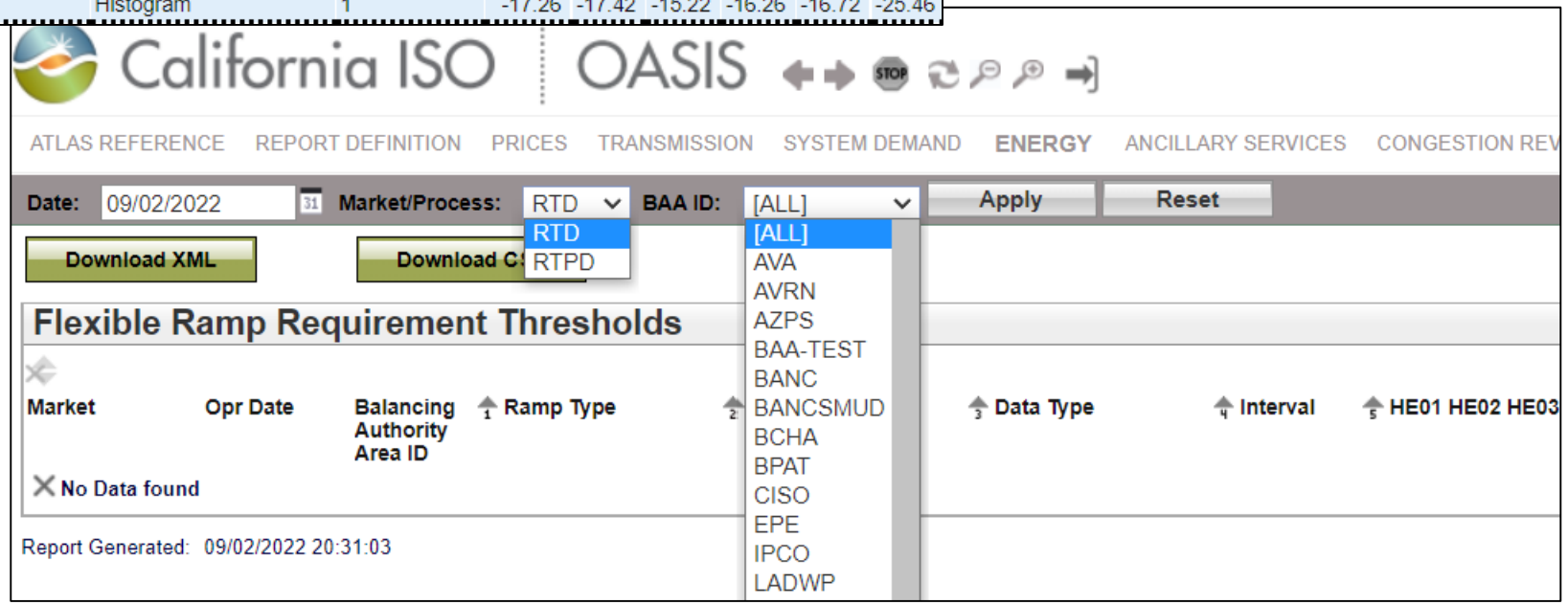
- Total RTD/RTPD binding & advisory resource forecast grouped by WEIM entity by tech type for solar/wind
- Report will also have a demand forecast component

OASIS

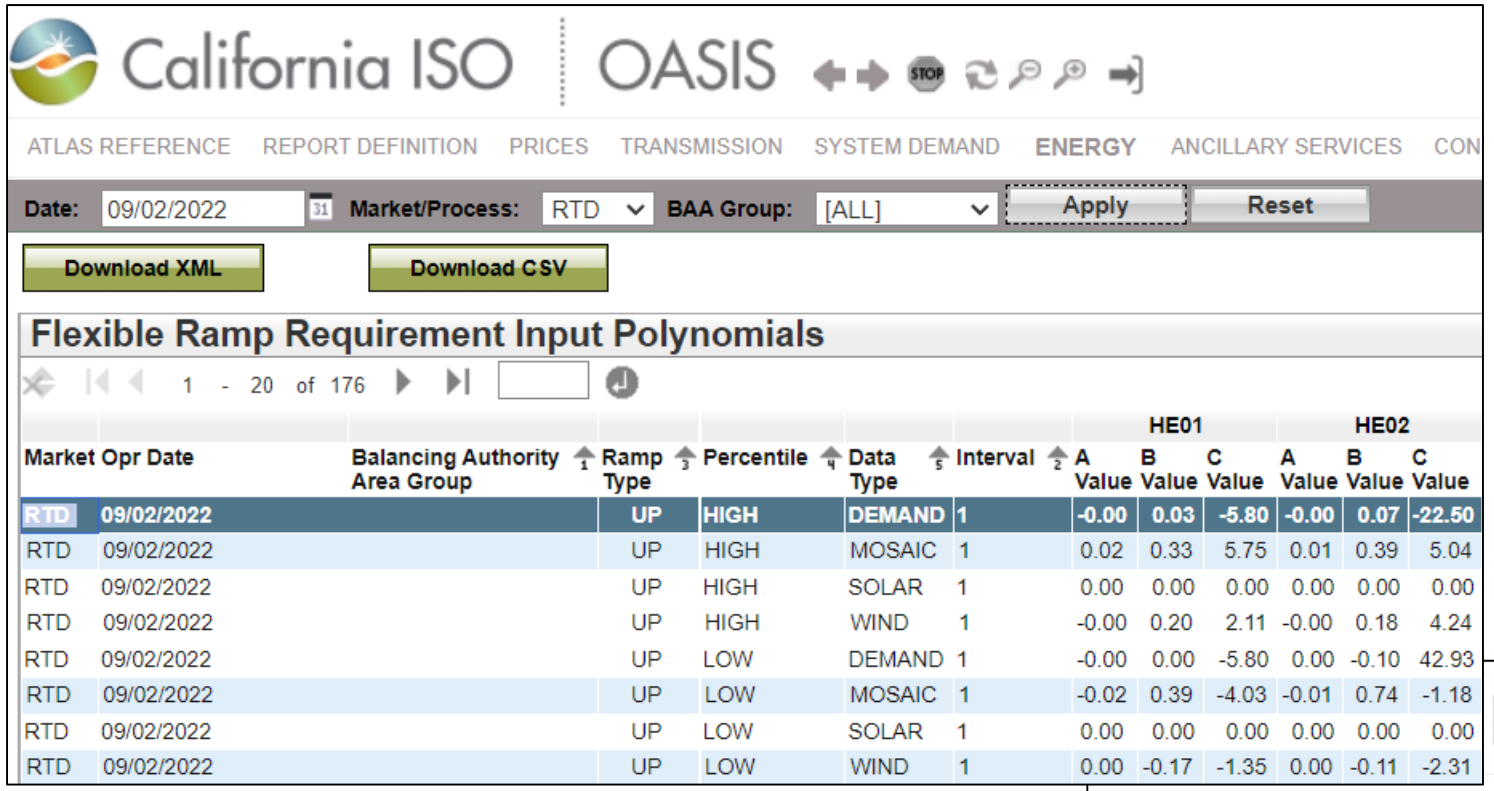
Flexible Ramp Requirement Thresholds



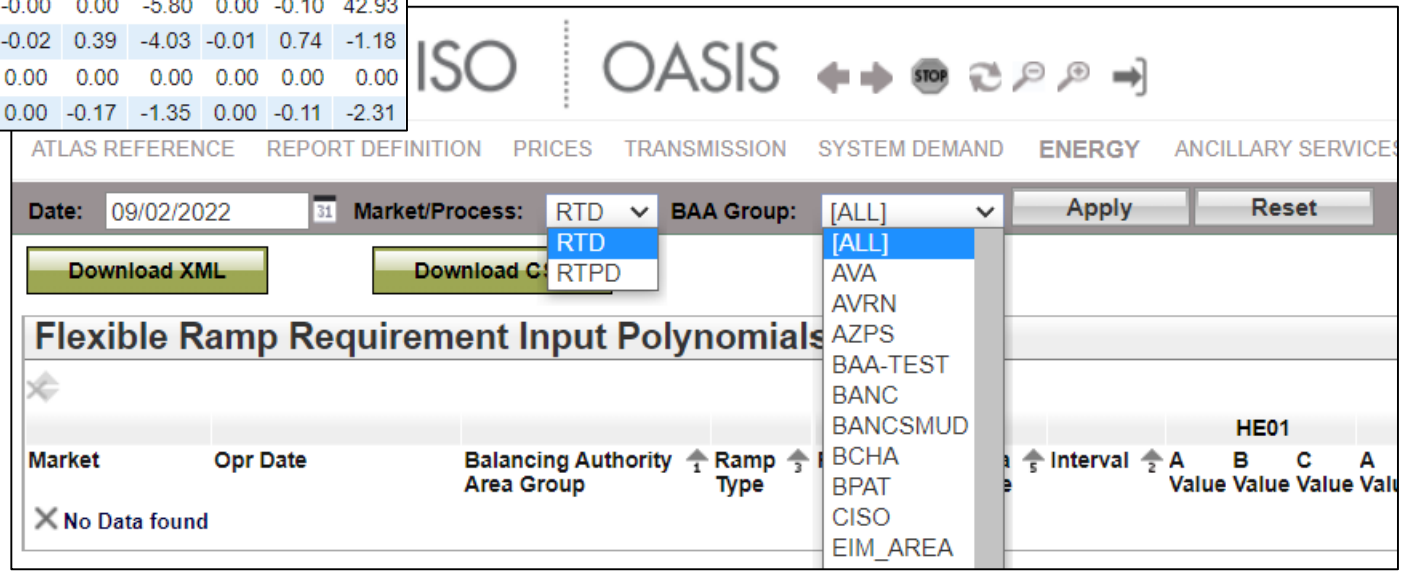
Threshold value for FRU/FRD requirement for each BAA/WEIM area



Flexible Ramp Requirement Input Polynomials



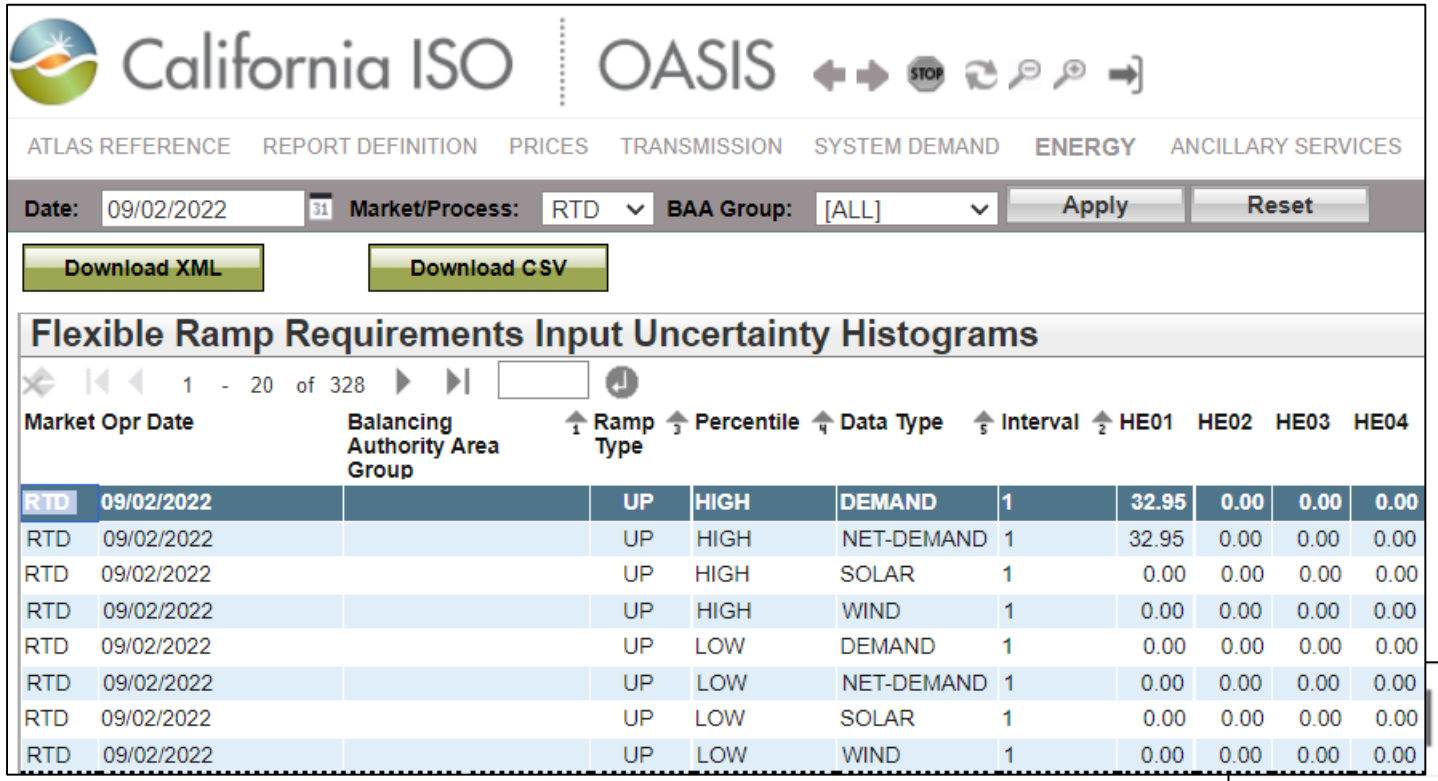
Market	Opr Date	Balancing Authority Area Group	Ramp Type	Percentile	Data Type	Interval	HE01 A Value	HE01 B Value	HE01 C Value	HE02 A Value	HE02 B Value	HE02 C Value
RTD	09/02/2022		UP	HIGH	DEMAND	1	-0.00	0.03	-5.80	-0.00	0.07	-22.50
RTD	09/02/2022		UP	HIGH	MOSAIC	1	0.02	0.33	5.75	0.01	0.39	5.04
RTD	09/02/2022		UP	HIGH	SOLAR	1	0.00	0.00	0.00	0.00	0.00	0.00
RTD	09/02/2022		UP	HIGH	WIND	1	-0.00	0.20	2.11	-0.00	0.18	4.24
RTD	09/02/2022		UP	LOW	DEMAND	1	-0.00	0.00	-5.80	0.00	-0.10	42.93
RTD	09/02/2022		UP	LOW	MOSAIC	1	-0.02	0.39	-4.03	-0.01	0.74	-1.18
RTD	09/02/2022		UP	LOW	SOLAR	1	0.00	0.00	0.00	0.00	0.00	0.00
RTD	09/02/2022		UP	LOW	WIND	1	0.00	-0.17	-1.35	0.00	-0.11	-2.31



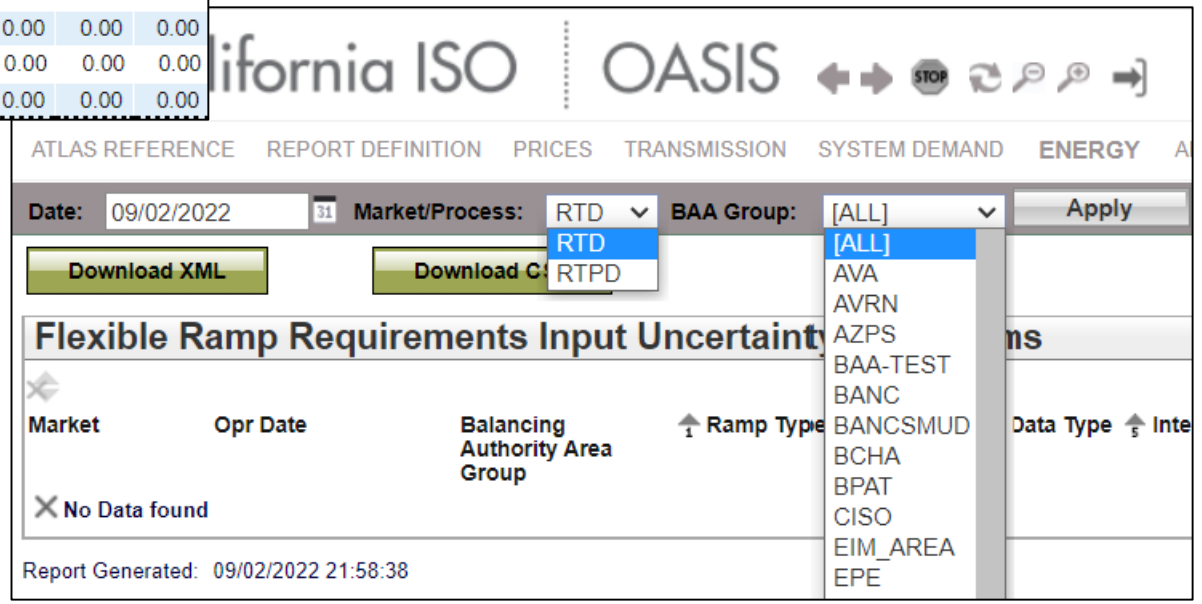
5 & 15 min. polynomial coefficients for both low/high for Mosaic, wind, solar, and demand forecast by WEIM entity/area

OASIS

Flexible Ramp Requirements Input Uncertainty Histograms



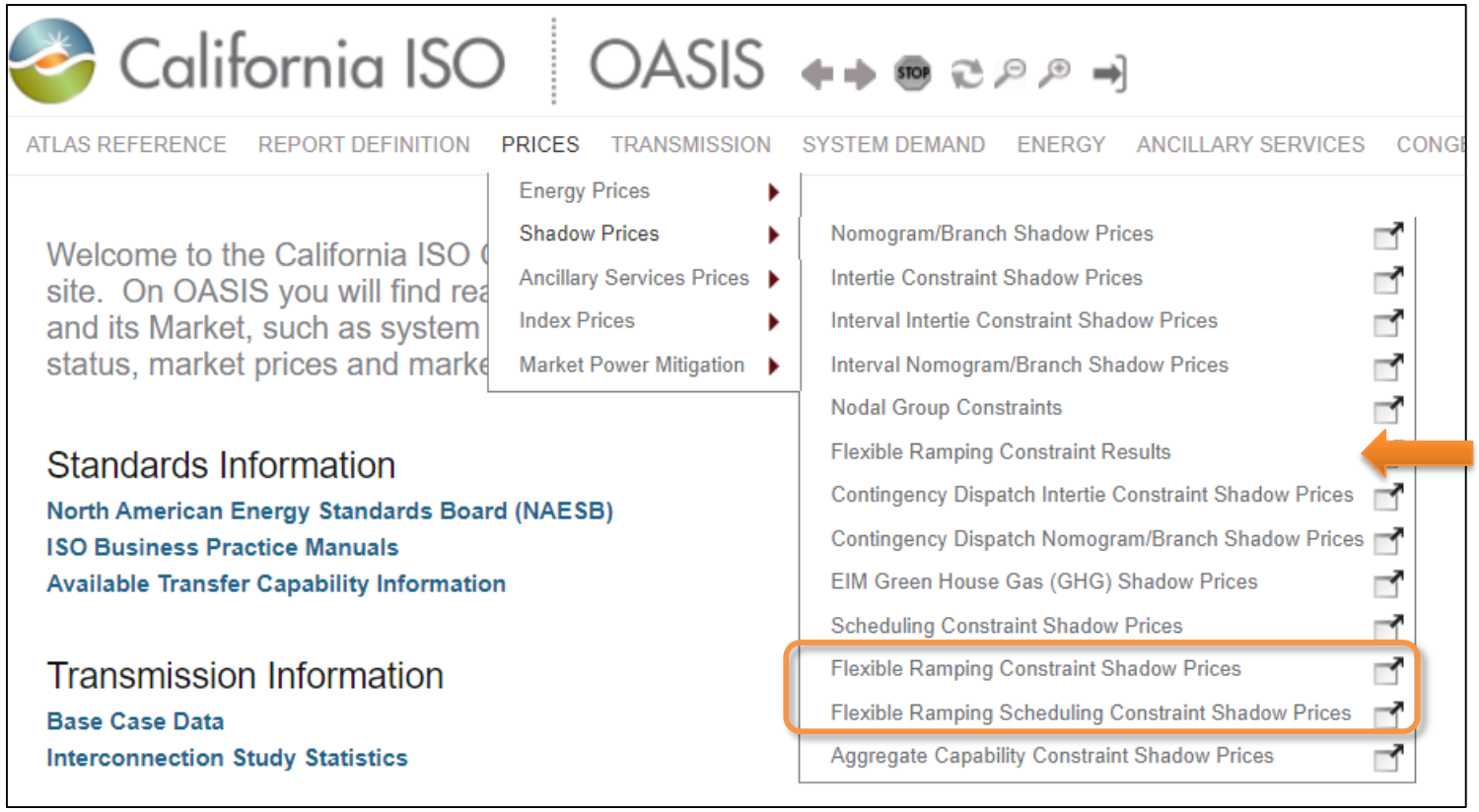
Market	Opr Date	Balancing Authority Area Group	Ramp Type	Percentile	Data Type	Interval	HE01	HE02	HE03	HE04
RTD	09/02/2022		UP	HIGH	DEMAND	1	32.95	0.00	0.00	0.00
RTD	09/02/2022		UP	HIGH	NET-DEMAND	1	32.95	0.00	0.00	0.00
RTD	09/02/2022		UP	HIGH	SOLAR	1	0.00	0.00	0.00	0.00
RTD	09/02/2022		UP	HIGH	WIND	1	0.00	0.00	0.00	0.00
RTD	09/02/2022		UP	LOW	DEMAND	1	0.00	0.00	0.00	0.00
RTD	09/02/2022		UP	LOW	NET-DEMAND	1	0.00	0.00	0.00	0.00
RTD	09/02/2022		UP	LOW	SOLAR	1	0.00	0.00	0.00	0.00
RTD	09/02/2022		UP	LOW	WIND	1	0.00	0.00	0.00	0.00



5 & 15 min. uncertainty histogram values for both low/ high percentile for wind, solar, net demand, and demand forecast by WEIM entity/area

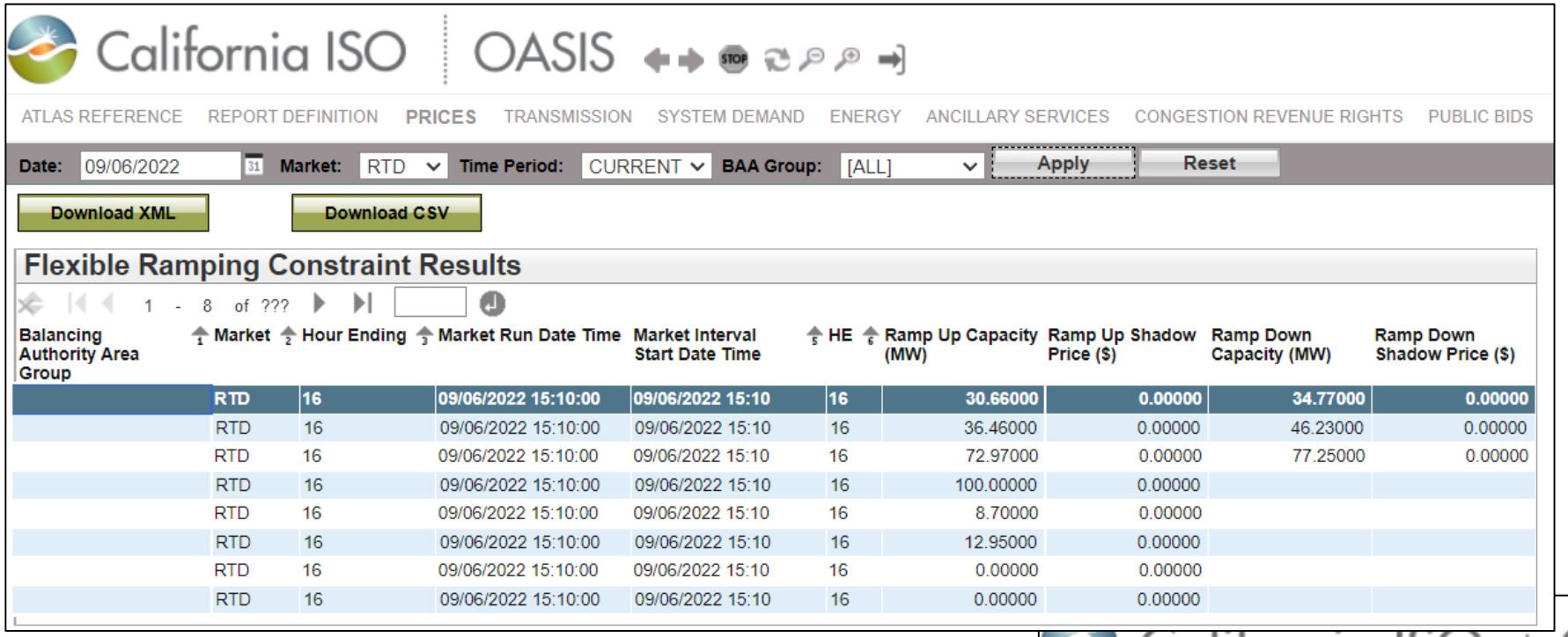
New OASIS Reports Accessible From Prices Menu

OASIS



Existing report

New reports

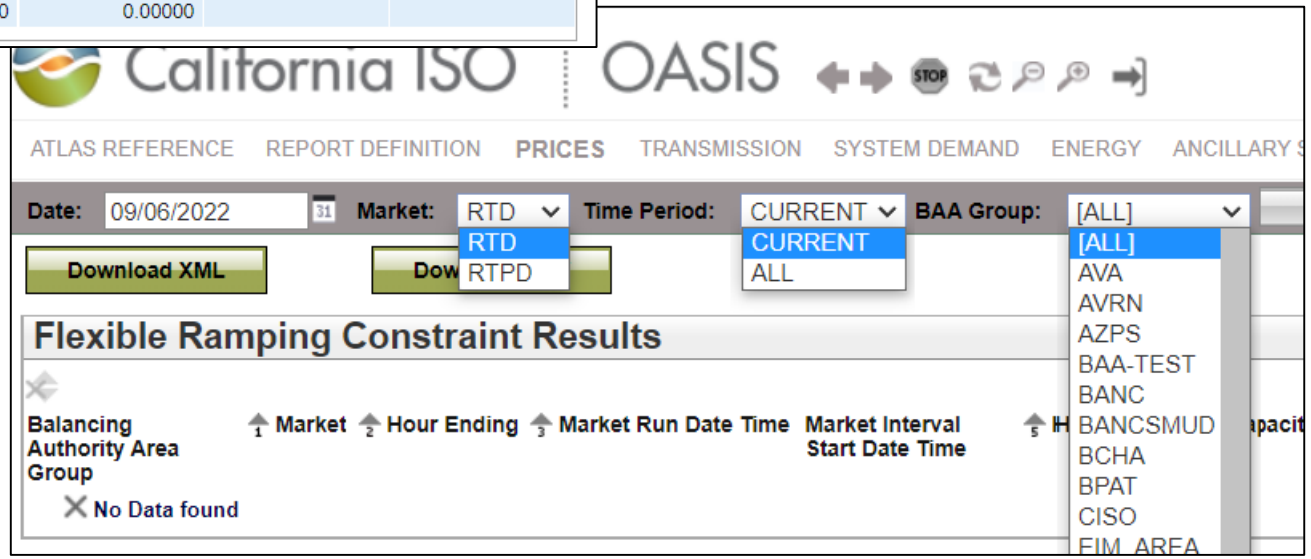


Balancing Authority Area Group	Market	Hour Ending	Market Run Date Time	Market Interval Start Date Time	HE	Ramp Up Capacity (MW)	Ramp Up Shadow Price ($)	Ramp Down Capacity (MW)	Ramp Down Shadow Price ($)
	RTD	16	09/06/2022 15:10:00	09/06/2022 15:10	16	30.66000	0.00000	34.77000	0.00000
	RTD	16	09/06/2022 15:10:00	09/06/2022 15:10	16	36.46000	0.00000	46.23000	0.00000
	RTD	16	09/06/2022 15:10:00	09/06/2022 15:10	16	72.97000	0.00000	77.25000	0.00000
	RTD	16	09/06/2022 15:10:00	09/06/2022 15:10	16	100.00000	0.00000		
	RTD	16	09/06/2022 15:10:00	09/06/2022 15:10	16	8.70000	0.00000		
	RTD	16	09/06/2022 15:10:00	09/06/2022 15:10	16	12.95000	0.00000		
	RTD	16	09/06/2022 15:10:00	09/06/2022 15:10	16	0.00000	0.00000		
	RTD	16	09/06/2022 15:10:00	09/06/2022 15:10	16	0.00000	0.00000		

OASIS

Flexible Ramping Constraint Results (Existing Report)

FRU/FRD shadow price and requirement for BAAs that fail the RSE and for the FRU/FRD passing group calculated by market runs



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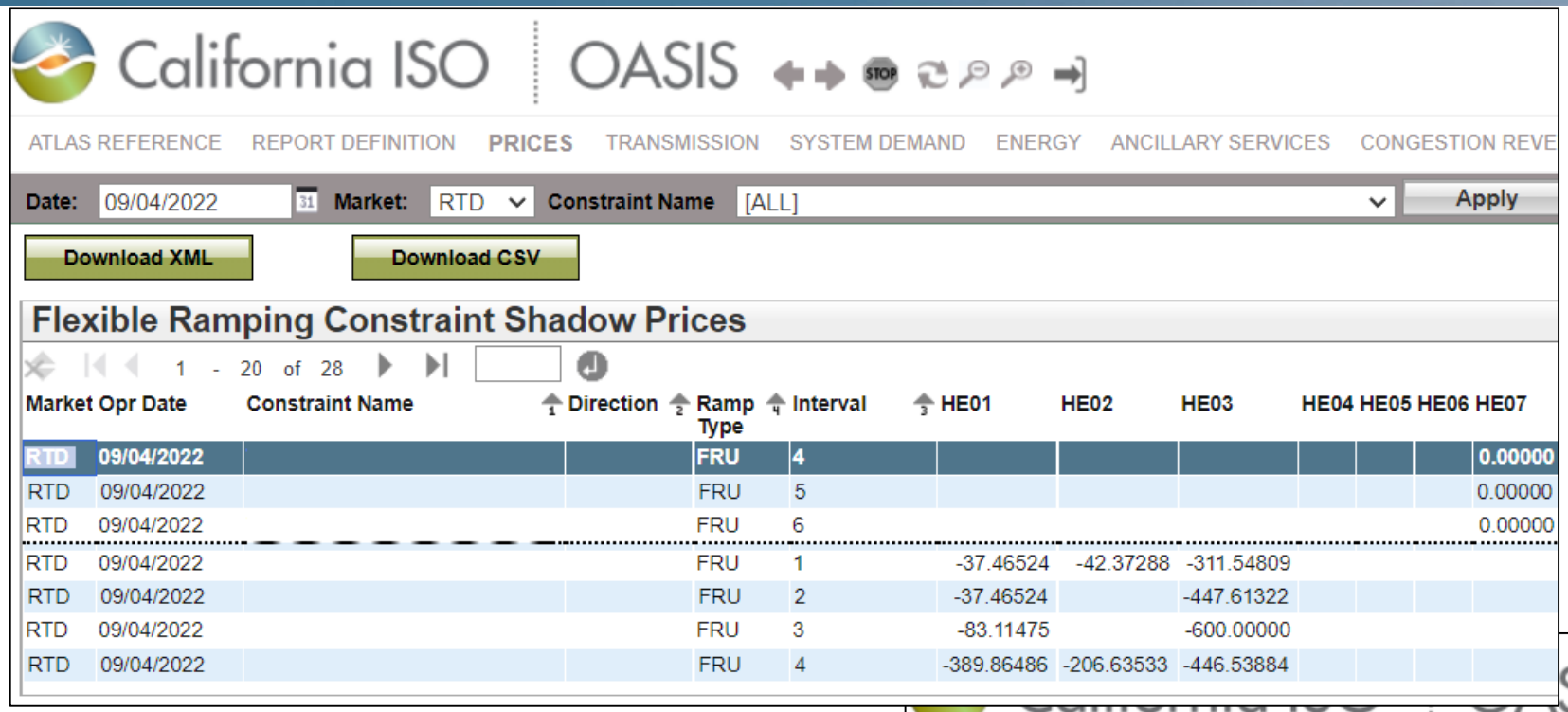
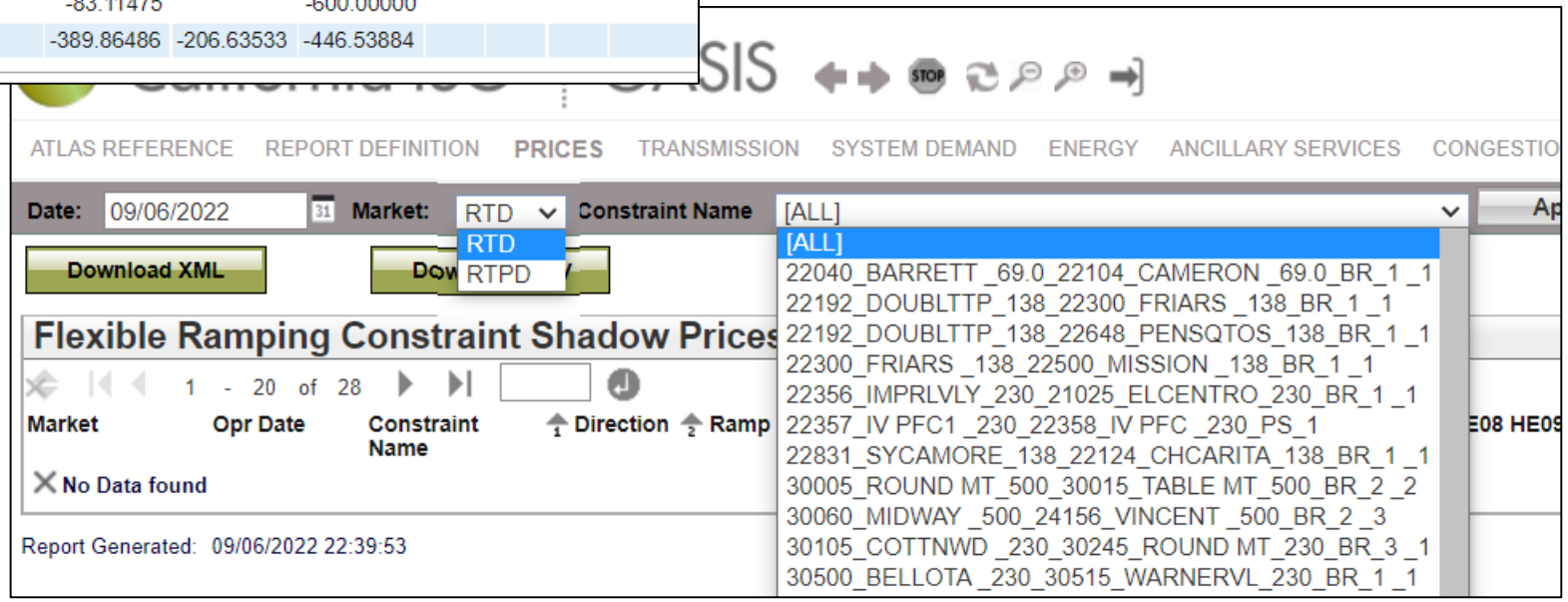
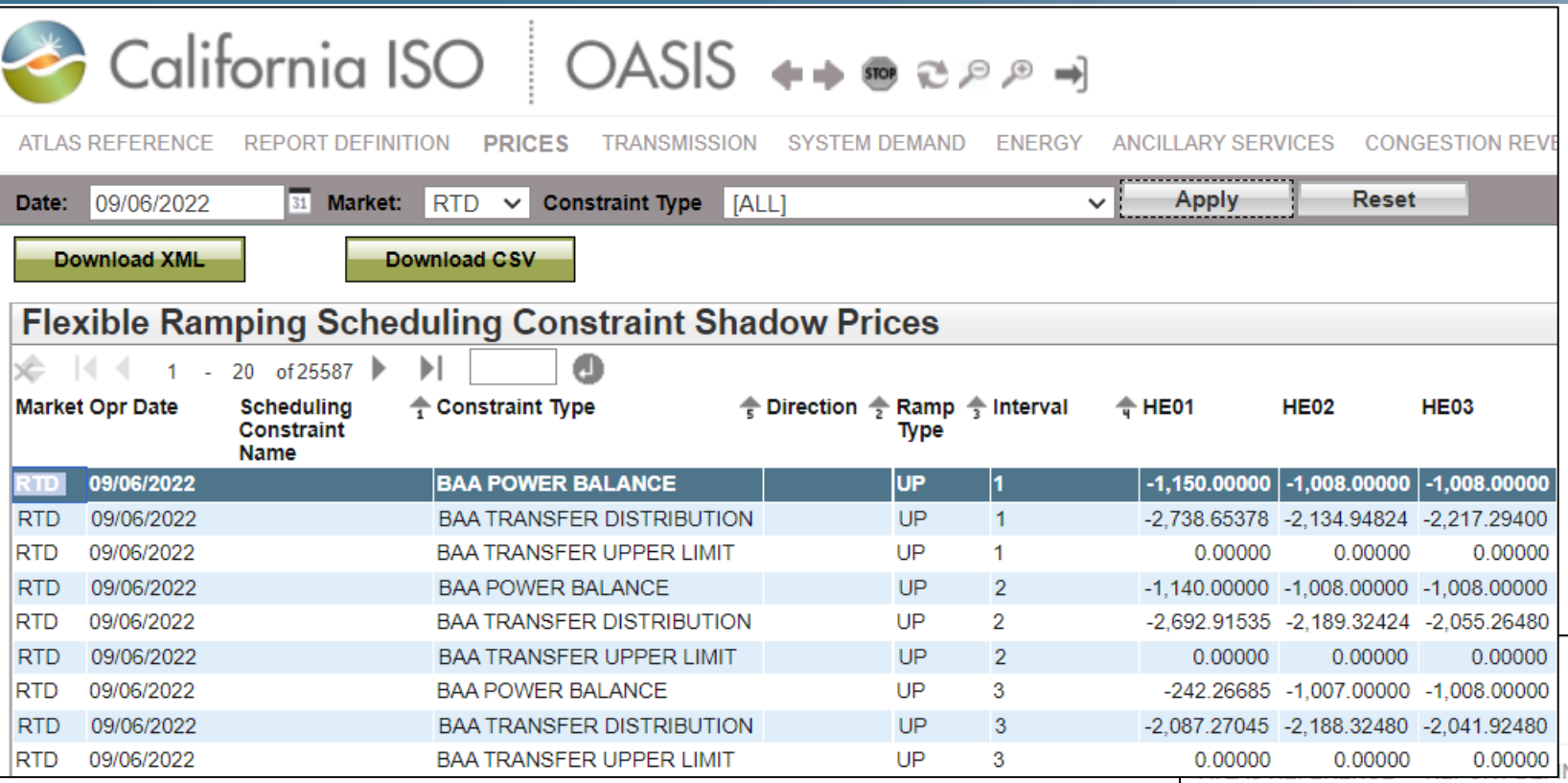
Flexible Ramping Constraint Shadow Prices



Market	Opr Date	Constraint Name	Direction	Ramp Type	Interval	HE01	HE02	HE03	HE04	HE05	HE06	HE07
RTD	09/04/2022			FRU	4							0.00000
RTD	09/04/2022			FRU	5							0.00000
RTD	09/04/2022			FRU	6							0.00000
RTD	09/04/2022			FRU	1	-37.46524	-42.37288	-311.54809				
RTD	09/04/2022			FRU	2	-37.46524		-447.61322				
RTD	09/04/2022			FRU	3	-83.11475		-600.00000				
RTD	09/04/2022			FRU	4	-389.86486	-206.63533	-446.53884				

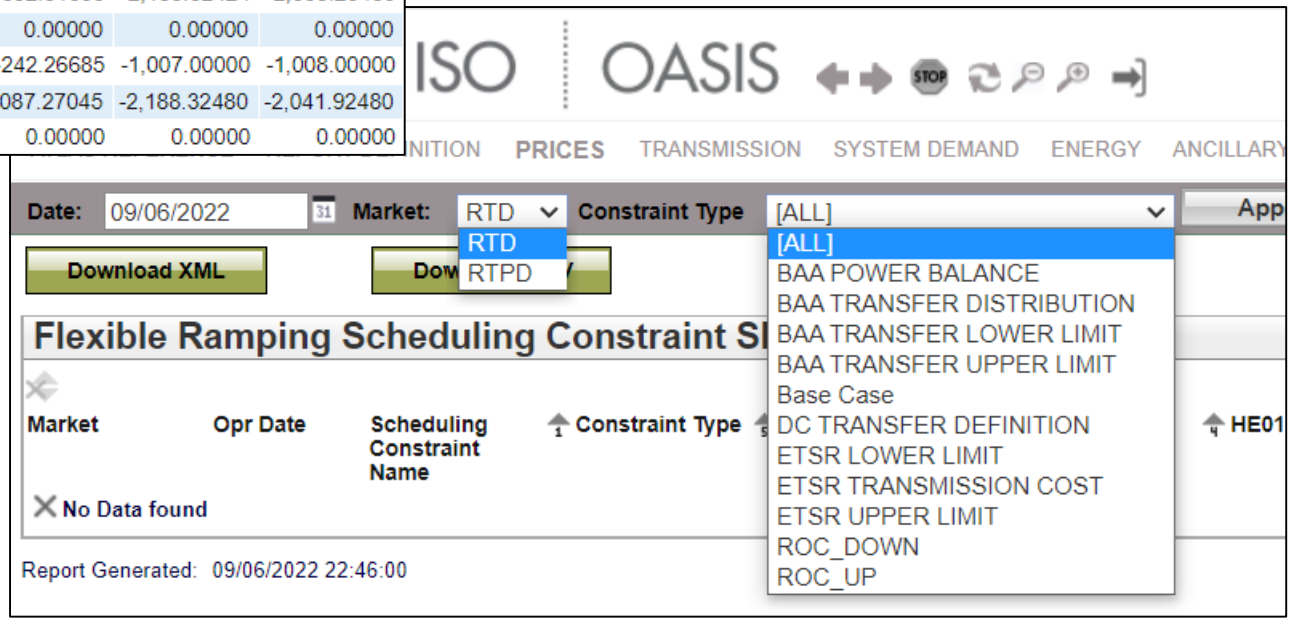


Transmission constraint shadow prices for FRU/FRD deployment scenarios in RTPD/RTD



OASIS

Flexible Ramping Scheduling Constraint Shadow Prices



Scheduling constraint shadow prices for FRU/FRD deployment scenarios in RTPD/RTD

FRP Settlements Changes

MRI-S

- FRP prices are nodal therefore mechanics for cost allocation pricing will change
- For all WEIM entities that pass either FRU or FRD settlements will derive the total quantity of each category
- For movement award costs associated with BAAs that pass the sufficiency test, those costs will be allocated to the metered demand of all BAAs that belong to the pass group
- For movement award costs associated with BAAs that fail the sufficiency test, those costs will be allocated to the metered demand of the respective BAA
- For the WEIM area host control area ID for flex ramp uncertainty allocations, Settlements shall allocate the costs to the BAAs that pass the sufficiency test based on FRU/FRD categories
- For the uncertainty award cost associated with the BAA that did not pass the sufficiency test, those costs will be allocated to the BAA based on its categories and any residual unallocated balance to the metered demand of that BAA

Changes to Settlements Configuration Guides

MRI-S

The following settlements configuration guides will be impacted:

- BPM CG PC Flexible Ramp Product_5.0
- BPM CG CC 7070 Flexible Ramp Forecasted Movement Settlement_5.3
- BPM CG CC 7071 Flexible Ramp Up Uncertainty Capacity Settlement_5.2
- BPM CG CC 7076 Flexible Ramp Forecast Movement Allocation_5.1
- BPM CG CC 7077 Daily Flexible Ramp Up Uncertainty Award Allocation_5.4
- BPM CG CC 7078 Monthly Flexible Ramp Up Uncertainty Award Allocation_5.1
- BPM CG CC 7081 Flexible Ramp Down Uncertainty Capacity Settlement_5.2
- BPM CG CC 7087 Daily Flexible Ramp Down Uncertainty Award Allocation_5.4
- BPM CG CC 7088 Monthly Flexible Ramp Down Uncertainty Award Allocation_5.1

Questions

Market Simulation

READINESS ACTIVITIES

Setup for Market Simulation Activities

- Market participants should have registered their request to participate in this simulation via the MarketSim@caiso.com mailbox by August 12, 2022
- Users must be provisioned for access in order to participate in Market Simulation
- Attend the Market Simulation calls to stay informed on the timing of activities for this and other Fall 2022 release initiatives

Market Simulation Scenario #1

Scenario Number	Unstructured guided scenario	
1	Description	Demonstrate the variability of locational pricing for FRU/ FRD.
	ISO Actions	N/A
	EIM Market Participant Actions	Market Participants should input economic energy bids to observe results
	ISO Market Participant Actions	N/A
	Expected Outcome	Verify the results in OASIS
	Anticipated Settlement Outcome	Flex Ramp Prices used in settlements will reflect the new locational pricing for FRD
	Expected Settlement Outcome	CC 7070, CC 7071, CC 7076, CC 7077, CC 7078

Market Simulation Scenario #2

Scenario Number	Scenario Execution Trade Date: TBD	
2	Description	Demonstrate the Settlements processing for FRP PASS/FAIL.
	ISO Actions	N/A
	EIM Market Participant Actions	Market Participants should input less that optimal flexible ramping requirements to fail the sufficiency test.
	ISO Market Participant Actions	N/A
	Expected Outcome	FRP Sufficiency test Failed: FRU/FRD is still procured separately for the respective FRU/FRD requirement, but the latter is only reduced by the FRU/FRD demand elasticity in that BAA, without any FRU/FRD credit.
	Anticipated Settlement Outcome	Allocation for both Movement and Uncertainty will be driven by the Pass Group, If a BAA Passes their Sufficiency test, the allocation amount will be a prorated between the BAA over EIM Area (All BAAs that belong to Pass Group). If a BAA Fails their Sufficiency test, the allocation amount will be directly allocated/isolated to the individual BAA.
	Expected Settlement Outcome	CC 7070, CC 7071, CC 7076, CC 7077, CC 7078, PC Flexible Ramp Product

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

Reference Material

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

- Business Requirements Specification:
  - https://www.caiso.com/Documents/BusinessRequirementsSpecifications12-FlexibleRampingProduct-Deliverability.pdf
  - https://www.caiso.com/Documents/BusinessRequirementsSpecifications12-FlexibleRampProduct-RequirementsEnhancements.pdf

- Initiative webpage:
  - https://stakeholdercenter.caiso.com/StakeholderInitiatives/Flexible-ramping-product-refinements

Reference Material

- Market Simulation Structured Scenarios:
  - https://www.caiso.com/Documents/Market-Simulation-Structured-Scenarios-Flexible-Ramping-Product.pdf
- Tariff amendment to refine FRP:
  - https://www.caiso.com/Documents/Aug15-2022-TariffAmendment-FlexibleRampingProductRefinements-ER22-2661.pdf
- Technical Specifications – located on the ISO's Developer Site which provides detailed descriptions of the API changes for:
  - OASIS