Flexible Resource Adequacy Criteria and Must Offer Obligation – Phase 2

Second Revised Draft Framework Proposal

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Stakeholder Meeting

May 3, 2018

FRACMOO 2 Stakeholder Meeting
Agenda – 5/3/2018

Time	Topic	Presenter
10:00 – 10:10	Introduction	Jody Cross
10:10 – 10:25	Summary of changes based on stakeholder comments	Karl Meeusen
10:25 – 10:30	Flexible Resource Adequacy Framework	
10:30 – 11:15	Identifying ramping needs	
11:15 – 12:00	Defining required products	
12:00 – 1:00	Lunch	
1:00 – 1:45	Quantifying capacity requirements	Karl Meeusen
1:45 – 3:30	Establishing resource qualification criteria	
3:30 – 3:50	Allocating of flexible capacity requirements	
3:50 – 4:00	Next Steps	Jody Cross

Stakeholder Engagement Plan

Milestone	Date
Second Revised Flexible Capacity Framework posted	April 27, 2018
Second Revised Flexible Capacity Framework stakeholder meeting	May 3, 2018
Stakeholder written comments due	May 17, 2018
Draft Final Flexible Capacity Framework posted and submitted to the CPUC RA proceeding	June 6, 2018
Draft Final Flexible Capacity Framework stakeholder meeting	June 13, 2018
Stakeholder written comments due	June 27, 2018
Complete coordination with CPUC's RA proceeding prior to Board approval of final flexible RA Framework	Q4 2018

SUMMARY OF CHANGES BASED ON STAKEHOLDER COMMENTS

The ISO made the following material changes from the Revised Flexible Capacity Framework

- Real-time flexible capacity needs will align with the need for imbalance reserves identified in the ISO's Day-Ahead Market Enhancements stakeholder initiative
- Start-up times as an eligibility criteria for providing flexible RA capacity eliminated
- Must-offer obligations will be limited to day-ahead
  - Real-time must offer obligations will be determined through day-ahead market awards
  - Consistent with ISO's Day-Ahead Market Enhancements proposal

The ISO made the following material changes from the Revised Flexible Capacity Framework

- VER EFCs will be based on PG&E's "simple" option
  - Scales VER EFC relative to the resource type's contribution to the three hour net load ramp
- Storage resources EFC will be determined by:
  - Resource's instantaneous maximum output, for real-time flexible capacity counting
  - Allowed a 15 minute transition time to count the full charge and discharge range for the day-ahead load shaping product
- RAAIM for flexible RA capacity will be assessed only on day-ahead bidding and over all 24 hours

FLEXIBLE RESOURCE ADEQUACY FRAMEWORK

Changes to flexible RA should closely align with ISO operational needs and align with ISO market runs

- The current flexible RA product results in fundamental gaps between the ISO's markets and operational needs:
  - Day-Ahead Market
  - Fifteen-Minute Market
  - Five-Minute Market
- Need to meet both:
  - Anticipated ramping needs and
  - Uncertainty within the time scales of the real-time market

The ISO seeks to close gap by developing a flexible RA framework that captures the ISO's operational needs and the (un)predictability of ramping needs

Basis of a new flexible RA framework in five steps

1) Identify the ramping needs that flexible RA should be procured to address
2) Define the product to be procured
3) Quantify the capacity needed to address all identified needs
4) Establish criteria regarding how resources qualify for meeting these needs
5) Allocate flexible capacity requirements based on sound causal principles

IDENTIFYING RAMPING NEEDS

Flexible capacity needs break down into two categories

1) Predictable: known and/or reasonably forecastable ramping needs, and

2) Unpredictable: ramping needs caused by load following and forecast error

These two types of flexible capacity needs drive different forms of flexible capacity procurement needs

The ISO is developing market rules to procure imbalance reserves as part of its Day-Ahead Market Enhancements stakeholder process

- Imbalance reserves ensure the day-ahead market has resources awarded with upward and downward ramping capabilities to address real-time imbalances
- Resources that receive an imbalance reserve award will have a must offer obligation in the real-time market
  - The energy bids from imbalance reserve awards enable the real-time market to address day-ahead to real-time uncertainty through economic bids
- **Real-time flexible resource adequacy capacity product needs will align with the proposed imbalance reserve**s

DEFINING REQUIRED PRODUCTS

Changes to flexible RA should closely align with ISO operational needs and align with ISO market runs

ISO will develop three flexible RA products:

- Day-ahead load shaping:
  - Ensure the ISO is able to meet its three-hour net load ramps
- Real-time products (five and fifteen minute flexible RA capacity):
  - Designed to address real-time imbalances that occur between day-ahead and real-time markets

Imbalance reserves are needed to cover FMM imbalances and the FMM flexible ramping product requirement

Upward imbalance reserve drivers	Downward imbalance reserve drivers
Load that is higher than IFM schedule	Load that is lower than IFM schedule
Virtual supply	Virtual demand
Conventional generators that are unable to meet their IFM schedule	Conventional generators that self-schedule above their IFM schedule
Variable energy resources that are unable to meet their IFM schedule	Variable energy resources that self-schedule above their IFM schedule
Imports that that do not tag their IFM schedule	Imports that self-schedule above their IFM schedule
Exports that self-schedule above their IFM schedule	Exports that do not tag their IFM schedule

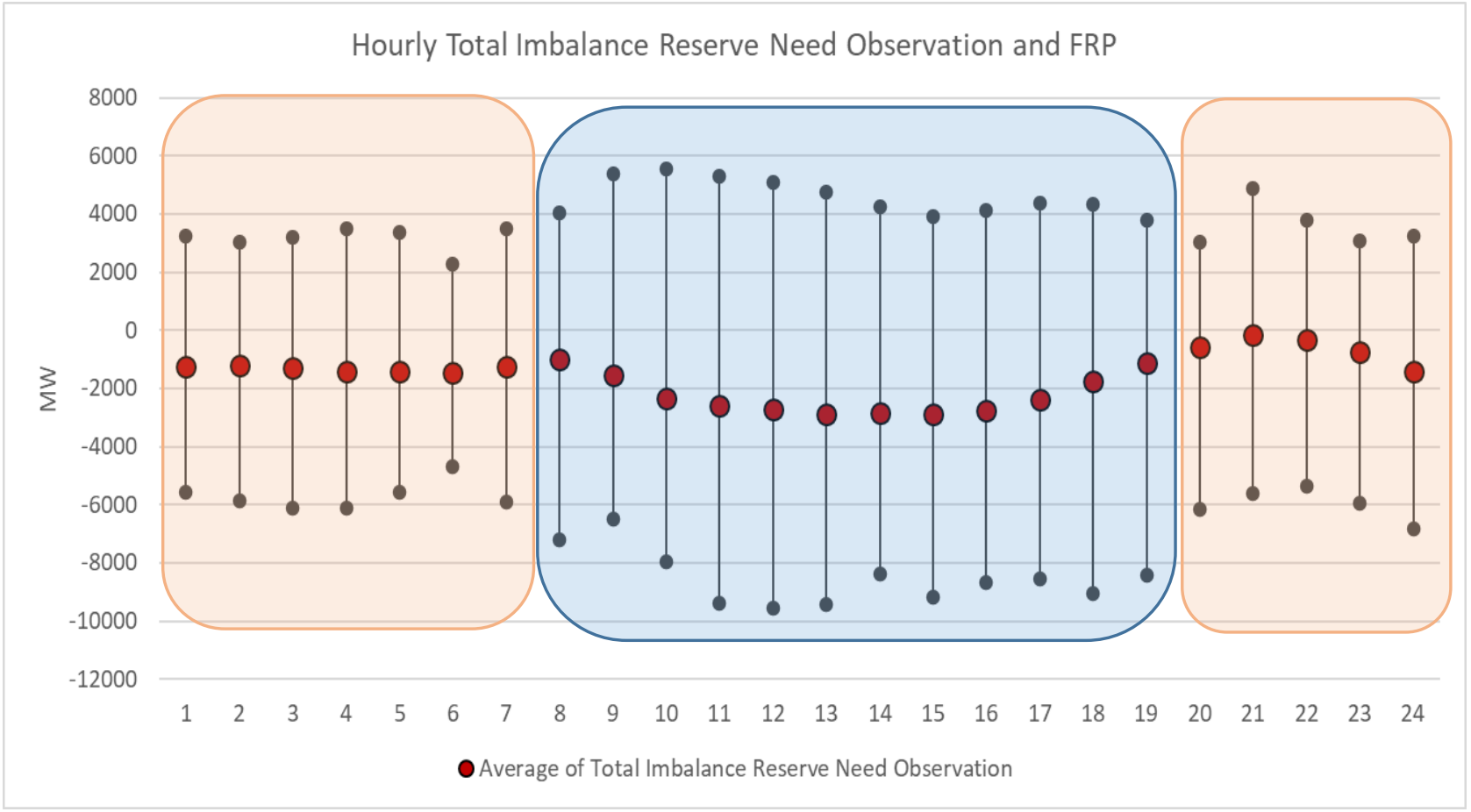
The distribution of the overall imbalances observed in 2017

Percentile	100%	99%	95%	90%	75%	50%	25%	10%	5%	1%	0%
Jan	2,933	2,337	1,783	1,380	456	-1,224	-2,269	-3,717	-4,524	-5,360	-7,208
Feb	3,253	2,028	1,339	935	-779	-1,672	-2,730	-4,393	-5,291	-7,142	-9,541
Mar	2,584	1,825	1,001	493	-1,003	-1,976	-3,339	-4,372	-5,127	-6,526	-7,827
Apr	4,989	2,637	1,482	868	-1,082	-2,188	-3,624	-5,087	-6,022	-6,992	-7,997
May	3,322	1,994	1,024	379	-1,494	-2,534	-3,608	-5,030	-5,857	-7,324	-8,848
Jun	2,377	1,258	-526	-1,106	-1,800	-2,617	-3,673	-5,282	-6,286	-7,628	-9,051
Jul	3,383	2,131	1,327	940	-1055	-1,824	-2,542	-3,279	-3,917	-5,209	-6,120
Aug	5,559	3,900	2,430	1,701	455	-1,582	-2,527	-3,556	-4,366	-5,839	-7,140
Sep	5,381	3,369	2,100	1,520	0	-1,458	-2,732	-4,138	-5,446	-7,076	-8,713
Oct	4,366	2,809	2,116	1,658	973	-719	-2,059	-3,412	-4,343	-6,147	-7,906
Nov	3,201	2,505	1,779	1,288	367	-1,217	-2,182	-3,292	-4,079	-5,224	-7,235
Dec	3,286	2,190	1,565	1,234	410	-1,129	-1,886	-2,669	-3,291	-5,201	-7,791

ISO must be prepared to address the largest uncertainties that occur with the shortest notice

- Real-time flexible RA needs also include the need for incremental real-time flexible ramping product
- It is not necessary to establish flexible RA needs to cover both upward and downward uncertainty ranges
  - Need to ensure sufficient flexible capacity available to provide for the largest imbalances in a single direction
- Procurement of imbalance reserves ensures the correct mix of upward and downward imbalance reserves are available in real-time
- **ISO proposes to set real-time flexible capacity requirements at the maximum absolute value of forecasted monthly imbalances**

Uncertainty occurs most often during daylight hours



QUANTIFYING CAPACITY REQUIREMENTS

The maximum forecasted three hour net load ramp plus contingency reserves should continue being the starting point for establishing flexible RA needs

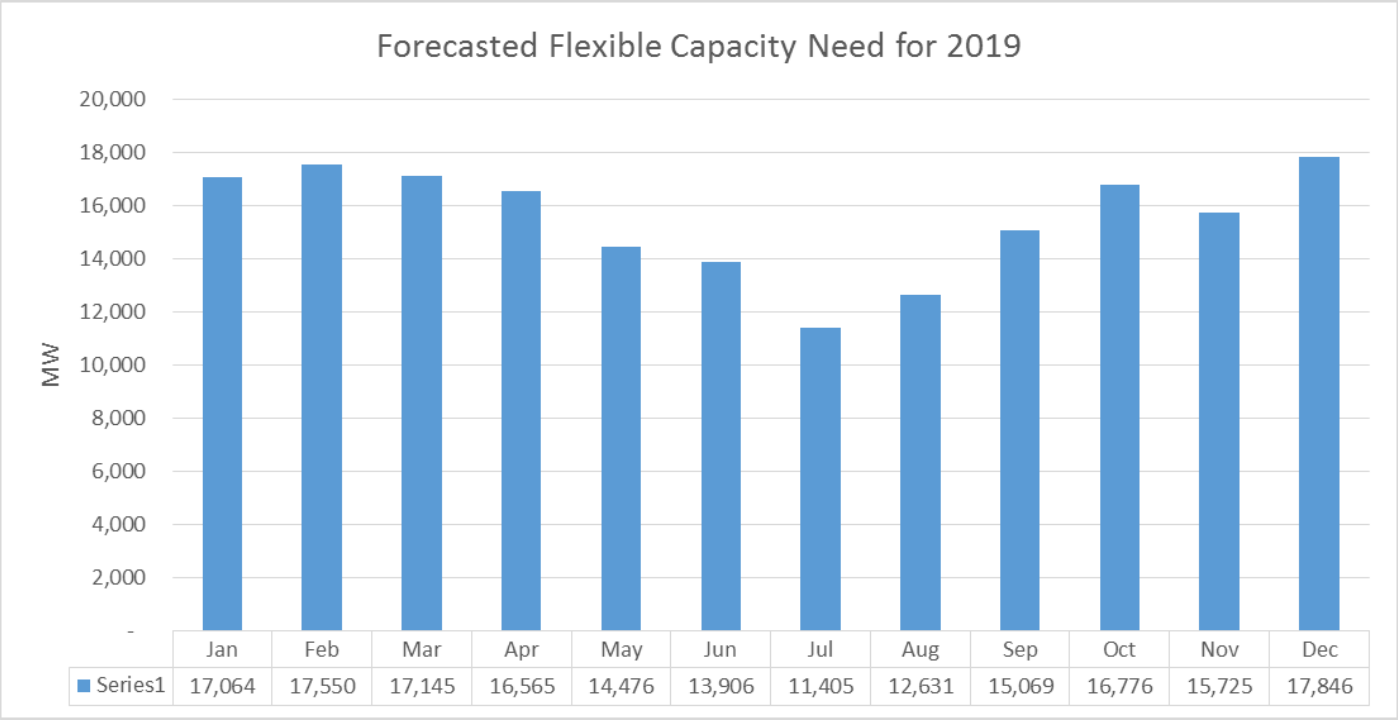
- The interplay between contingency reserves and flexible capacity identified in FRACMOO process still exists
  - ISO will modify this to be consistent with modifications to WECC Standard BAL-002-WECC-2a

- The ISO will reconstruct overall available wind and solar output into formulation of the three hour net load ramp

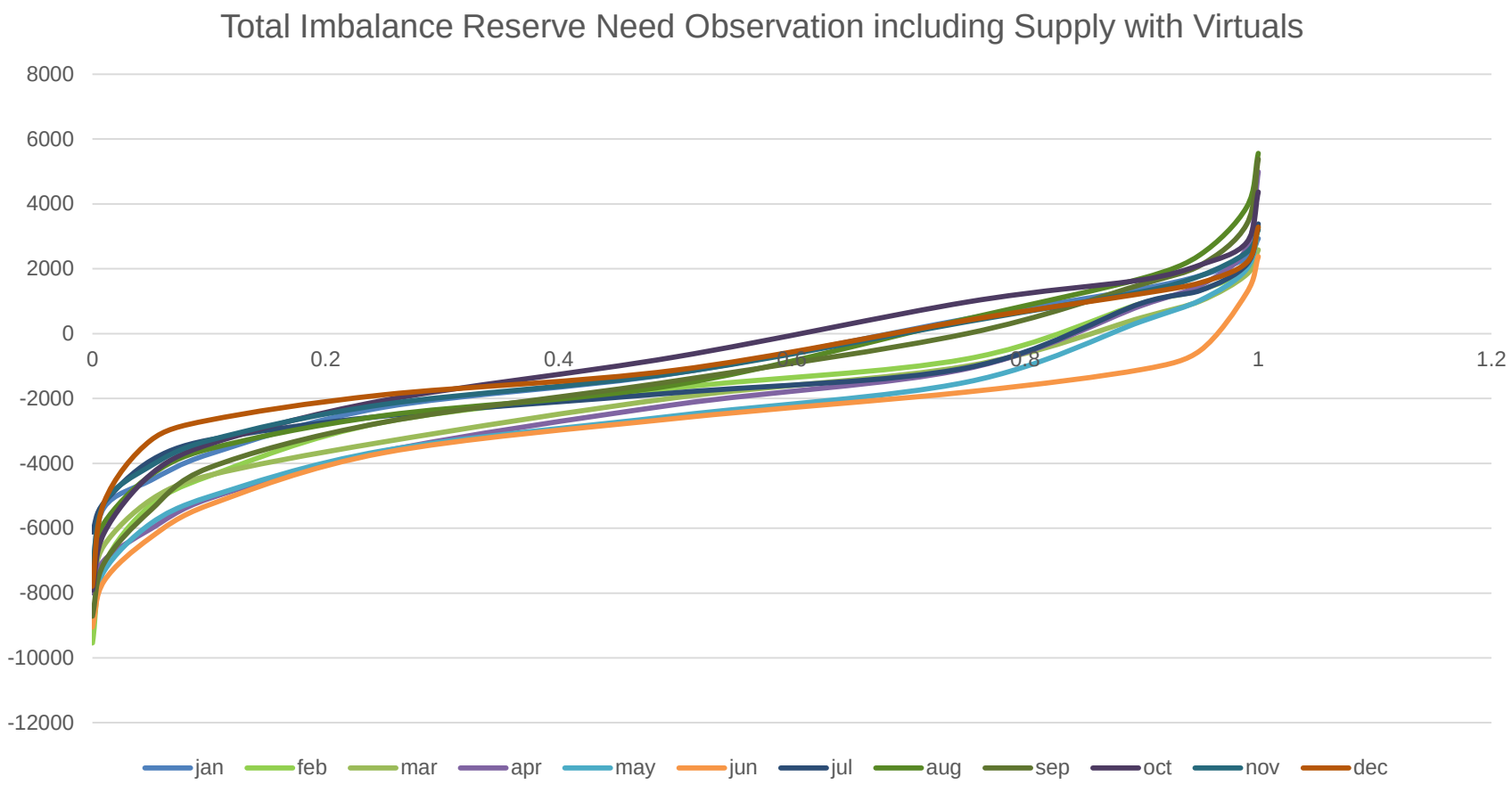
Overall flexible capacity needs should be defined as a function of the maximum three-hour net load ramp

Overall flexible capacity need

- Maximum forecasted three-hour net load ramp (including reconstituted renewable curtailments) + ½ Max(MSSC, 6% of the monthly expected peak load) + ε



Distribution of observed imbalances

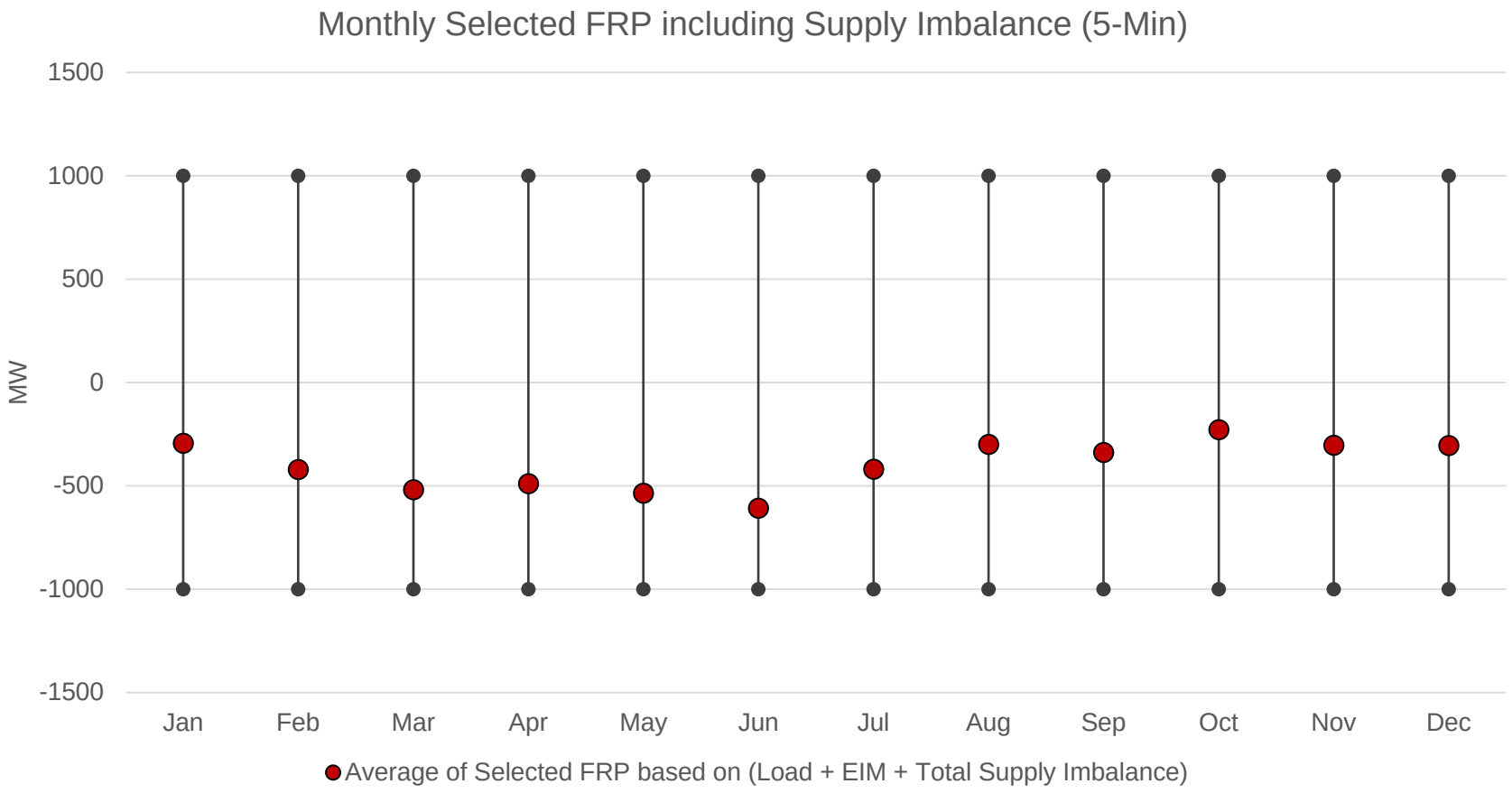


The ISO proposes to set real-time flexible capacity requirements to encompass the largest forecasted imbalances

Month	Real-time flexible RA capacity need	Month	Real-time flexible RA capacity need
Jan	7,208	Jul	6,120
Feb	9,541	Aug	7,140
Mar	7,827	Sep	8,713
Apr	7,997	Oct	7,906
May	8,848	Nov	7,235
Jun	9,051	Dec	7,791

The ISO proposes that 100% of the monthly needs be procured for year-ahead showings

The ISO will define the need for five-minute flexible capacity based on expected need for the flexible ramping product uncertainty requirement



The ISO will propose using the maximum identified needs for both predictable and unpredictable ramps

Overall flexible capacity need

Maximum forecasted three-hour net load ramp (including reconstituted renewable curtailments) + ½ Max(MSSC, 6% expected monthly peak load) + ε

Five-minute flexible RA product

expected need for the flexible ramping product uncertainty requirement

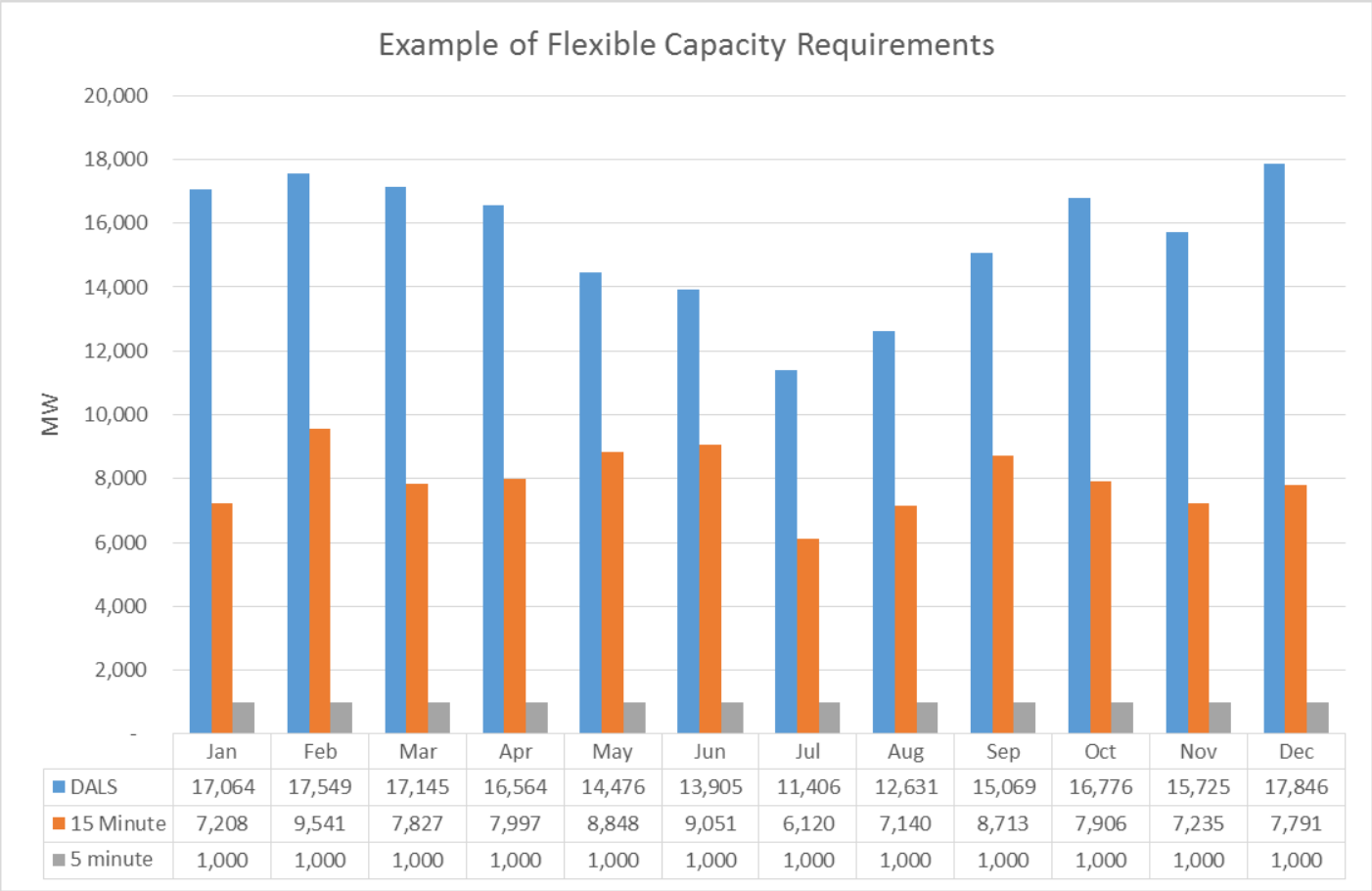
Fifteen-minute flexible RA Product (Five-Minute Product count towards requirement)

Max forecasted imbalances plus incremental flexible ramping need

Day-ahead load shaping (Five and Fifteen-Minute Products count towards requirement)

Overall flexible capacity need

Estimated flexible capacity requirements based on 2017 observed imbalances and 2019 flexible RA study



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DALS	17,064	17,549	17,145	16,564	14,476	13,905	11,406	12,631	15,069	16,776	15,725	17,846
15 Minute	7,208	9,541	7,827	7,997	8,848	9,051	6,120	7,140	8,713	7,906	7,235	7,791
5 minute	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

ISO is currently exploring methodologies for forecasting year-ahead real-time flexibility that mirror the day-to-day drivers of imbalances

- **Methodology #1 – Near Term Approach:**
  - Requirement will be determined based on differences between the day-ahead market and RTD
- **Methodology #2 – Mid Term Approach:**
  - Utilize a statistical regression technique to estimate the variation for individual components of load, wind and solar
- **Methodology #3 – Long Term Approach:**
  - Utilize probabilistic forecasting in combination with a statistical regression technique (methodology #2) to estimate the variation for individual components of load, wind and solar

ESTABLISHING RESOURCE QUALIFICATION CRITERIA

Eligibility criteria should be simple, based on operational attributes, and reasonably inclusive

- Establish criteria regarding how resources qualify for meeting these needs including:
  - Basic eligibility criteria
  - Must-offer obligations
  - Counting rules
  - Rules necessary to determine if sufficient capacity has been procured
    - Includes any necessary backstop procurement rules

Eligibility criteria should be simple, based on operational attributes, and reasonably inclusive (cont.)

- Eligibility criteria must be provided for each of the three flexible RA products
  - Five-minute flexible RA product
  - Fifteen-minute flexible RA product
  - Day-ahead load shaping product
- Must be done separately for
  - Internal resources
  - EIM resources
  - Purely external resources (i.e. resources external to both the ISO BAA and any EIM)

Requirements for Internal Resources

The five-minute and fifteen-minute flexible RA products must be dispatchable in the ISO real-time markets

Eligibility criteria:

- Capacity comes from a specific resource
  - Defined as a single resource ID, not a single physical facility
- Must be studied for EFC deliverability
- ISO has removed start-up time as an eligibility criteria
  - Resources procured for imbalance reserves will be self-committed based on their cleared energy schedule or issued a start-up instruction by the ISO to ensure timely delivery of imbalance reserve awards

There is no need to impose a start-time requirement to provide the day-ahead load shaping product

- ISO can make commitments of long-start resources in the IFM
- Resources providing day-ahead load shaping product must be studied for EFC deliverability
- Eliminate the three categories of flexible capacity currently being used for three-hour net load ramps in favor of a single product
  - Should help simplify flexible RA procurement and understanding of obligations

EFC eligibility will include a flexible capacity deliverability study for the times of greatest flexibility needs

- Current deliverability assessments do not test deliverability of capacity during times of greatest flexible capacity need
- Deliverable flexible capacity means the output of a flexible resource can be ramped simultaneously with other flexible resources in the same generator pocket to match the net load ramping without being constrained by the transmission capability
  - The specific conditions that will be studied (i.e. the most stressed conditions) must be determined through a separate stakeholder process

There are at least two main benefits of a separate EFC deliverability study

1. Confirms that the EFC is deliverable under stressed grid conditions
   – Similar to the ISO's deliverability studies for NQC

2. ISO will no longer have to rely on the use of the "dispatchable" flag in Masterfile as a primary qualifying attribute to provide flexible capacity

With two separate deliverability studies, NQC and EFC can be reasonably and reliably unbundled

- This allows a resource to have:
  - An NQC with no EFC
  - An EFC with no NQC
  - Both an NQC and EFC equal to one another
  - Different NQC and EFC

- The EFC deliverability study will study all flexible resources

All flexible RA resources must submit economic bids for the shown EFC value for all 24 hours in the day-ahead market

- Must offer economic bids for all energy, ancillary services, and imbalance reserves
- Only resources that receive awards in the day-ahead market will be subject to a real-time must-offer obligation
- VERs may not be capable of providing the full shown EFC value during all hours
  - Must offer the lower of the shown EFC value or the resource's forecasted output
  - For example, a solar resource would have to bid up to its shown EFC during daylight hours and 0 MW overnight

ISO proposes 24 hour RAAIM calculation for flexible RA capacity

- Flexible RA capacity is designed to ensure the ISO can efficiently shape day-ahead market awards and address uncertainty at any time
- VERs will be assessed relative to their EFC or forecast during all hours
- Applies only to day-ahead bidding

Flexible capacity products will be “nested”

- Capacity procured to meet a higher quality product will automatically be counted towards meeting the lower quality requirements
  - Fifteen-minute requirement = 7,500 MW and the
  - Five-minute requirement = 1,000 MW,
  - Then 7,500 MW – 1,000 MW or 6,500 MW of additional fifteen-minute flexible RA capacity must be procured

ISO proposes to limit solar capacity to providing 25 percent of any single flexible RA product

- Uncertainty can occur at any time
  - Must have most resources available at all hours
- Somewhat conservative but still provides opportunities for solar resources to provide flexible RA
- Proxy demand resources typically have similar production profiles as solar resources
  - The ISO is not including proxy demand resources in this cap because this may not be universally true
- Wind resources are explicitly not included in this limit
  - May have 24 hour fuel availability

Resource counting for real-time products will be based on the MWs the resource can ramp in five or fifteen minutes

- For example, a 100 MW resource with a 10 MW/minute ramp rate would be eligible to provide
  - 50 MW of five-minute flexible RA capacity
  - 100 MW of fifteen-minute flexible RA capacity
- The EFC value for long- and medium-start resources will be limited to the ramping capability above PMin
  - 200 MW resource
  - Start-up time of eight hours
  - PMin of 50 MW
  - Eligible to provide a maximum of 150 MW of EFC, depending on ramp rates

EFC for VERs will be based on the technology's contribution to the three-hour net load as determined by the annual flexible capacity needs assessment

Nameplate Capacity of Solar Resource 1	200 MW
Aggregate Nameplate Capacity of all solar resources	10,000 MW
3-hour net load ramp + 3.5 Percent of Forecast Peak Load in December 2018	15,000 MW
Total solar resources' contribution to 3-hour net load ramp in December 2018 (%)	48%
Total solar resources' contribution to 3-hour net load ramp in December 2018 (MW)	15,000 MW * 48% = 7,200 MW
Solar Resource 1 contribution to 3-hour net load ramp in December 2018 (MW)	7,200 MW * 200 MW/10,000 MW = 7,200 * 0.02 = 144 MW

Mirrors PG&E's proposed "simple" option

Examples of EFC estimates for 1 MW of wind and solar using the ISO's Draft Flexible Capacity Needs Assessment

1 MW installed solar:

- January EFC = (1/10,095)*16,092*0.5269 = 0.84 MW
- July EFC = (1/10,095)*10,052*0.8063 = 0.80 MW

1 MW installed wind:

- January EFC = (1/4,761)*16,092*0.1894 = 0.64 MW
- July EFC = (1/4,761)*10,052*0.8063 = 0.63 MW

EFC for the day-ahead load shaping product will no longer be reduced for start-up times greater than 90 minutes

- ISO will remove the start-time as a means to determine if the PMin is flexible
- Allow a resources to provide EFC for the full range of the resource over three hours
- Long-start resources can receive day-ahead market awards that align commitment and ramping needs with forecasted operational needs

Storage resources can provide flexible RA capacity

- For real-time flexible capacity counting, storage resources will be limited to the resource's instantaneous maximum output

- ISO would allow a fifteen-minute transition time for a storage resource to count the full charge and discharge range for the day-ahead load shaping product

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Requirements for EIM resources

EIM resources must be registered as an EIM Participating Resource

- The eligibility criteria apply to all real-time and day-ahead load shaping products
- A mechanism is needed to pair the intertie schedule at the ISO balancing area authority boundary with an internal participating EIM flexible RA resource
  - Allows ISO to see resource's participation in both the day-ahead and real-time markets

Any LSE using an EIM resource for flexible capacity must demonstrate that it has sufficient Maximum Import Capability (MIC) capacity

- MIC capacity is how LSEs demonstrate that the resource's output, and therefore flexibility, is deliverable to the ISO
- ISO will still need to ensure the flexible capacity is credited to the ISO BAA for purposes of the EIM sufficiency tests
  - All EIM sufficiency tests will credit the ISO with any capacity from resources based in an EIM BAA shown as flexible RA capacity and remove the resources from any EIM entity's sufficiency tests

EIM resources have similar offer obligations to internal resources providing flexible RA capacity

- Must submit economic bids into day-ahead market with an energy bid range of at least the shown EFC value
- Transmission capacity must be secured prior to the DAM
  - Shown in the e-tag from the EIM Participating Resource ISO Scheduling Point
  - Specified in the DAM/RTM bid for System Resource
- The OASIS field on the e-tag must specify the System Resource name and with an association to the EIM participating resource ID shown for flexible RA capacity

The ISO will use the same counting rules for EIM resources as are used for internal resources

- Applies to all real-time and day-ahead load shaping products
- One primary difference: EIM resources will be deemed deliverable for purposes of EFC calculations
- All resources must have an associated MIC allocation for an LSE to count the resources towards its flexible RA requirements

Requirements for purely external resources

Purely external resources may provide the fifteen-minute, but not the five-minute flexible RA product

- Purely external resources are not dispatchable on a five-minute basis
  - The exception to this limitation is for dynamic and pseudo-tied resources
    - dynamic and pseudo-tied resources are five-minute dispatchable
- Any LSE using an import resource for flexible capacity must demonstrate that it has sufficient MIC capacity
- Must submit fifteen-minute bids

ISO will require that the Resource SC provide to the ISO the physical resources used to support the resource ID

- Resource SC must also provide any information necessary to determine if the resources are capable of providing the flexible capacity for which it has been procured

- Resource combinations must be submitted prior to issuance of final EFC list to be eligible to provide flexible RA capacity

The ISO expects to have sufficient information to count external resources comparable to internal resources

- Because the ISO proposes to require details regarding the purely external resources, the ISO can calculate the EFC for external resources

- Applies to all real-time and day-ahead load shaping products

ALLOCATING FLEXIBLE CAPACITY REQUIREMENTS

Proper allocation of flexible capacity requirements must be based on reasonable causation principles

- Requirements will be allocated based on an LRA's jurisdictional LSEs' contribution
  - The primary driver operational needs identified here continue to be driven by LSE procurement to meet state policy objectives

- Existing allocation methodology
  - May be a reasonable reflection of the need for three-hour net load ramps
  - May not reflect the drivers of uncertainty

Flexible capacity requirements allocated based on the primary contributing factors to each product

- For unpredictable ramping (i.e. real-time flexible RA)
  - All imbalances attributable LRAs' jurisdiction LSEs' load, wind, and solar will be allocated directly to LRA
  - All other factors contributing to the need for real-time flexible RA capacity will be allocated to LRA based on load-ratio share
- For allocating day-ahead load shaping requirements
  - Rely on current practices of allocating based on each LRA's contribution to the three hour net-load ramp

Next steps

- Stakeholder comments due May 17, 2018
  - Comments template posted by COB May 4, 2018

- Draft Final Flexible Capacity Framework posted early June 6, 2018
  - Simultaneously submitted into CPUC RA proceeding

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