Resource Sufficiency Evaluation

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Agenda

- What is Resource Sufficiency Evaluation

- Resource Sufficiency Evaluation for CAISO

- Bid Range Capacity Test

- Flexible Ramp Sufficiency Test

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Resource Sufficiency Evaluation

EIM does not include any forward resource adequacy requirements or obligations for resources to submit bids, but instead includes several tests to ensure each EIM balancing authority has sufficient resources to serve its load while still realizing the benefits of increased resource diversity

- Balancing Test
- Bid-Range Capacity Test
- Flexible Ramp Sufficiency Test
- Feasibility evaluation

California ISO

Resource Sufficiency Evaluation

Tests Applicable to ISO

- Flexible Ramp Sufficiency Tests
- Bid Range Capacity Test

Tests Not Applicable to ISO

- Balancing Test
- Feasibility Test

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Bid Range Capacity Test

- Purpose

- Requirement Calculation

- Resource Capacity Calculation

- Pass Criteria

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Bid Range Capacity Test- Purpose

Assess whether there is sufficient Bid-Range Capacity test in the BAA to meet the over and under imbalance requirements

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Rules for Bid Range Capacity Tests

- Three tests are performed: (T-75, T-55 and T-40)

- Tests are performed for both Under and Over direction for each 15-minute interval

- The first two tests (T-75 and T-55) are advisory and enable a BAA to adjust their schedules in order to make necessary adjustments to pass the test (T-40)

- A BAA fails the bid-range capacity test if they fail the test at (T-40)

- If a BAA fails the bid-range capacity under test, it automatically fails the flexible ramp sufficiency up test.

- If a BAA fails the bid-range capacity over test, it automatically fails the flexible ramp sufficiency down test.

Requirement for Bid Range Capacity Test

Inputs

- Fifteen-Minute Demand Forecast
- Net Schedule Interchange
- Generation Base Schedule
- Histogram data (relative low percentile, absolute low percentile, relative high percentile and absolute high percentile)

$Bid\ Range\ Capacity\ Test\ Requirement(t) = Demand\ Forecast(t) + sum\ of\ exports\ (t) - Sum\ of\ generation\ base\ schedule(t) - sum\ of\ import\ base\ schedules\ (t)$

If $Bid\ Range\ Capacity\ Test\ Requirement(t) > 0$, test for Under capacity

If $Bid\ Range\ Capacity\ Test\ Requirement(t) < 0$, test for Over capacity

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Requirement for Bid Range Capacity Test

- If $Bid\ Range\ Capacity\ Test\ Requirement(t)$ + additional incremental Requirement > 0, test for Under capacity

- If $Bid\ Range\ Capacity\ Test\ Requirement(t)$ + additional decremental Requirement < 0, test for Over capacity

additional incremental and decremental requirements are added to imbalance requirement to account for historical inter-tie deviation between T-40 Net Scheduled Interchange (NSI) base schedules and T-20 NSI tags. The BPM for Energy Imbalance Market section 11.3.2.2 has additional details.
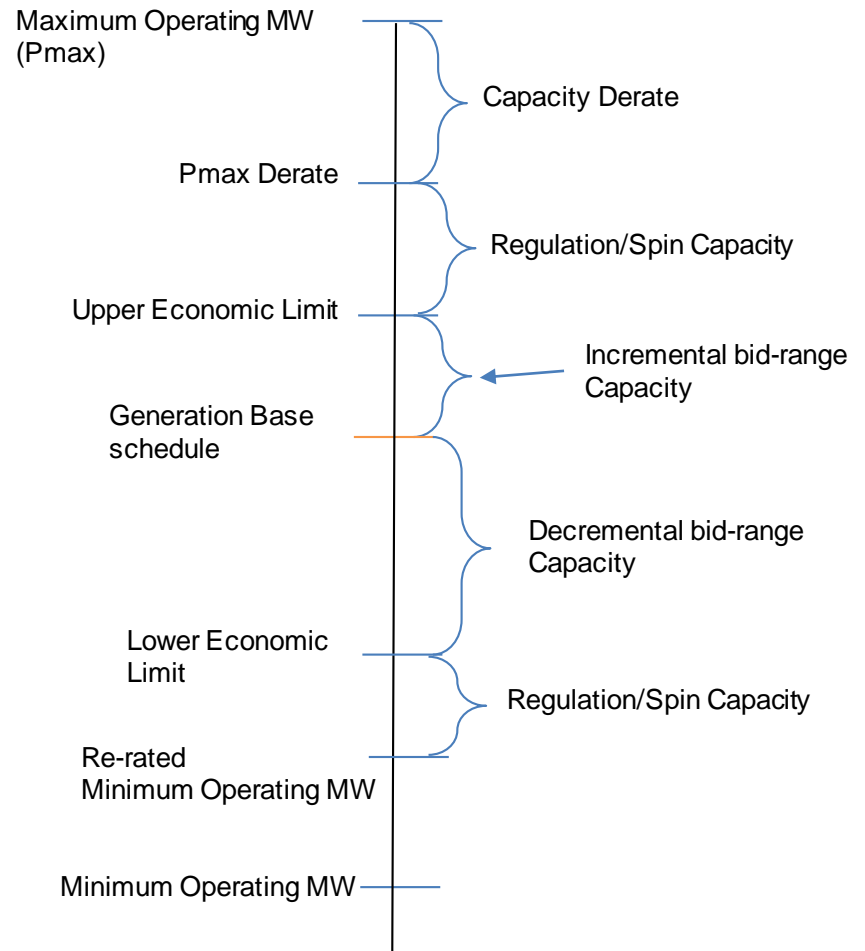
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Resource Bid Range Capacity

Incremental bid-range Capacity

- Capacity above base schedule generation and below economic max

- For offline resources incremental capacity is minimum of (Pmax derate, Maximum operating MW, Bid-in Economic Maximum)

decremental bid-range Capacity

- Capacity below base schedule generation and above economic min

Maximum Operating MW (Pmax)

Capacity Derate

Pmax Derate

Regulation/Spin Capacity

Upper Economic Limit

Incremental bid-range Capacity

Generation Base schedule

Decremental bid-range Capacity

Lower Economic Limit

Regulation/Spin Capacity

Re-rated Minimum Operating MW

Minimum Operating MW

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Passing Criteria for Bid Range Capacity Test

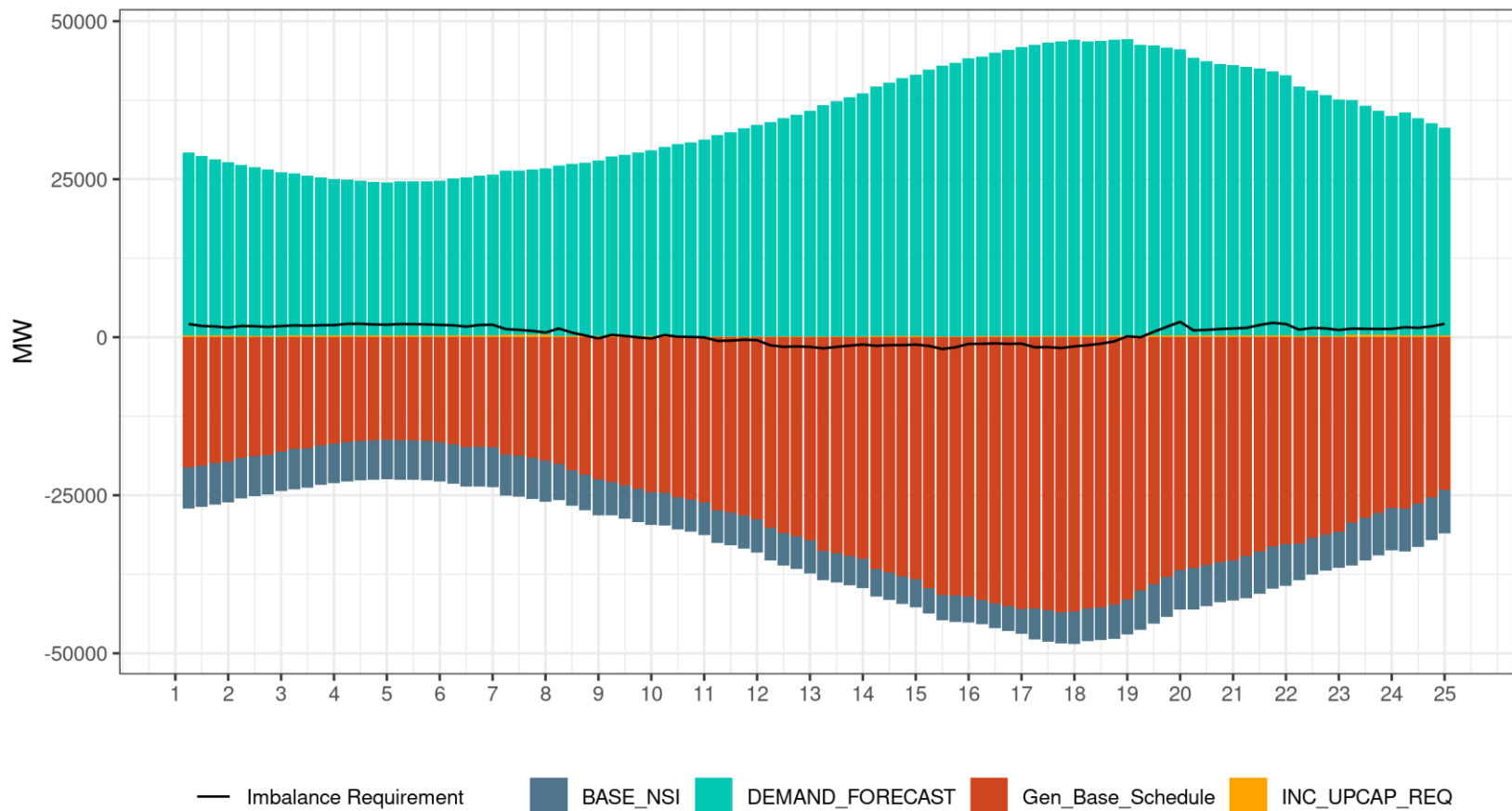Under bid-Range capacity test

If sum of resource incremental bid-range capacity is greater than the incremental bid range requirement then BAA passes the Test
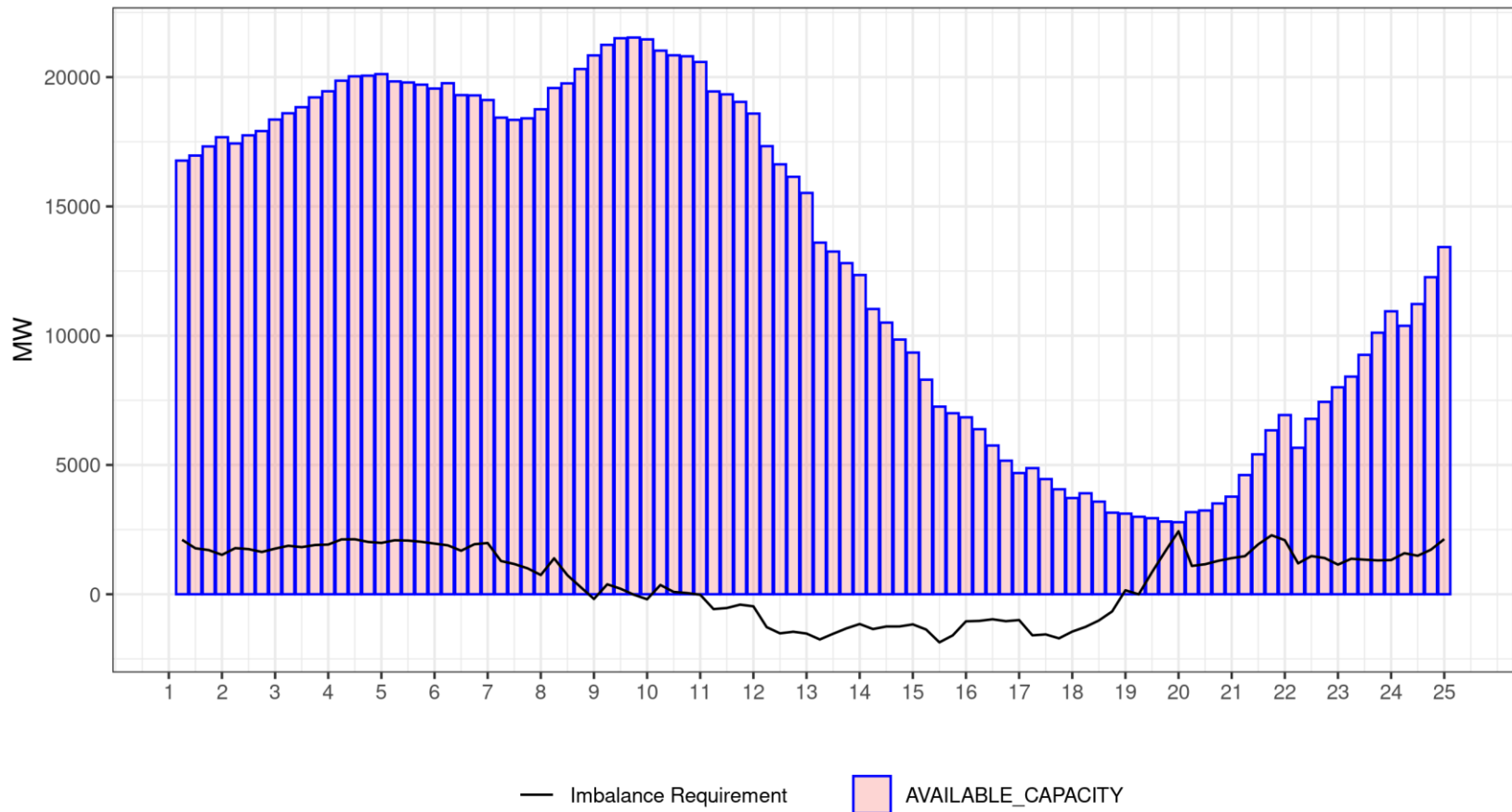

Over bid-Range capacity test

If sum of resource decremental bid-range capacity is greater than the decremental bid range requirement then BAA passes the Test

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Bid Range Capacity Test Requirement
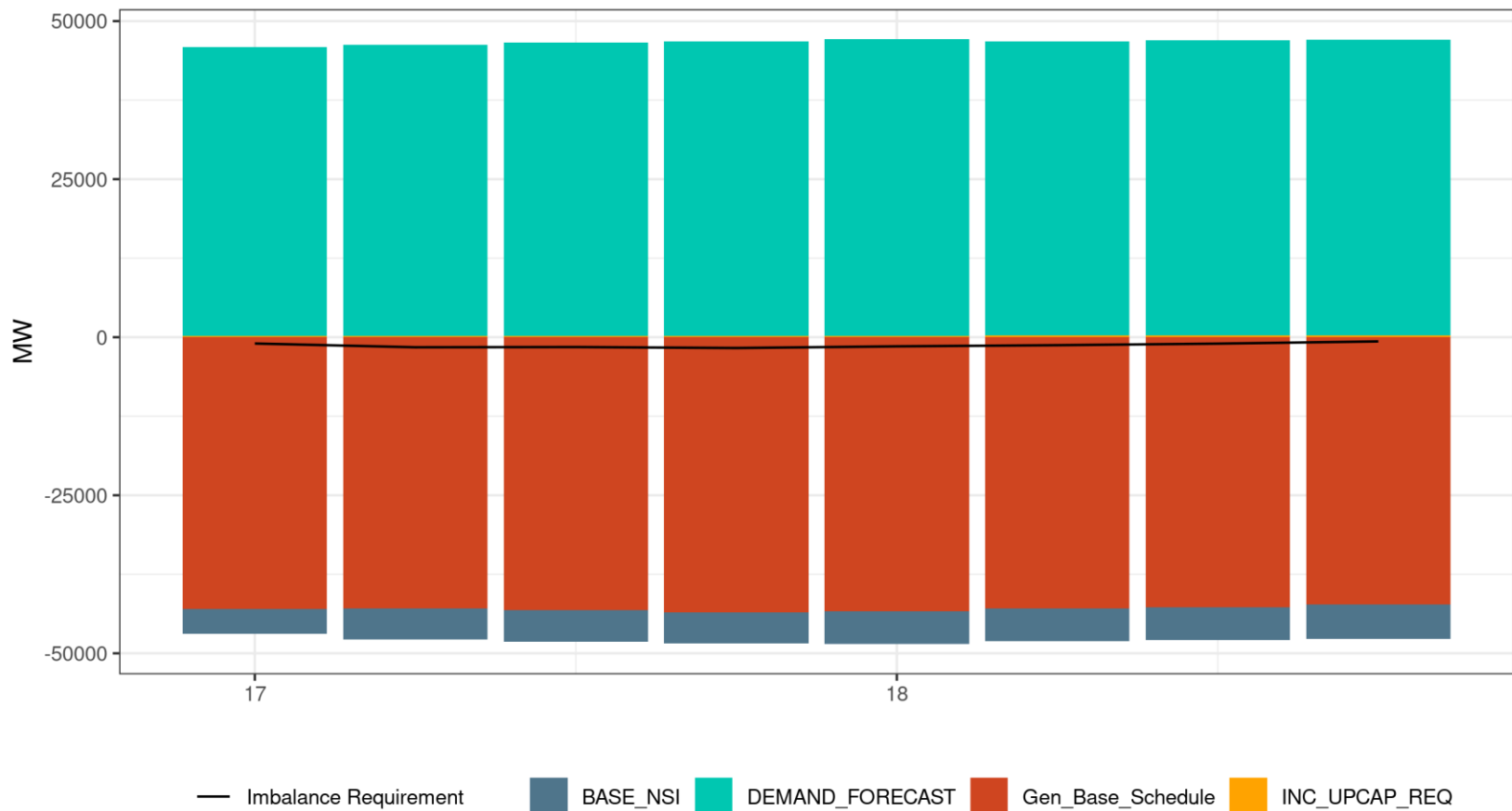# August 14, 2020

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Bid Range Resource Capacity and Incremental Bid Range Capacity Requirement for August 14, 2020

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Bid Range Capacity Test Requirement for August 14, 2020 Hour Ending 17 and 18

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Bid Range Resource Capacity and Incremental Bid Range Capacity Requirement for August 14, 2020 Hour Ending 17 and 18
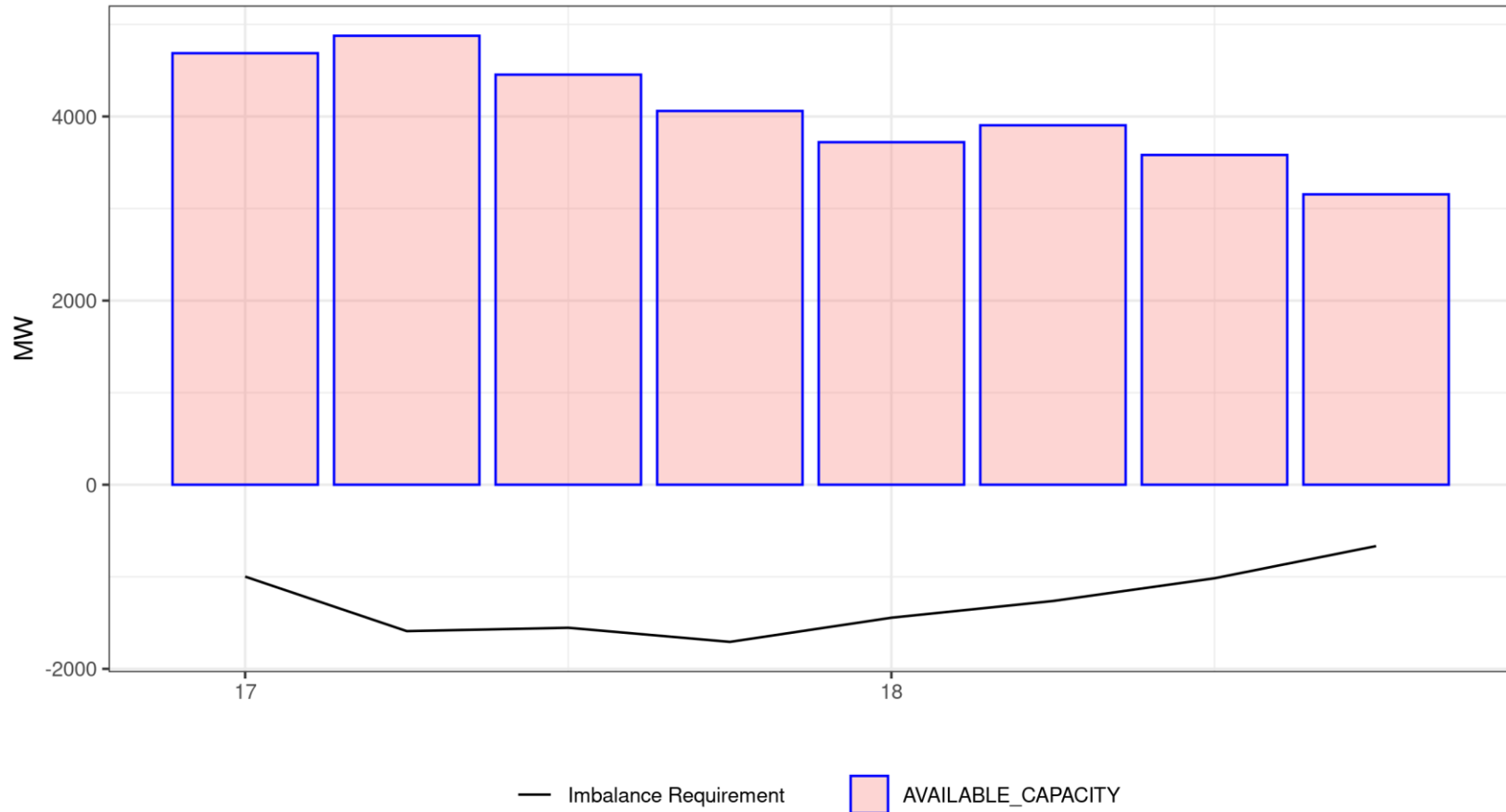

When the Resource Available Capacity (Bar) is above the Imbalance Requirement (line) the BAA passes the bid-range capacity test

Bid-Range Capacity Test – Current situation

- Found a couple of issues in the calculation of the capacity test:
  - Resource Pmax Derate and Pmin Rerates are not included in Resource capacity calculations. This impacts calculation for all EIM BAAs including CAISO.
  - Inaccurate Net Schedule Interchange values used for CISO BAA due to inclusion of the mirror resources
- Any false pass in capacity is captured by the Flex ramp test which is more limiting test than the capacity test as it considers derates, has the correct NSI calculation, and also considers ramp rates.

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Original and Approximately Adjusted Imbalance Requirement and Resource Capacity For August 14, 2020 Hour Ending 18

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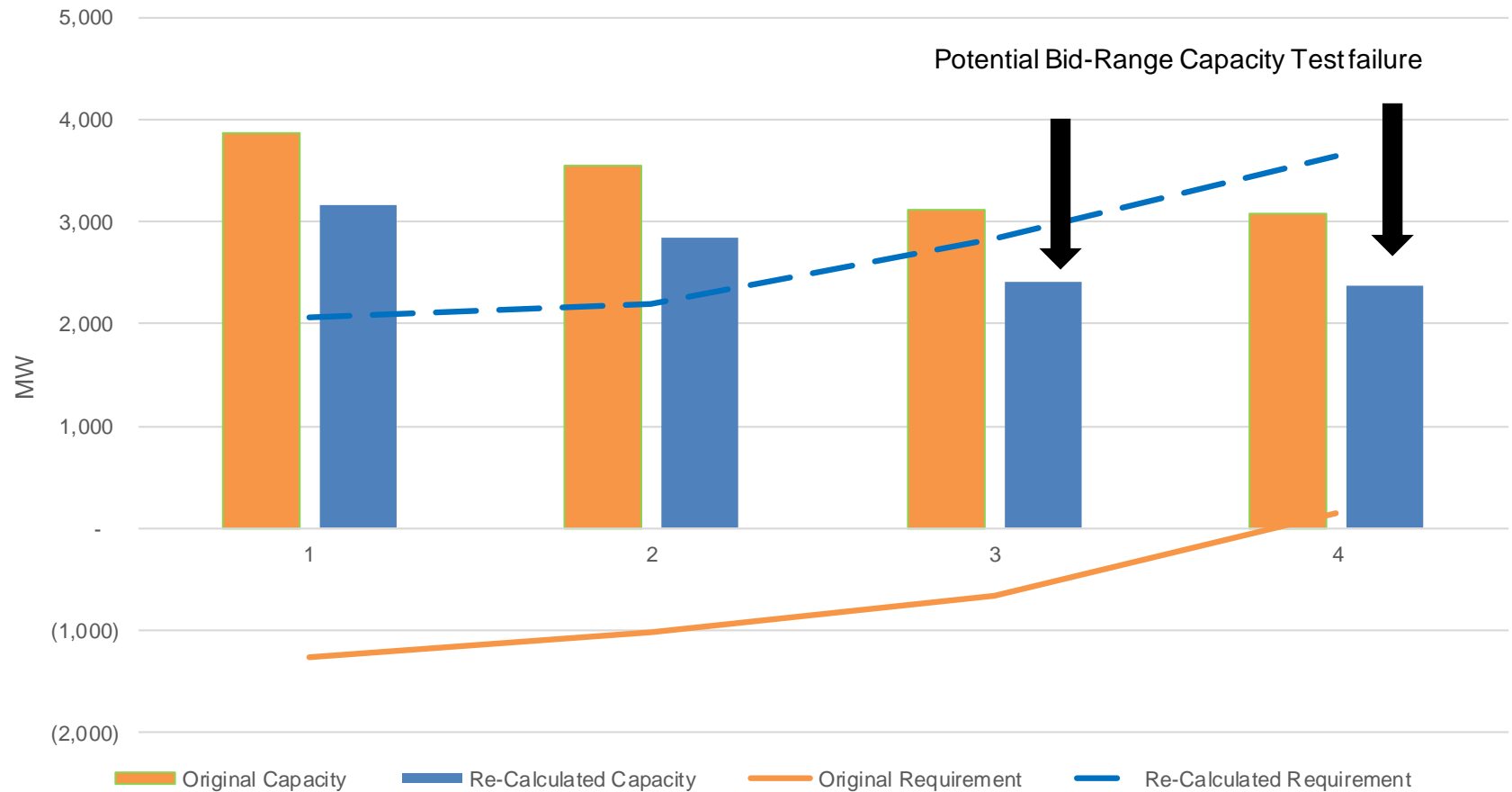
Actual Flex Ramp Test up Requirement and Resource Capacity for August 14, 2020 Hour ending 18
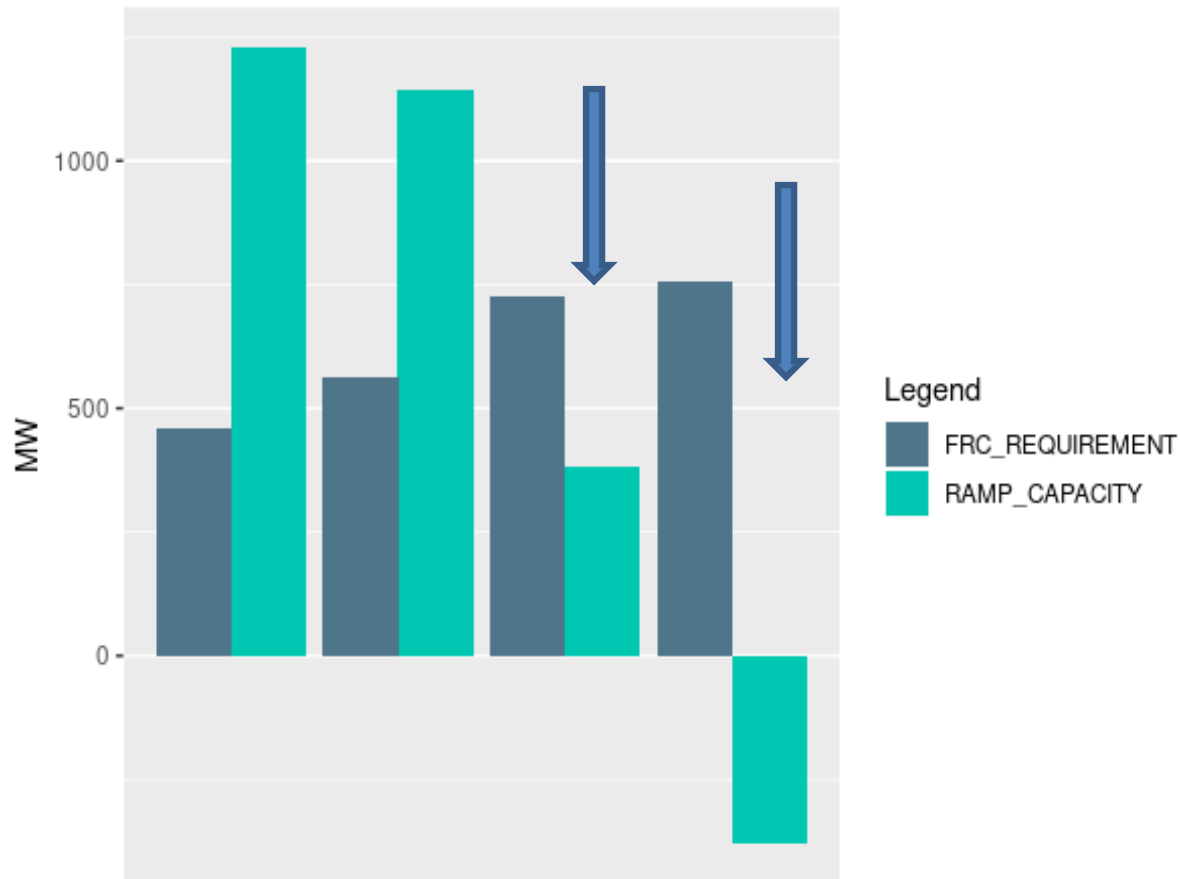
To pass the flex ramp test
Ramp Capacity >FRC Requirement

California ISO

Flexible Ramp Sufficiency Test

- Purpose

- Flexible Ramp Sufficiency Test Rules

- Requirement Calculation

- Capacity Calculation

- Passing Criteria

Flexible Ramp Sufficiency Test- Purpose

Assess whether there is sufficient ramping capability among all resources in the BAA to meet the forecasted demand change across intervals plus historical uncertainty

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Flexible Ramp Sufficiency Tests – Rules

- Three tests are performed: (T-75, T-55 and T-40)

- Tests are performed for both Up and Down direction

- The flexible ramp sufficiency test is performed during each run and is tested for each 15-minute interval

- The first two test (T-75 and T-55) are advisory runs and enable a Balancing Area Authority (BAA) to adjust their schedules in order to make necessary adjustments to pass the tests

- A BAA fails the sufficiency test if they fail the third test (T-40)

- If a BAA fails the flexible ramp sufficiency test up for a15-minute interval, then its import EIM transfers are capped for that specific interval

- Similarly, If a BAA fails the flexible ramp sufficiency test down for a 15-minute interval, then its export EIM transfers are capped for that specific interval

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Four 15-minute Interval Tests

For each 15-minute interval test validate if there is enough ramp capability to meet the requirement. The flexible ramp requirement and resource ramp capacity for the each 15-minute intervals as:

- first 15 minute interval: T-7.5 minutes to T+7.5 minutes

- Second 15 minute interval: T-7.5 minutes to T+22.5 minutes

- Third 15 minute interval: T-7.5 minutes to T+37.5 minutes

- Fourth 15 minute interval: T-7.5 minutes to T+52.5 minutes

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Flexible Ramp Sufficiency Test (FRST) Passing Criteria

Flexible Ramp Requirement	Flexible Ramp Capacity
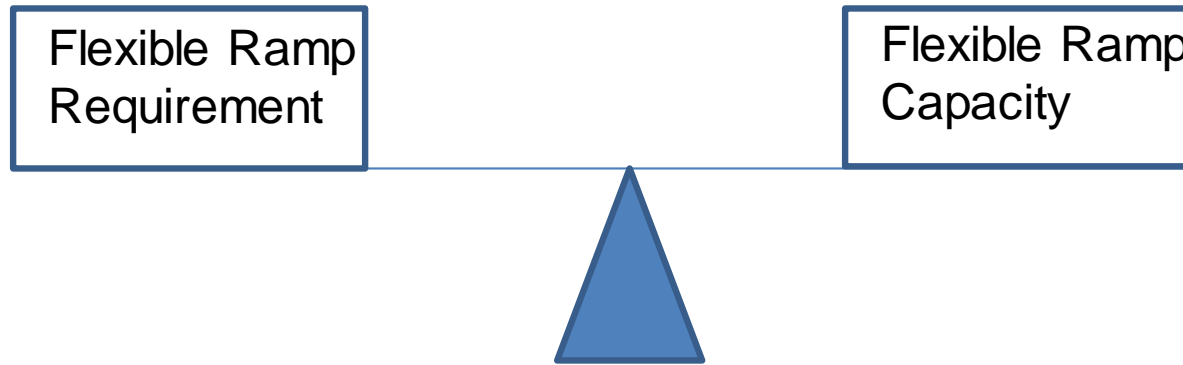
- An EIM entity can pass the flexible ramp sufficiency test if the sum of flexible ramp capacity is above the flexible ramp requirement
- A 1% tolerance band threshold or 1 MW is applied to the flexible ramping uncertainty requirement

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FRST Requirement Calculations

- The requirement is calculated from six components
  - Forecasted Change in Demand
  - Flexible Ramping Product Uncertainty
  - Diversity Benefit
  - Flexible Ramp Credit
  - Net Import Capability
  - Net Export Capability

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FRST Requirement Calculations - Equation

- *Flex Up Uncertainty*: Net Demand Forecast Error
- Demand Change: the forecasted change in demand from T-7.5 to the given 15-minute interval (T+7.5, T+22.5, T+37.5, or T+52.5)
- The Diversity Benefit (MW) calculated as BAA Uncertainty*(1-EIM_AREA Uncertainty/Sum of BAA Uncertainty)
- Flex Ramp up credit which is the incremental export EIM transfer from a BAA

$$Flex\ Ramp\ Up\ Requirement\ (T)$$
$$= Demand\_Change$$
$$+ \max \begin{bmatrix} Flex\ Up\ Uncertainty - Net\ Import\ Capability, \\ Flex\ Up\ Uncertainty - Diversity\ Benefit - Flex\ Ramp\ Up\ Credit \end{bmatrix}$$

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CAISO FRST Requirement Breakdown-
August 14, 2020

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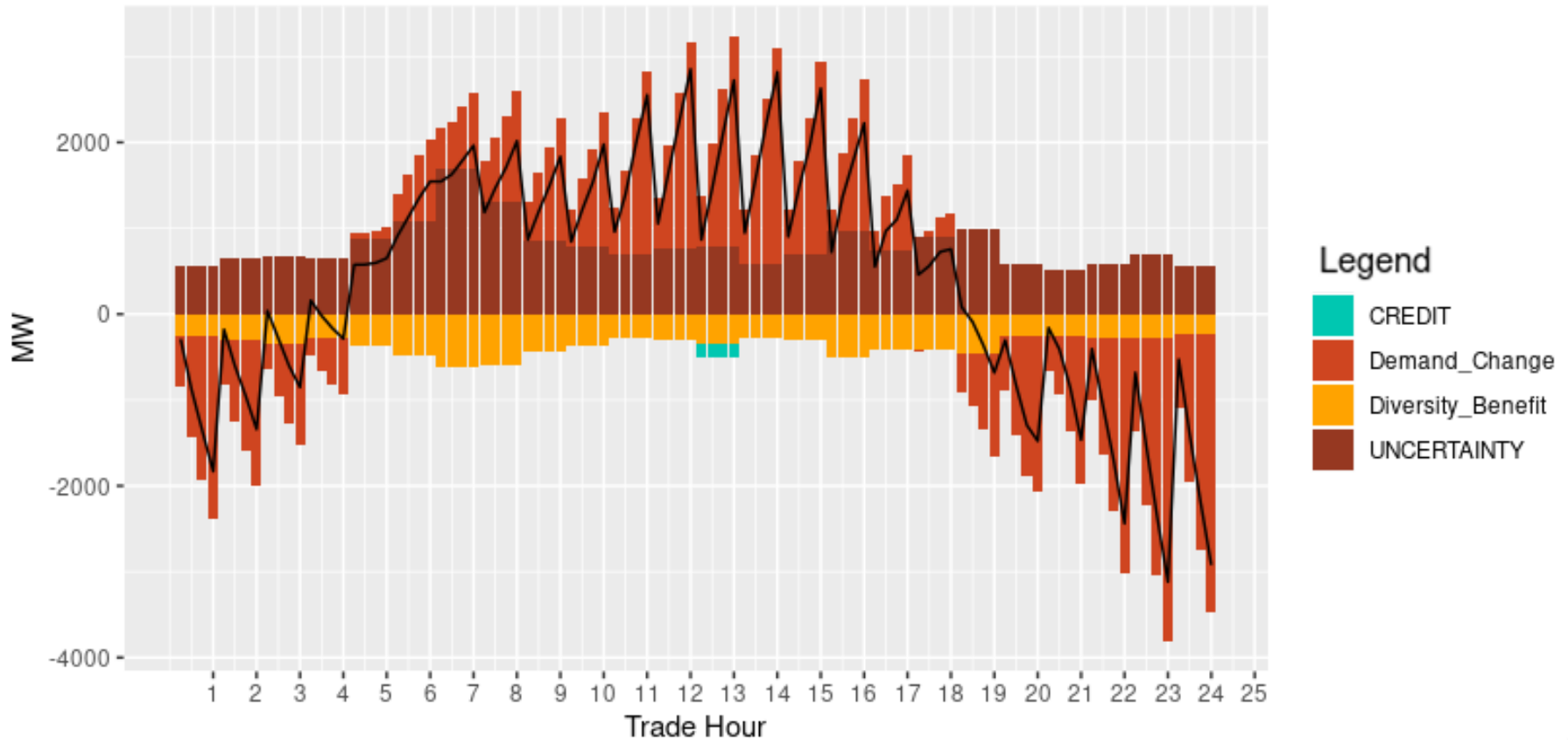
FRST Resource Ramp Capacity By unit type-
August 14, 2020

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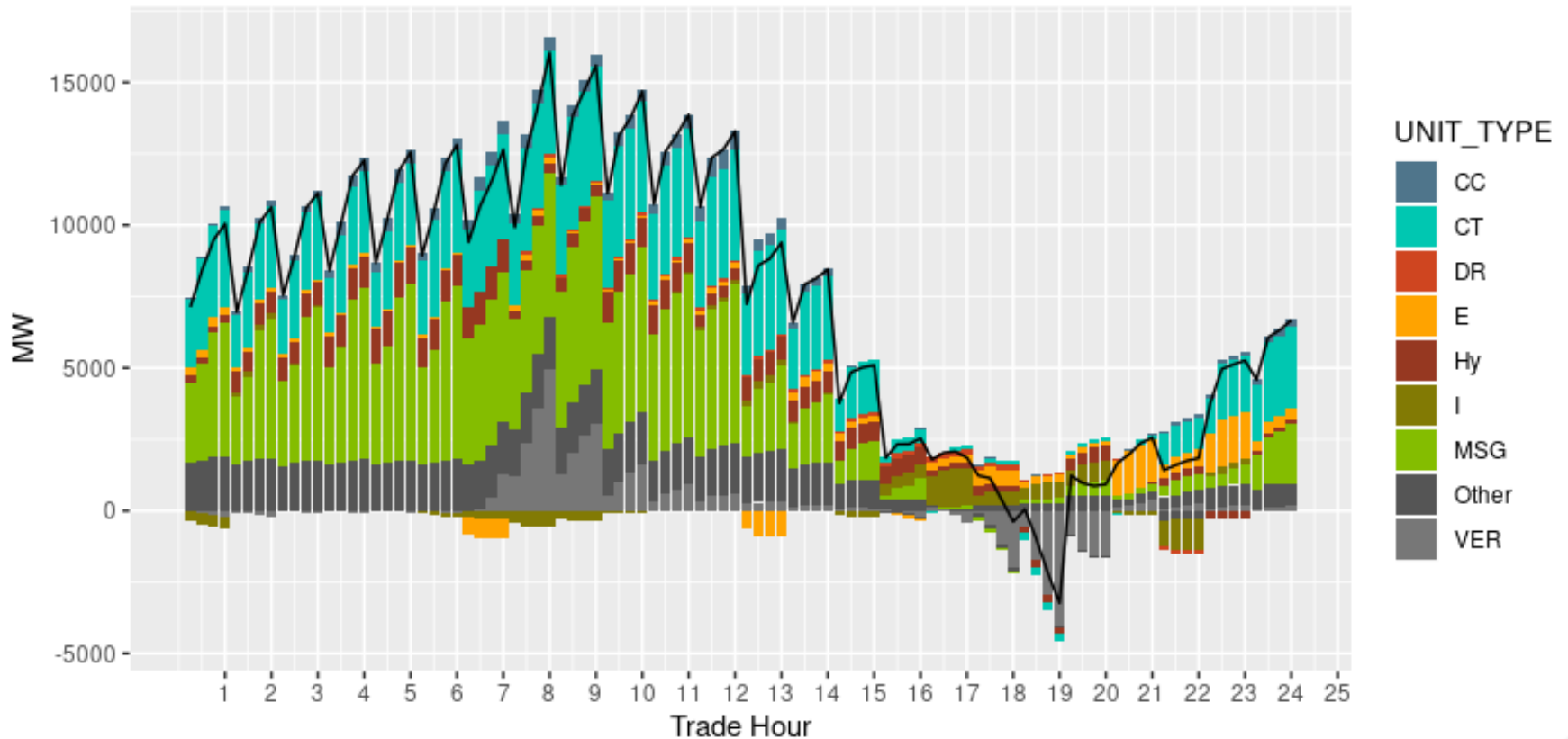
FRST Requirement and Ramp Capacity - August 14, 2020

Flex Ramp Up Test Failure

Legend: RAMP_CAPACITY, REQUIREMENT
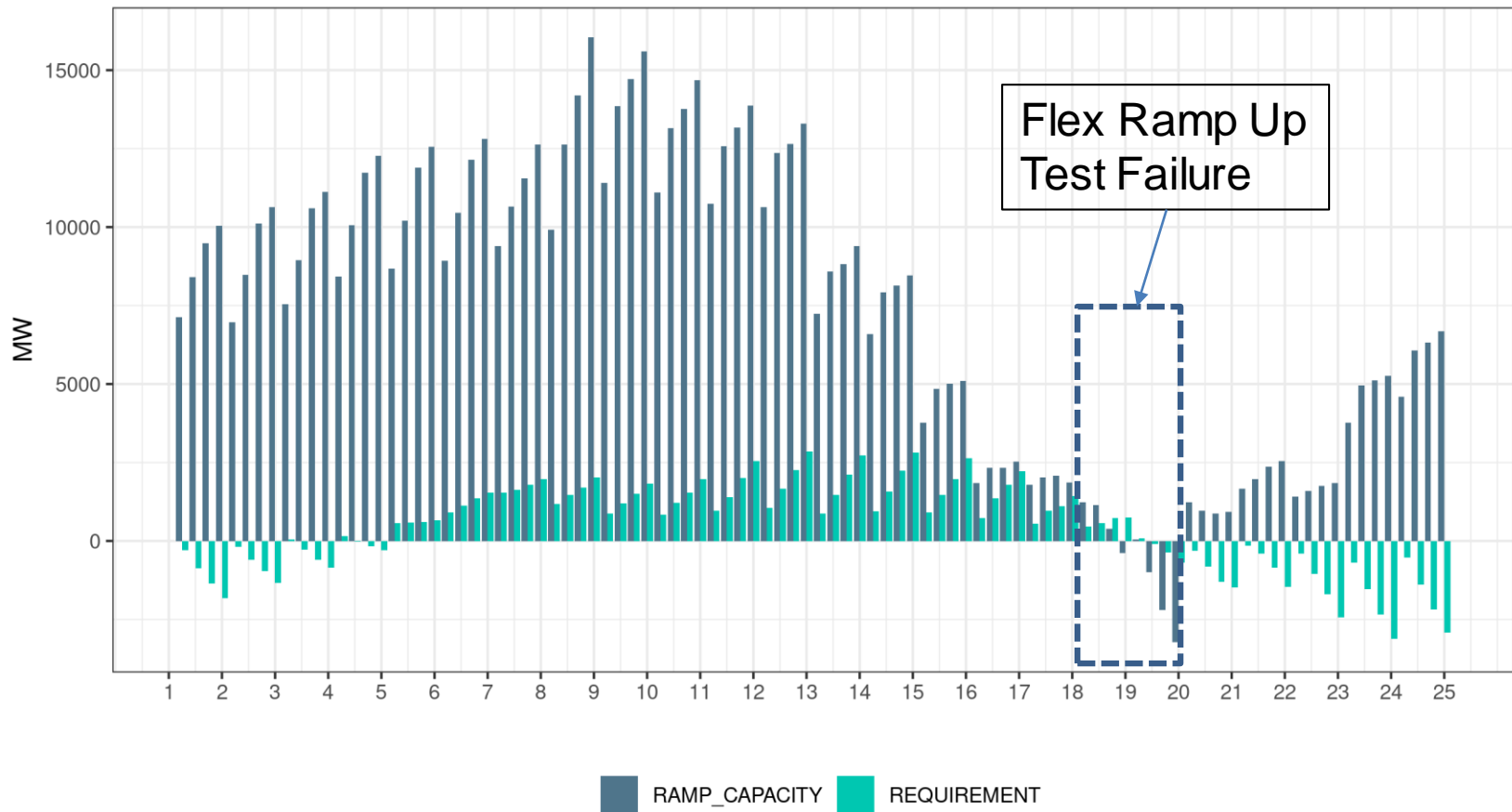
Flex Ramp Requirement Breakdown – August 14, 2020 – Hour ending 17 and 18

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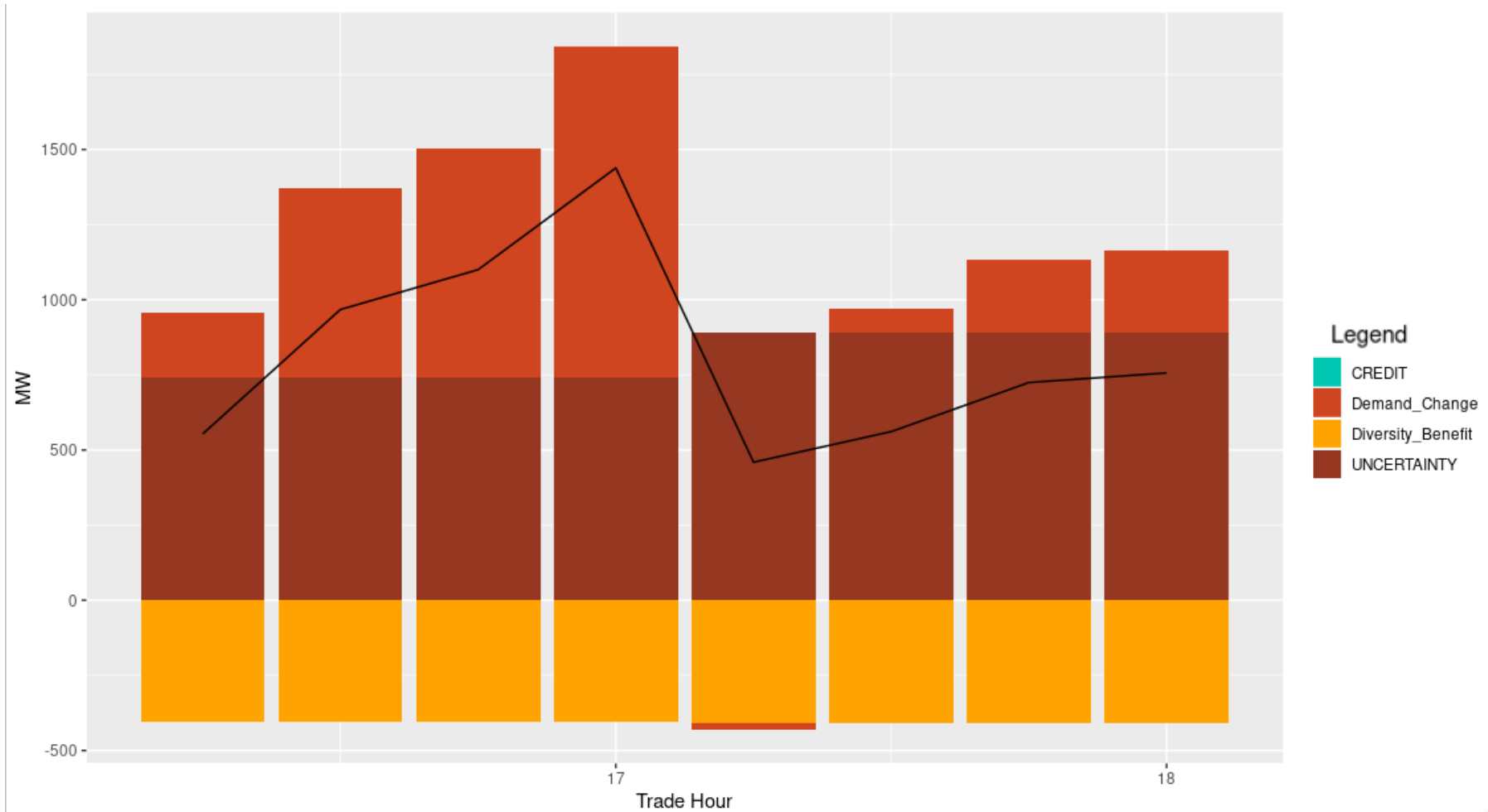
August 14, 2020 -Flexible Ramp Uncertainty

- Uncertainty
  - Hour Ending 17: 742
  - Hour Ending 18: 889

| Date: 08/14/2020 | To: 08/14/2020 | Market: RTPD ∨ | BAA Group: CISO ∨ | Apply | Reset |

| Download XML | Download CSV |

Flexible Ramp Requirements

161 - 180 of 192

| | | | | | | | Flexible Ramp Product |
Balancing Authority Area Group	Market	Interval Start Date Time	Hour-Ending	Ramp Type	Flexible Ramp Constraint Requirement (MW) - Flex Requirement Constraint	Net Demand Movement Component (MW) - Flex Requirement Constraint	Uncertainty Component (MW)
CISO	RTPD	08/14/2020 16:00	17	UP			742.00
CISO	RTPD	08/14/2020 16:15	17	UP			742.00
CISO	RTPD	08/14/2020 16:30	17	UP			742.00
CISO	RTPD	08/14/2020 16:45	17	UP			742.00
CISO	RTPD	08/14/2020 17:00	18	UP			889.00
CISO	RTPD	08/14/2020 17:15	18	UP			889.00
CISO	RTPD	08/14/2020 17:30	18	UP			889.00
CISO	RTPD	08/14/2020 17:45	18	UP			889.00

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August 14, 2020 – Diversity benefit

Hour Ending 17

GROUP_NAME	UNCERTAINTY
SCL	13
BANCSMUD	26
PSEI	38
IPCO	87
PGE	99
PACW	106
SRP	143
NEVP	159
BCHA	184
AZPS	187
PACE	245
CISO	742
EIM_AREA	925

Sum of BAA Uncertainty = 2029

$$\text{Diversity Benefit Factor} = \frac{EIM\_AREA\ UNCERTAINTY}{Sum\ of\ BAA\ Uncertainty}$$
$$= 0.46$$

$$\text{Scaled Uncertainty} = Div\ Ben\ Fac * CISO\ Uncertainty$$
$$= 338.27$$

Hour Ending 18

GROUP_NAME	UNCERTAINTY
SCL	12
BANCSMUD	29
PSEI	64
PGE	96
PACW	102
BCHA	104
IPCO	150
SRP	151
AZPS	182
NEVP	188
PACE	255
CISO	889
EIM_AREA	1198

Sum of BAA Uncertainty = 2222

$$\text{Diversity Benefit Factor} = \frac{EIM\_AREA\ UNCERTAINTY}{Sum\ of\ BAA\ Uncertainty}$$
$$= 0.54$$

$$\text{Scaled Uncertainty} = Div\ Ben\ Fac * CISO\ Uncertainty$$
$$= 479.31$$

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Net Import Capability

- $NIC - Dynamic$
  - Sum of Dynamic Import ETSR limits minus sum of dynamic Net ETSR schedule from the prior hour
- $NIC - Static$
  - Sum of Static Import ETSR limits minus sum of static Net ETSR schedule from the prior hour
- NIC = NIC-Dynamic + NIC static

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NIC Calculations

- NIC (T) = $\begin{cases} \sum_{k \in Dyamic}^{N} IT_{max}^{k}(t + 7.5) + \\ \sum_{k \in Dyamic}^{N}\left(ET^{k}(t - 7.5) - IT^{k}(t - 7.5)\right) + \\ \sum_{l \in Static}^{M} IT_{max}^{l}(t + 7.5) + \\ \sum_{l \in Static}^{M}\left(ET^{l}(t - 7.5) - IT^{l}(t - 7.5)\right) \end{cases}$

T – {1,2,3,4} Represents four fifteen-minute test intervals.
N – Set of all dynamic ETSR for the BAA
M – Set of all static ETSR for the BAA
IT – Import ETSR schedule
ET – Export ETSR schedule
IT_{max} – Import ETSR limit
ET_{max} – Export ETSR limit
T-7.5 – represent schedules from latest RTPD run for the fifteen- minute interval prior to the test hour
T+7.5 – represent schedules first fifteen- minute interval of the test hour

August 14, 2020 – Net Import Capability

Hour Ending 17

	Dynamic	Static
Import ETSR limits	11,903	97
Net ETSR Schedule	1,810	276
NIC	10,093	(179)

NIC = 10093 -179

NIC = 9914

Hour Ending 18

	Dynamic	Static
Import ETSR limits	11,980	97
Net ETSR Schedule	1944	97
NIC	10035	0

NIC = 10035 +0

NIC = 10035

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Dynamic ETSR	Itmax
CISO_ELDORADO230_NEVP_I_EIMDYN	1,564
CISO_SUMMIT120_NEVP_I_EIMDYN	18
CISO_PVWEST_AZPS_I_EIMDYN	1,822
CISO_NRTHGILA500_AZPS_I_EIMDYN	320
CISO_MEAD230_NEVP_I_EIMDYN	3,716
CISO_MEAD230_AZPS_I_EIMDYN	103
CISO_RANCHOSECO_SMUD_I_EIMDYN	988
CISO_LAKE_SMUD_I_EIMDYN	358
CISO_MEAD230_SRP_I_EIMDYN	248
CISO_PVWEST_SRP_I_EIMDYN	2,494
CISO_MARKETPLACE_SRP_I_EIMDYN	349
	11,980

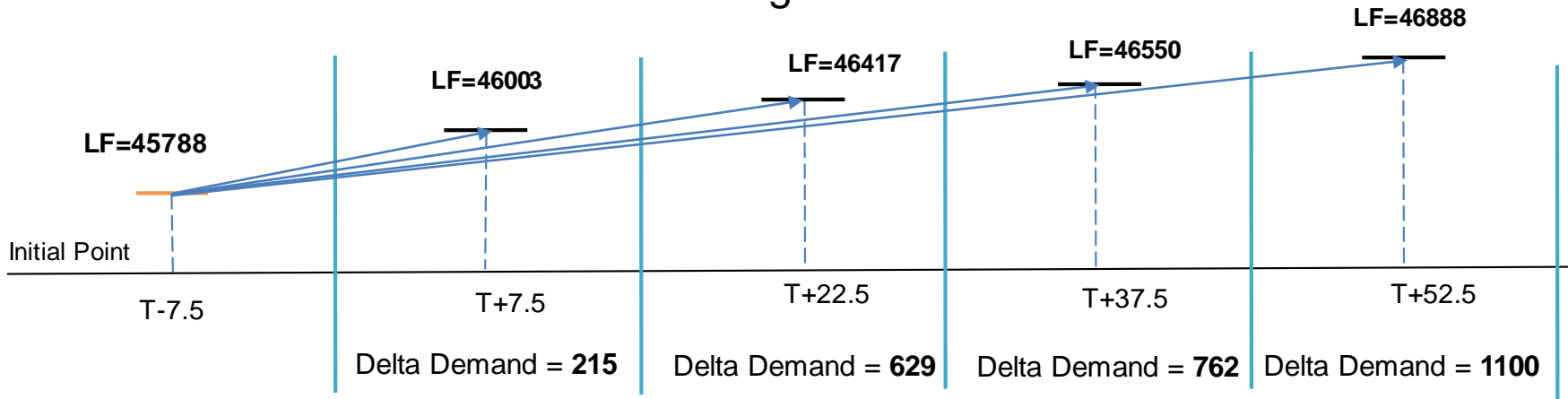| Dynamic ETSR	IT
CISO_ELDORADO230_NEVP_I_EIMDYN	636
CISO_PVWEST_AZPS_I_EIMDYN	339
CISO_NRTHGILA500_AZPS_I_EIMDYN	320
CISO_RANCHOSECO_SMUD_I_EIMDYN	246
CISO_MEAD230_SRP_I_EIMDYN	248
CISO_PVWEST_SRP_I_EIMDYN	54
CISO_MARKETPLACE_SRP_I_EIMDYN	101
	1,944

Static ETSR	Itmax
CISO_MALIN500_PACW_I_EIMSTA	97
	97

Static ETSR	IT
CISO_MALIN500_PACW_I_EIMSTA	97
	97

	Dynamic	Static
Import ETSR limits	11,980	97
Net ETSR Schedule	1944	97
NIC	10035	0

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August 14, 2020 – Demand Forecast Change (Net movement)

Hour Ending 17
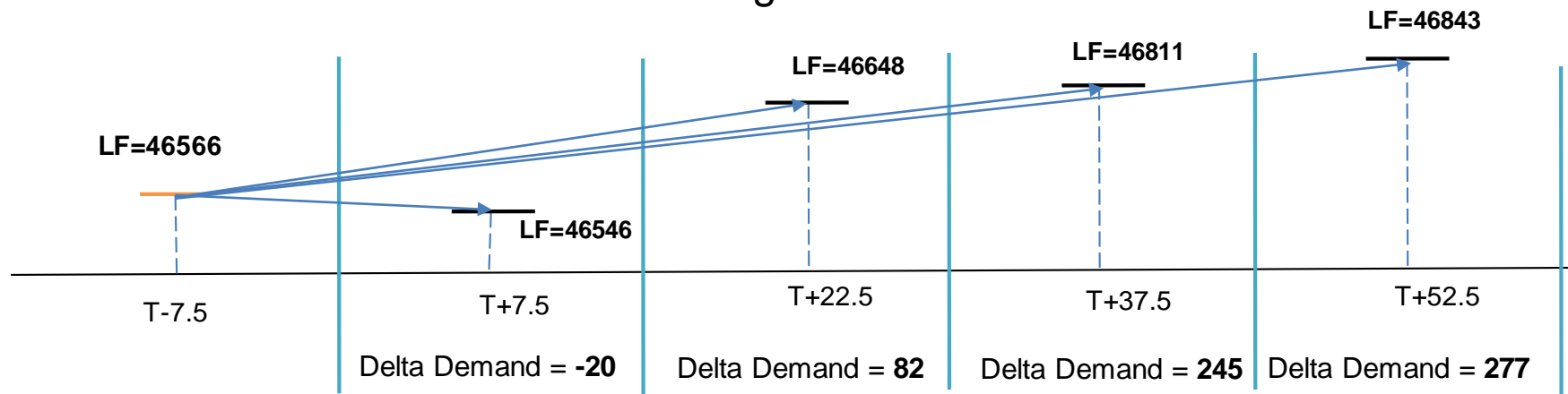
LF=46888

LF=46550

LF=46417

LF=46003

LF=45788

Initial Point

T-7.5   T+7.5   T+22.5   T+37.5   T+52.5

Delta Demand = **215** | Delta Demand = **629** | Delta Demand = **762** | Delta Demand = **1100**

Hour Ending 18

LF=46843

LF=46811

LF=46648

LF=46566

LF=46546

T-7.5   T+7.5   T+22.5   T+37.5   T+52.5

Delta Demand = **-20** | Delta Demand = **82** | Delta Demand = **245** | Delta Demand = **277**

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August 14, 2020 – Flexible Ramp Sufficiency Test (UP) - Requirement

$$FRUR = Demand\ Change + \max(Uncertainty\ Up$$

Interval	Demand Change	Uncertainty Up	Net Import Capability	DB Scaled Uncertainty	Credit	FRUR
1	215	742	9914	338	0	553
2	629	742	9914	338	0	967
3	762	742	9914	338	0	1100
4	1100	742	9914	338	0	1438

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August 14, 2020 Flexible Ramp Sufficiency Test (UP) - Requirement

$$FRUR = Demand\ Change + \max(Uncertanity\ Up$$

Interval	Demand Change	Uncertainty Up	Net Import Capability	DB Scaled Uncertainty	Credit	FRUR
1	-20	889	10035	479	0	459
2	82	889	10035	479	0	561
3	245	889	10035	479	0	724
4	277	889	10035	479	0	756

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Ramp Requirement and Capacity

Hour Ending 17
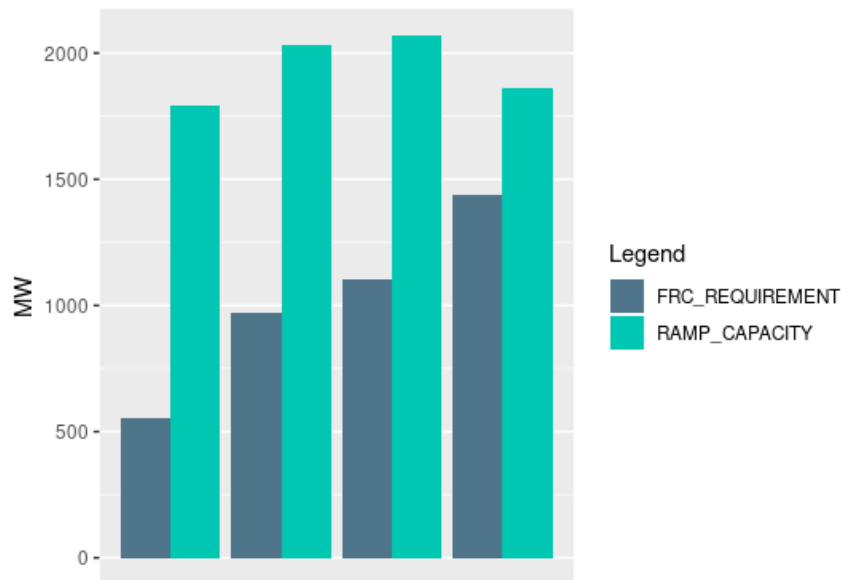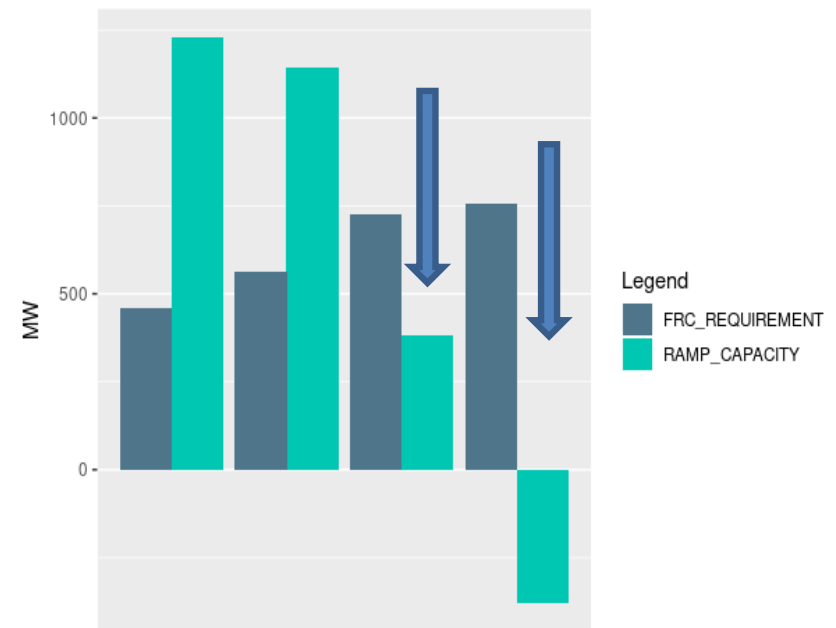
Hour Ending 18

To pass the Test
Ramp Capacity >FRC Requirement

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August 14, 2020 Resource Ramp Capacity

Hour Ending 17

Hour Ending 18
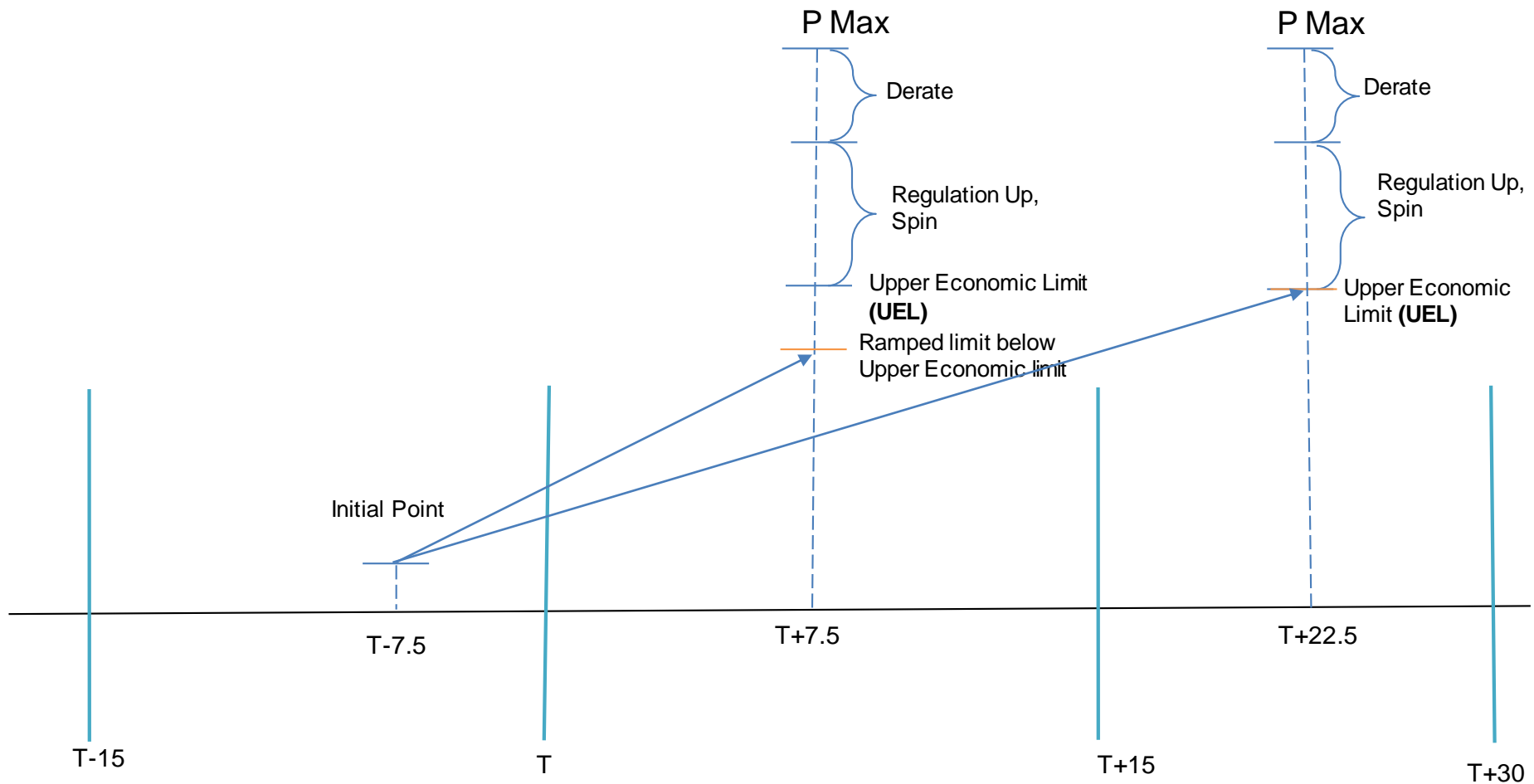
California ISO
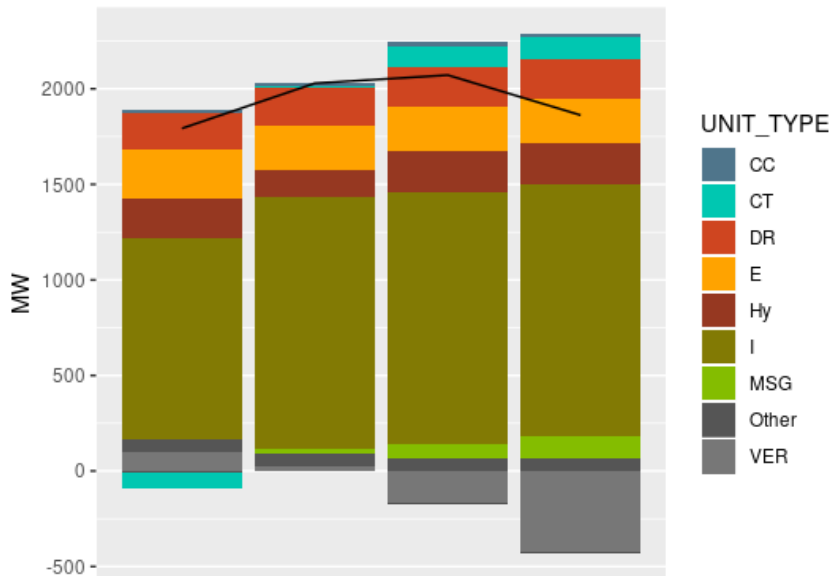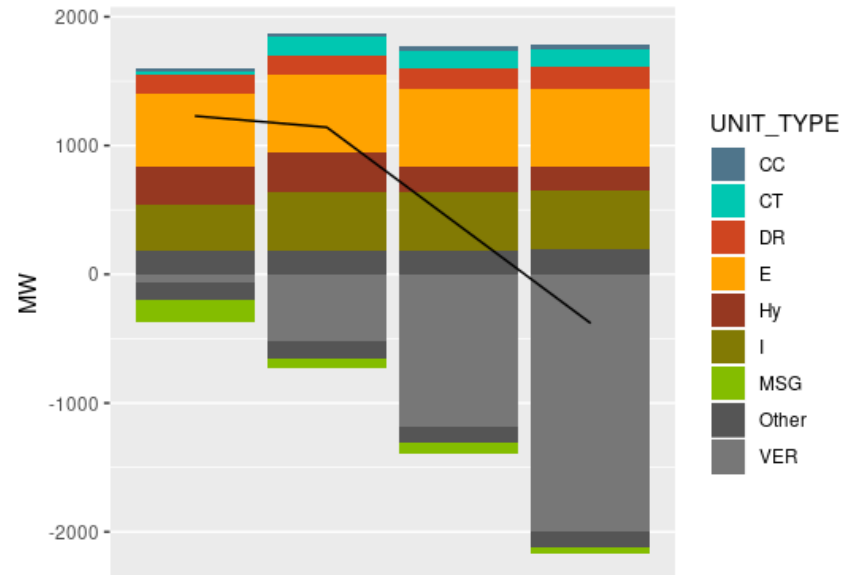
Ramp Capacity Calculation

Ramp capacity is calculated for every resource

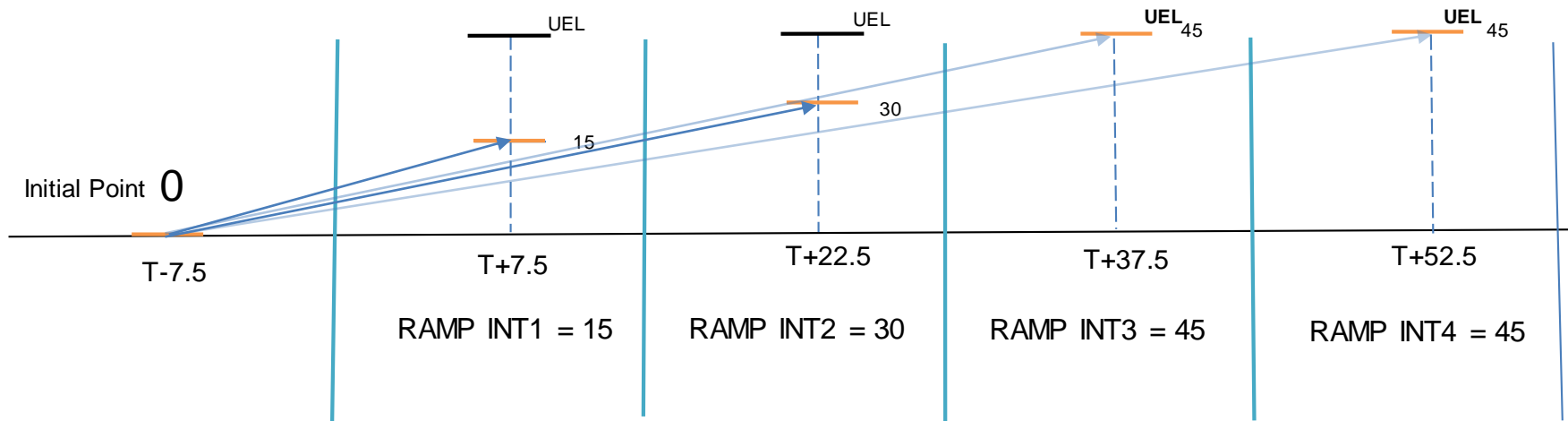Ramp capacity can be either a positive or negative value

Ramp capacity calculation is explained for following resources

- – Conventional Generating Resource
- – Variable Energy Resources (VERs)
- – Imports

Ramp Capacity Calculation for Interval 1 & 2 (conventional generator)

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Conventional Generators Ramp Capacity for all Intervals

Initial Point 0

UEL   UEL   **UEL** 45   **UEL** 45

15   30   45   45

T-7.5   T+7.5   T+22.5   T+37.5   T+52.5

RAMP INT1 = 15   RAMP INT2 = 30   RAMP INT3 = 45   RAMP INT4 = 45

Ramp Rate = 1 MW/Min

Interval	Initial MW	Economic Max	Ramp Capacity
1	0.00	45.00	15.00
2	0.00	45.00	30.00
3	0.00	45.00	45.00
4	0.00	45.00	45.00

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VER Resource Ramp Capacity – Positive Upper limit is minimum of (Bid/Forecast)

251 Forecast **296** Forecast

210 Forecast

162 Forecast

Initial Point 30

T-7.5   T+7.5   T+22.5   T+37.5   T+52.5

RAMP INT1 = 132   RAMP INT2 = 180   RAMP INT3 = 221   RAMP INT4 = 266
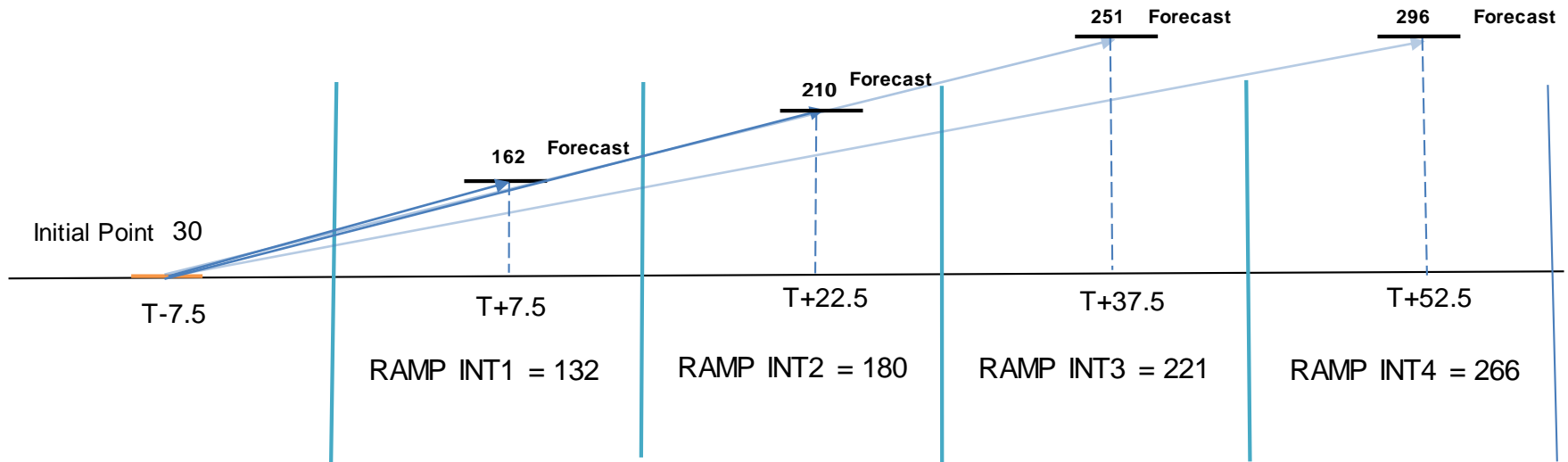
Ramp Rate = 30 MW/Min			
Interval	Initial MW	Current Hour Forecast	Ramp Capacity
1	30	162	132
2	30	210	180
3	30	251	221
4	30	296	266

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VER Resource Ramp Capacity - Negative
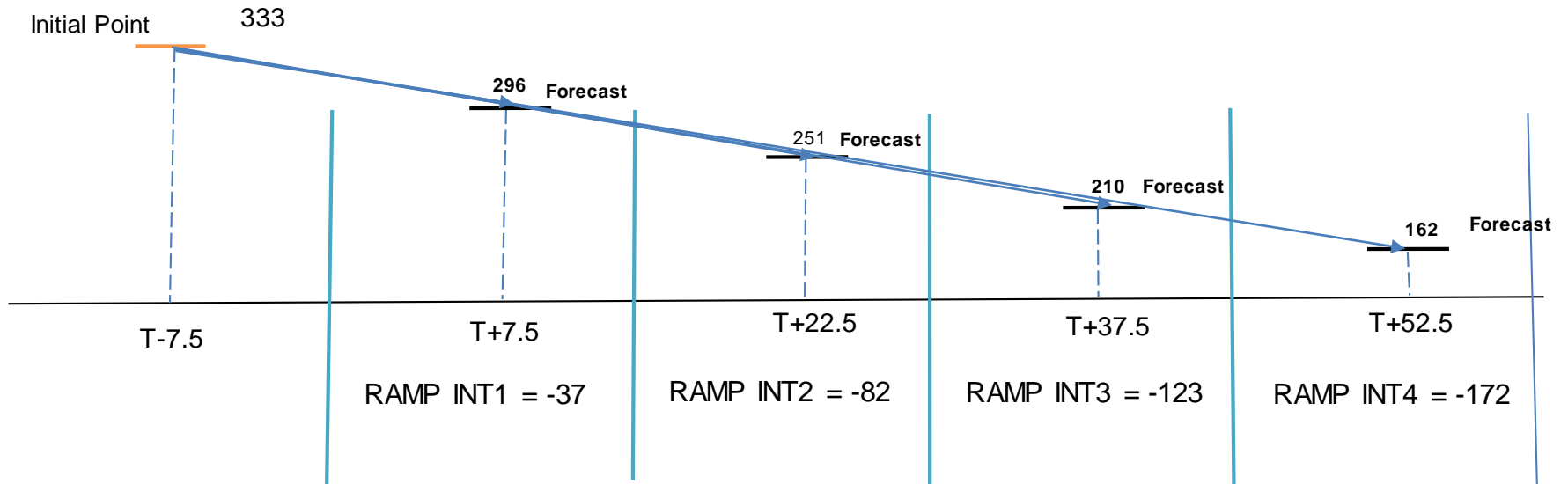
Interval	Initial MW	Forecast	Ramp Capacity
1	333	296	-37
2	333	251	-82
3	333	210	-123
4	333	162	-172

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Import Transaction – Flex Ramp Capacity
Based on HASP resource award or Tagged Value

Tag Value or HASP Award

Tag Value or HASP Award
154

Tag Value or HASP Award
154

Tag Value or HASP Award
154

132

Initial Point
44

RAMP INT1 = 88   RAMP INT2 = 110   RAMP INT3 = 110   RAMP INT4 = 110
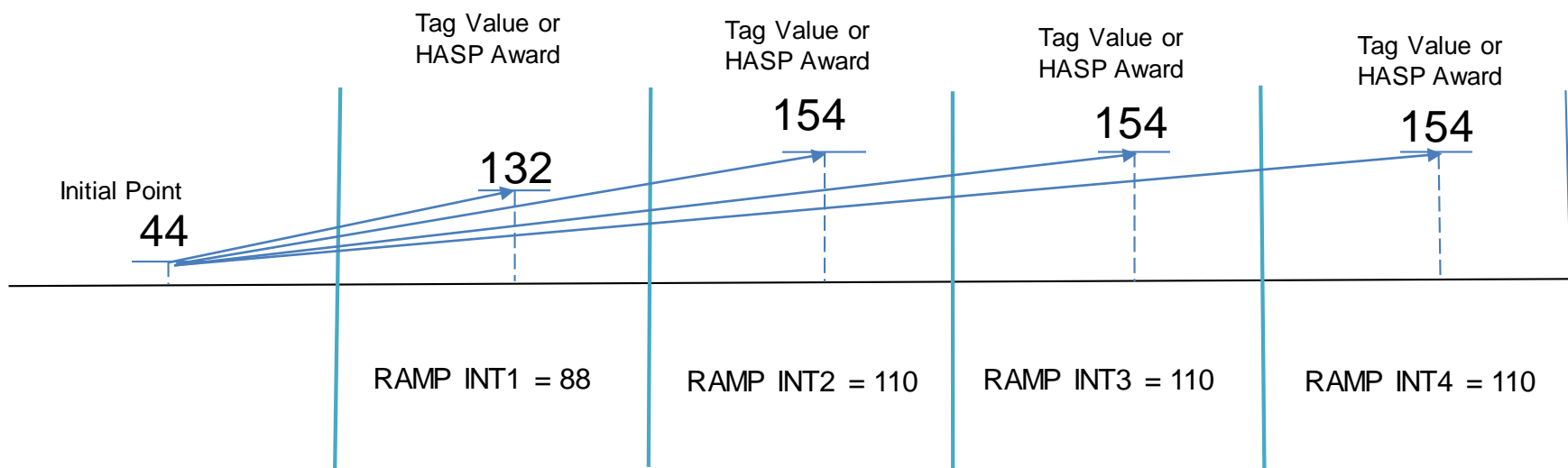
| Interval	Previous Hour Schedule	Current Hour Schedule	Initial MW	Average Tag profile	Ramp Capacity
1	22	154.00	44.00	132.00	88.00
2	22	154.00	44.00	154.00	110.00
3	22	154.00	44.00	154.00	110.00
4	22	154.00	44.00	154.00	110.00

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FRST Trends comparison between Advisory and Binding Results

- First Test at T-75 (Advisory)

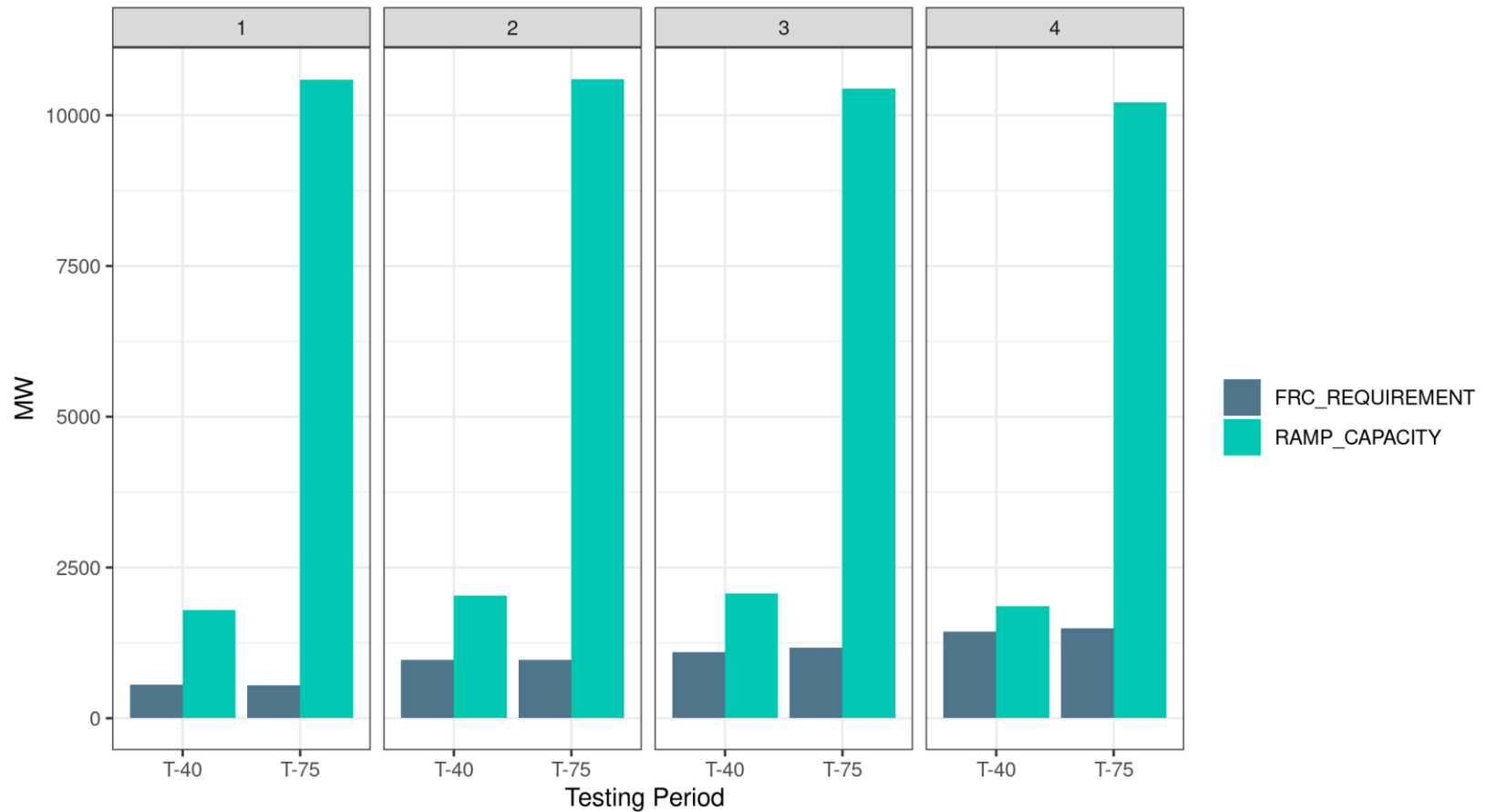- Second Test at T-55 (Advisory)

- Final Test at T-40 (Binding)

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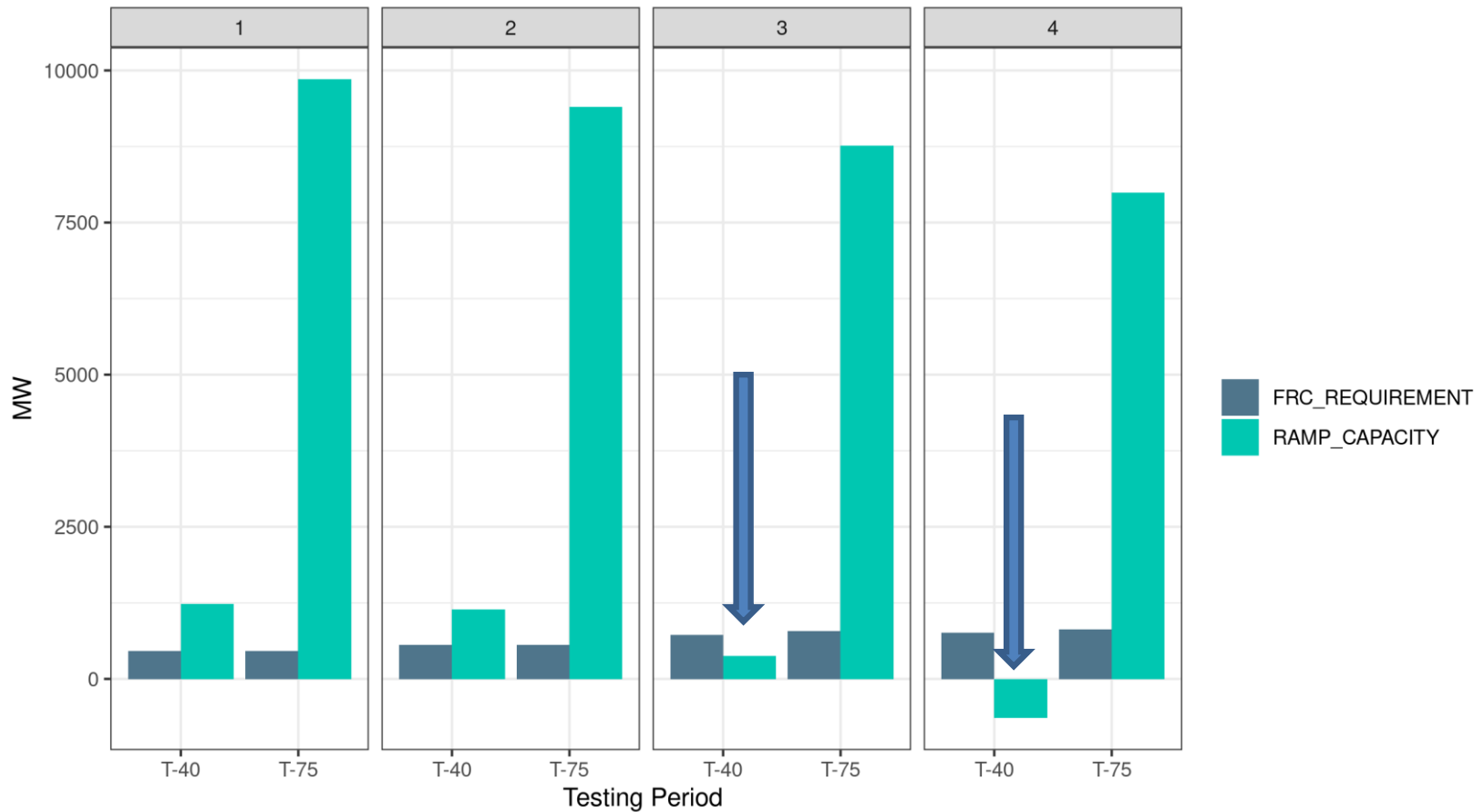# CAISO FRST Requirements Components at T-75 and T-40 for Hour Ending 17
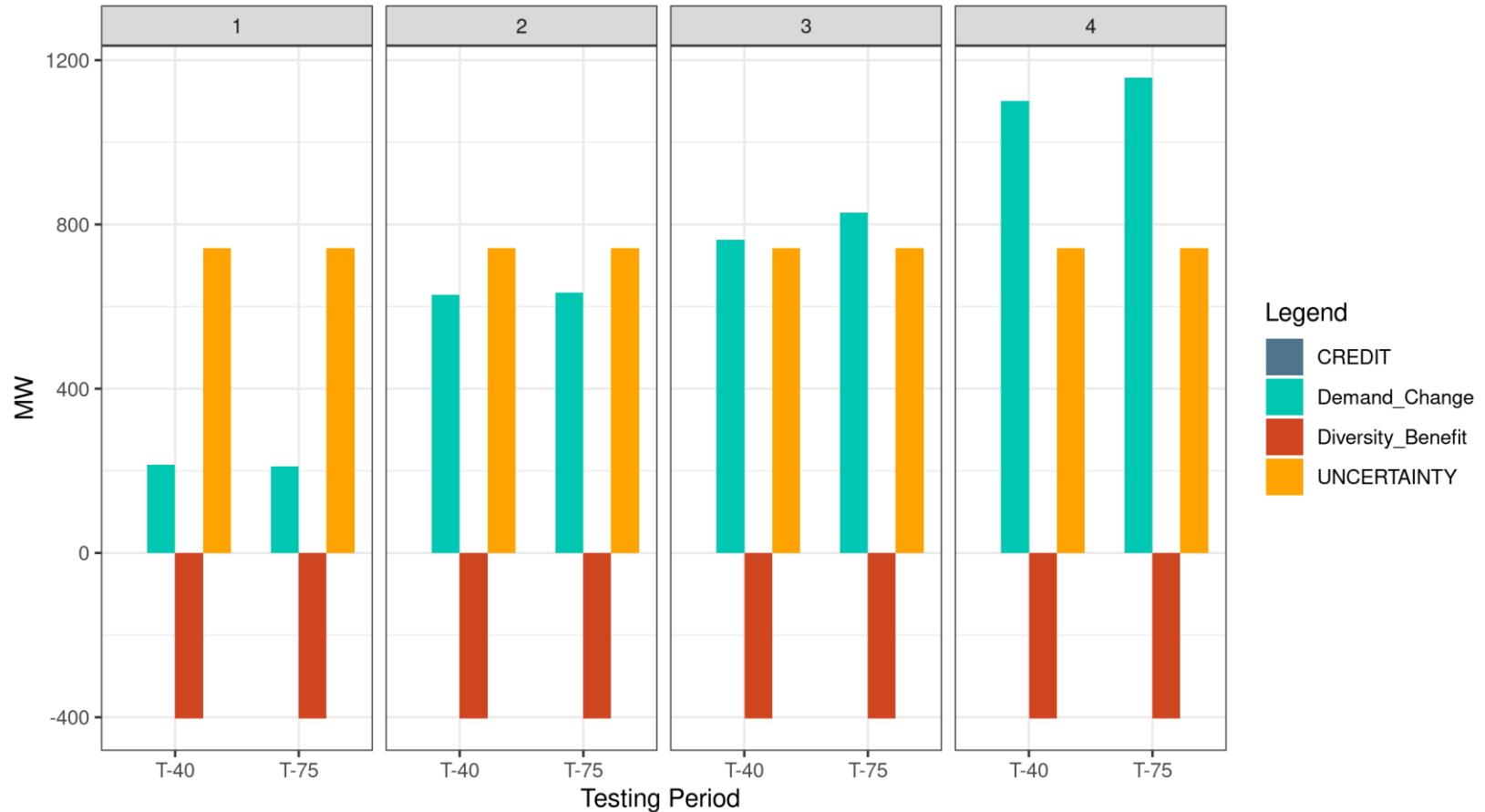
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CAISO FRST Requirements Components at T-75 and T-40 for Hour Ending 18

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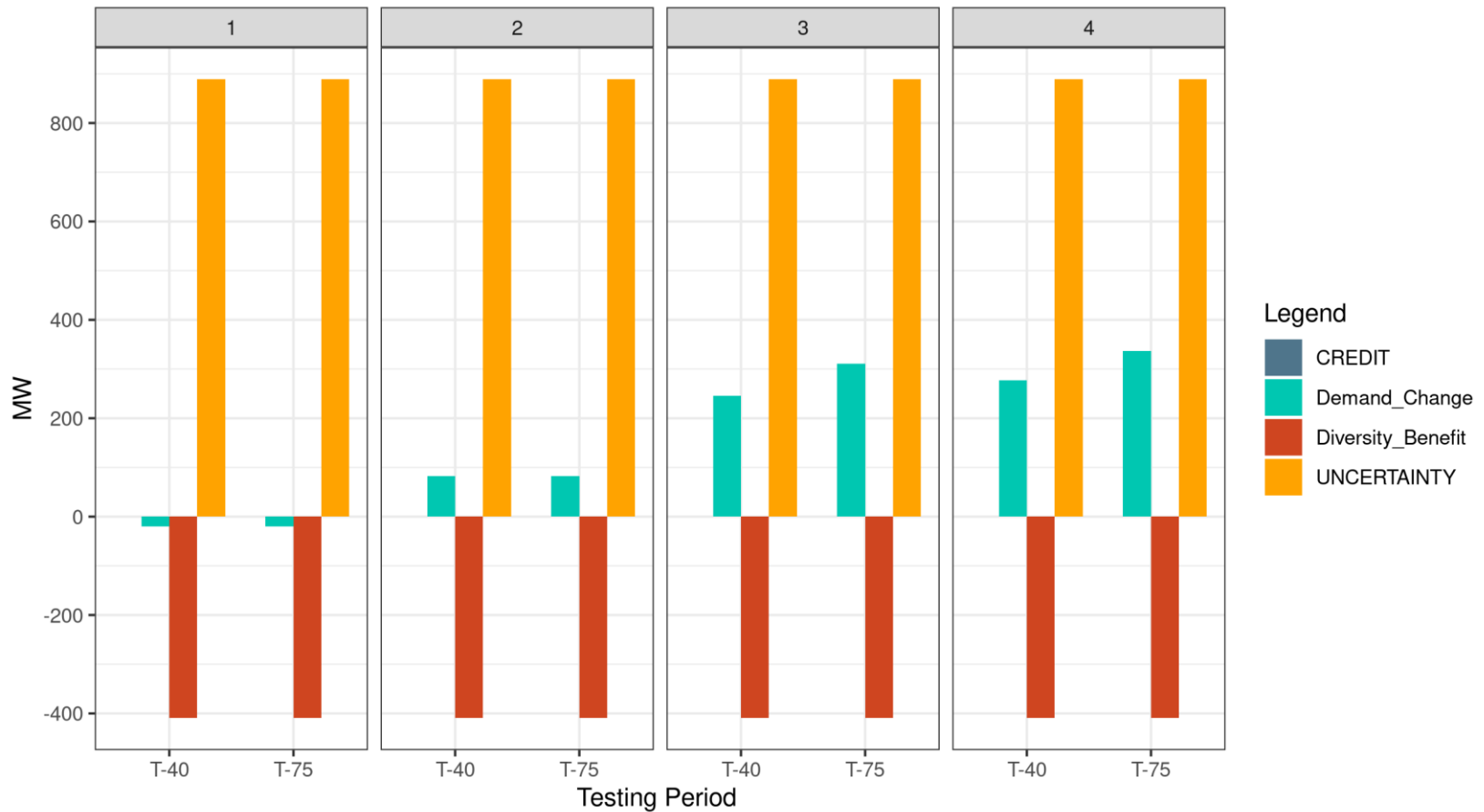
CAISO FRST Requirement and Resource Ramp Capacity Hour Ending 17

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CAISO FRST Requirement and Resource Ramp Capacity Hour Ending 18
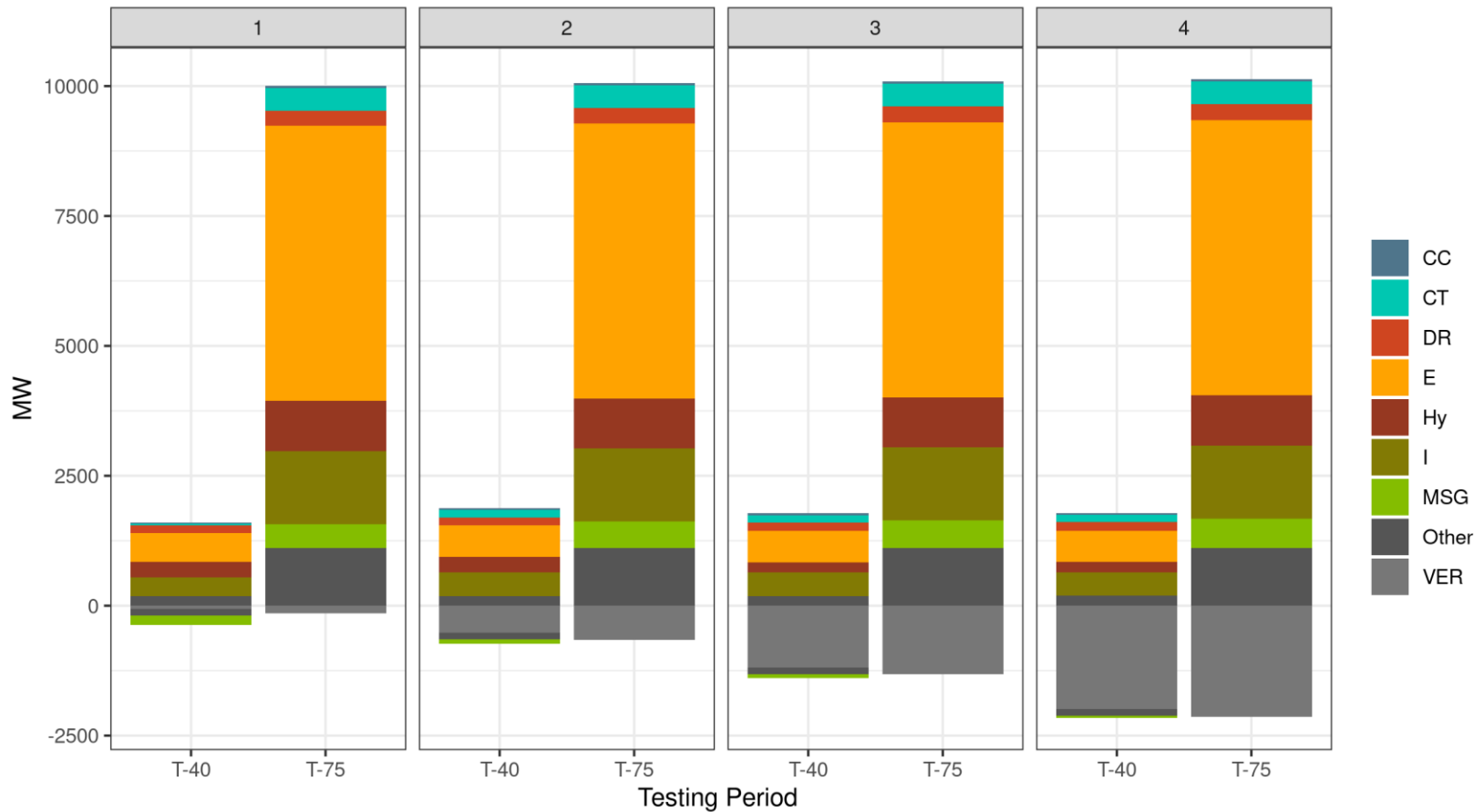
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CAISO FRST Resource Ramp Capacity by Unit Type Hour Ending 17

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CAISO FRST Resource Ramp Capacity by Unit Type Hour Ending 18

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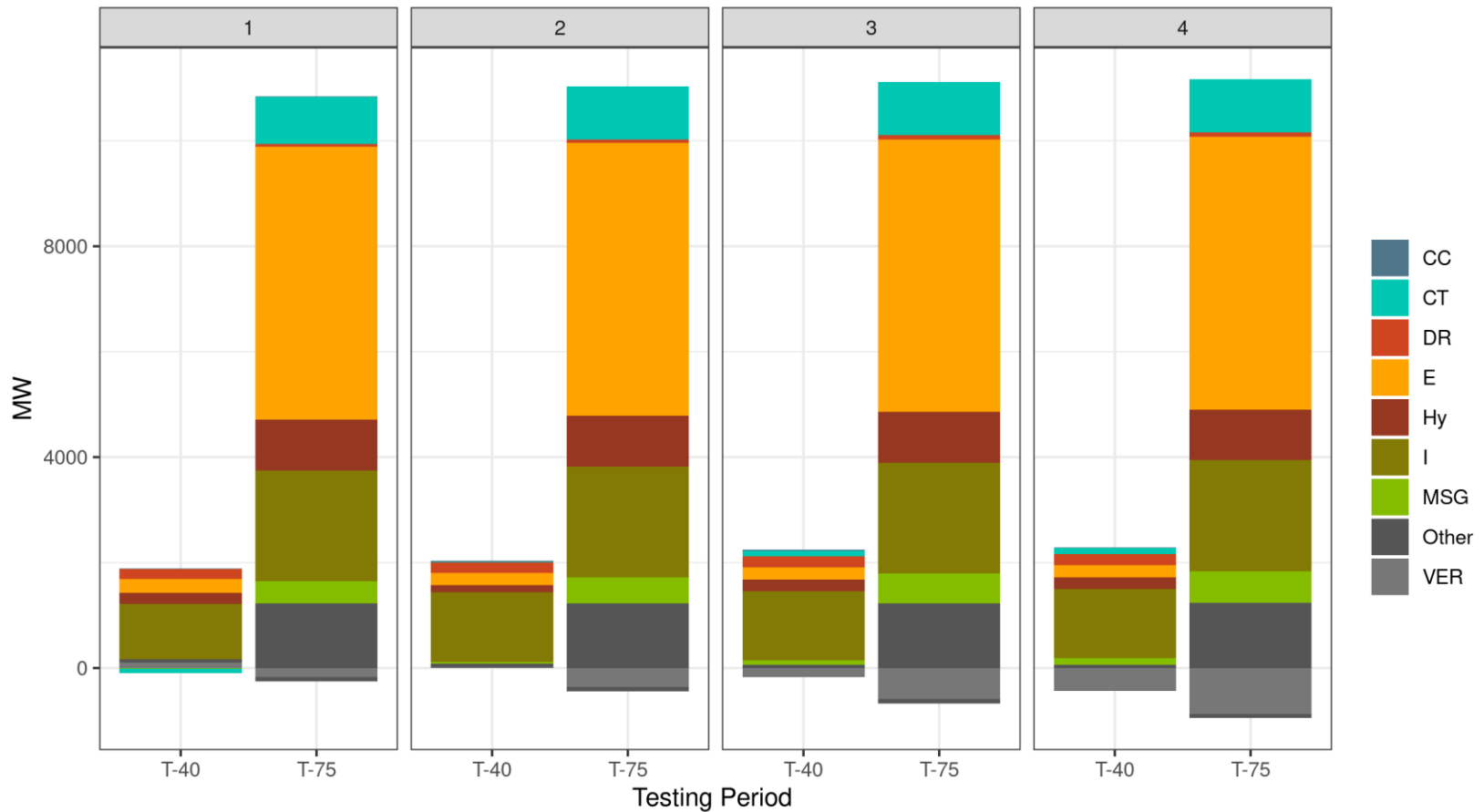
Schedule (1 of 2)

Date	Milestones
Jan 12	Workshop on export and load scheduling priorities
Jan 13	Workshop on EIM resource sufficiency evaluation
Jan 14	Comments due on Jan 6 call discussion/presentation
Jan 20	Comments due – Jan 12-13 workshop discussions/presentations
Jan 22*	Post straw proposal
Jan 26 or 27*	Stakeholder call
Feb 3*	Comments due

*TBD

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Schedule (2 of 2)

Date	Milestones
Feb 8-12*	Post draft final proposal (board memo), business requirement specifications, and tariff language
Feb 16-18*	Stakeholder call
Feb 25*	Comments due – draft final proposal and draft tariff language
Mar 10	EIM Governing Body meeting
Mar 24-25	ISO Board of Governors meeting
Jun 1	Implementation

*TBD

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Next Steps

- Meeting details are available on the initiative webpage at https://stakeholdercenter.caiso.com/StakeholderInitiatives/Market-enhancements-for-summer-2021-readiness

- Submit comments on the workshop presentations and discussions by Jan. 20 using the comment template on the initiative webpage at link above.

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