Real-Time Market Insights Forum

10 October 2023

Hosted by the WA Real-Time Market Monitoring Team

Please send questions, feedback and ideas to:
wa.rtm@aemo.com.au

Disclaimer

This material provides general information about the operation of the Western Australian Wholesale Electricity Market (WEM).

The information may be subject to specific exceptions or may not apply to particular circumstances.

To fully understand their obligations, participants should refer to the WEM Rules and WEM Procedures.

AEMO has taken all due care in preparing this material but accepts no liability for any errors it may contain.

AEMO Competition Law & Meeting Protocol

AEMO is committed to complying with all applicable laws, including the Competition and Consumer Act 2010 (CCA). In any dealings with AEMO regarding proposed reforms or other initiatives, all participants agree to adhere to the CCA at all times and to comply with this Protocol. Participants must arrange for their representatives to be briefed on competition law risks and obligations.

Participants in AEMO discussions **must**:

- Ensure that discussions are limited to the matters contemplated by the agenda for the discussion
- Make independent and unilateral decisions about their commercial positions and approach in relation to the matters under discussion with AEMO
- Immediately and clearly raise an objection with AEMO or the Chair of the meeting if a matter is discussed that the participant is concerned may give rise to competition law risks or a breach of this Protocol.

Participants in AEMO meetings **must not** discuss or agree on the following topics:

- Which customers they will supply or market to
- The price or other terms at which Participants will supply
- Bids or tenders, including the nature of a bid that a Participant intends to make or whether the Participant will participate in the bid
- Which suppliers Participants will acquire from (or the price or other terms on which they acquire goods or services)
- Refusing to supply a person or company access to any products, services or inputs they require.

Under no circumstances must Participants share Competitively Sensitive Information. Competitively Sensitive Information means confidential information relating to a Participant which if disclosed to a competitor could affect its current or future commercial strategies, such as pricing information, customer terms and conditions, supply terms and conditions, sales, marketing or procurement strategies, product development, margins, costs, capacity or production planning.

Agenda

#	Time	Item	Speaker
1	13:00 – 13:15	• Welcome, Terms of Reference (ToR) and RTM Insights Forum (RIF) Overview. • Quick recap of 1st week of the Real-Time Market.	Rick Dolling
3	13:15 – 13:30	Available vs In-Service Real-Time Market Submissions (RTMS).	Erika Canuti
4	13:30 – 13:45	Co-Optimisation of the largest contingency.	Sophie Burgess
5	13:45 – 14:00	ESS Pre-processing Update	Adrian Pearce
6	14:00 – 14:15	Affected Dispatch Intervals review.	Rachel Tandy
7	14:15 – 14:30	Questions, feedback and ideas.	Rick Dolling

Terms of Reference

Presenter	Rick Dolling
Purpose	Provide a summary of the Terms of Reference of the RIF.
Driver	-
Outcome	Market Participants understand the purpose and scope of the RIF, and its relationship to other forums.

Objectives

The role and objectives of the RIF is to:

- To enable effective engagement between AEMO and Market Participants on the operation of, and matters relating to, the WEM RTM and WEMDE.
- To provide Market Participants with analysis and insights regarding the operation and functionality of the RTM and WEMDE.
- To provide Market Participants and AEMO with the opportunity to raise and address issues relating to the operation and functionality of the RTM and WEMDE.
- To support Market Participants' understanding of and effective interaction with the RTM with respect to RTM Submissions.
- To provide Market Participants with an opportunity to share information and insights regarding the operation and functionality of the RTM and WEMDE.

The relationship to other forums:

Forum	Hight Level Summary
Industry Testing Forum (ITF)	Provide information and updates regarding the IT system and operational process changes related to the WEM Reform program.
WEM Reform Implementation Group (WRIG)	Information on discussion on WEM reform, changes to WEM Rules and WEM Procedures.
WA Electricity Consultative Forum (WAECF)	Enable effective consultation between AEMO and interested and impacted organisations and stakeholders in Western Australia.
WEM Surveillance Metering	ERA, EPWA and AEMO only. Discuss specific market effectiveness and compliance matters.

Key Points

The RIF is a forum available to all WEM Market Participants. Market Participants may nominate representatives to attend by emailing waelectricityforum@aemo.com.au.

Meetings will be typically held weekly on Tuesday from 1:00-2:30 pm, Western Australian local time, via Microsoft Teams. A meeting invitation will be circulated to all nominated attendees ahead of time.

In order to ensure the most up-to-date content is included in the meeting materials, RTMM will not distribute meeting materials in advance, but will aim to publish them on the WEM Website as soon as practicable after each meeting.

RTMM will use examples raised by Market Participants to produce content for the forum where it can do so using publicly available data.

RTMM will respond promptly to questions raised that have operational impacts but may defer responses to general questions to a future RIF.

Forums will not be recorded, interested parties are encouraged to attend Forums to engage in the discussion and ask questions are the meeting.

The RIF is not intended to be a substitute for training. AEMO offers external training to Market Participants if required. For more information on external training, please email energyeducation@aemo.com.au.

Questions, feedback or ideas can be sent to the RTMM team at wa.rtm@aemo.com.au.

Quick recap of first week

- We are currently working through the stabilisation phase of the dispatch cutover process.
- WEMDE performance has stabilised.
- Energy Price stabilising but still reaching Market Price Limits daily.
- RoCoF market has stabilised with prices sitting at $0 most of the time.
- ESS shortfalls occurring, notably in the Contingency Raise and Regulation Raise markets, driving shortfall pricing.

Available and In-Service

Presenter	Erika Canuti
Purpose	Provide an overview of the meaning of Available and In-Service Real-Time Market Submissions and explain the requirement (when) to adjust these RTMS to meet Reserve Capacity Obligations.
Driver	AEMO have observed submission behaviour that does not align to the requirement of the WEM Rules and is causing operational challenges. AEMO has engaged 1:1 with relevant Market Participants but we believe there is value in an overview for all Market Participants.
Outcome	Market Participants understand Available and In-Service requirements.

Rules definitions

- ***In-Service Capacity****: For a Registered Facility in a Dispatch Interval, Injection or Withdrawal capacity that the Market Participant* ***expects to be ready for dispatch in the Dispatch Interval****, allowing for expected operating conditions, commitment and control intentions and the effect of any Outages that have not been rejected for the Registered Facility. To avoid doubt, In-Service Capacity is not limited by the expected availability of intermittent fuels for an Intermittent Generating System such as wind*
- ***Available Capacity****: For a Registered Facility in a Dispatch Interval, Injection or Withdrawal capacity that the Market Participant is* ***not expecting to make ready for dispatch in the Dispatch Interval, but expects to be able to make ready for dispatch in the Dispatch Interval if given notice before the relevant Start Decision Cutoff****, allowing for expected operating conditions and the effect of any Outages that have not been rejected for the Registered Facility. To avoid doubt, Available Capacity is not limited by the expected availability of intermittent fuels for an Intermittent Generating System such as wind.*
- ***Start Decision Cutoff****: For a Registered Facility and Dispatch Interval, the latest time before the start of the Dispatch Interval at which a Market Participant could decide to change a quantity of Available Capacity to In-Service Capacity so as to make the capacity ready for dispatch in that Dispatch Interval, as reflected in its Real-Time Market Submission.*

Example of RTM submissions

Offer for AVAILABLE capacity

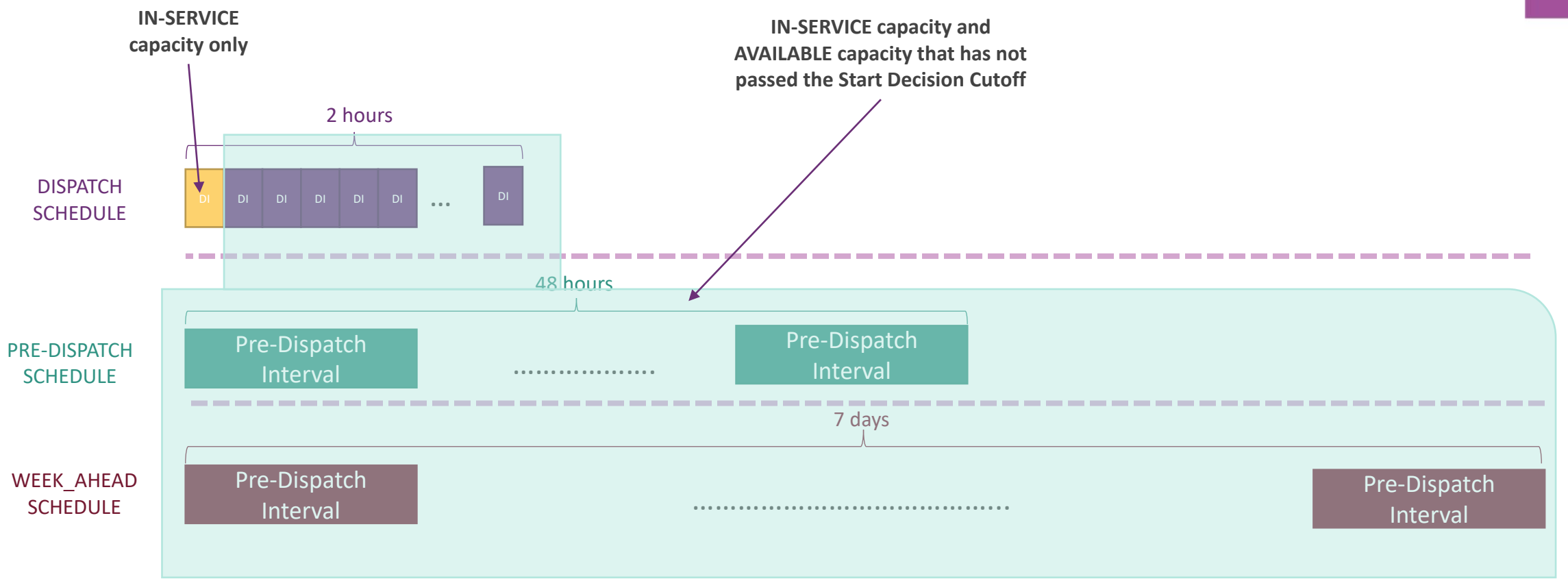

```
"tradingDays": [
  {
    "dateFrom": "2023-10-05",
    "dateTo": "2023-10-05",
    "energy": {
      "facilities": [
        {
          "facilityCode": "FACILITY_ALPHA",
          "dispatchIntervals": [
            {
              "dispatchIntervalFrom": 1,
              "dispatchIntervalTo": 100,
              "unconstrainedInjectionForecast": 0,
              "unconstrainedWithdrawalForecast": 0,
              "maxInjectionCapacity": 100,
              "maxWithdrawalCapacity": 0,
              "inflexibleFlag": "NO",
              "maxUpwardRampRate": 5,
              "maxDownwardRampRate": 5,
              "tranches": [
                {
                  "tranche": 1,
                  "fuelType": "NON-LIQUID",
                  "quantity": 100,
                  "price": 150,
                  "capacityType": "AVAILABLE",
                  "noticeTime": 60
                },

              ]
```


Start Decision Cutoff time

Offer for IN-SERVICE capacity


```
"tradingDays": [
  {
    "dateFrom": "2023-10-05",
    "dateTo": "2023-10-05",
    "energy": {
      "facilities": [
        {
          "facilityCode": "FACILITY_ALPHA",
          "dispatchIntervals": [
            {
              "dispatchIntervalFrom": 95,
              "dispatchIntervalTo": 100,
              "unconstrainedInjectionForecast": 0,
              "unconstrainedWithdrawalForecast": 0,
              "maxInjectionCapacity": 100,
              "maxWithdrawalCapacity": 0,
              "inflexibleFlag": "NO",
              "maxUpwardRampRate": 5,
              "maxDownwardRampRate": 5,
              "tranches": [
                {
                  "tranche": 1,
                  "fuelType": "NON-LIQUID",
                  "quantity": 100,
                  "price": 150,
                  "capacityType": "IN-SERVICE"
                },
```

Use in WEMDE


IN-SERVICE capacity only
IN-SERVICE capacity and AVAILABLE capacity that has not passed the Start Decision Cutoff
2 hours
DISPATCH SCHEDULE
DI
DI
DI
DI
DI
DI
...
DI
48 hours
PRE-DISPATCH SCHEDULE
Pre-Dispatch Interval
.....
Pre-Dispatch Interval
7 days
WEEK_AHEAD SCHEDULE
Pre-Dispatch Interval
.....
Pre-Dispatch Interval

What to do when forecasted to be dispatched

- Market Participants for Facilities that are assigned Capacity Credits are required to present the Facility's capacity at least up to its Reserve Capacity Obligation Quantity in their market submissions as ‘AVAILABLE’ or ‘IN-SERVICE’.
- When a Facility with an AVAILABLE offer is forecasted to be dispatched in a future interval, the relevant Market Participant is required to amend their submissions for the relevant Dispatch Interval to make the capacity IN-SERVICE, before the Start Decision Cutoff time.
- When this is not the case, the Not-In-Service capacity (7.13A) will be subject to capacity refunds.
- Market Participants are encouraged to actively monitor results of all Market Schedules.

Example

- FACILITY_ALPHA has a Standing RTM submission with AVAILABLE capacity for the Energy Market and notice time of 60 minutes.
- From the 12:30 Dispatch Schedule, the Facility is forecasted to be dispatched for Energy at 13:50 and to stay on for a few intervals.
- Taking the 13:50 Dispatch Interval as an example, the Market Participant is required to change FACILITY_ALPHA's offer to IN-SERVICE for that interval before the 12:50 Dispatch Interval schedule for not incurring in No In-Service Capacity Refunds.

Standing submission with AVAILABLE capacity


```
{
  "standing": {
    "comment": "",
    "submissionReason": "Standing",
    "effectiveTradingDateFrom": "2023-10-01",
    "effectiveDispatchIntervalFrom": 1,
    "daysOfTheWeek": [
      {
        "dayOfWeek": "ALL",
        "energy": {
          "facilities": [
            {
              "facilityCode": "FACILITY_ALPHA",
              "dispatchIntervals": [
                {
                  "dispatchIntervalFrom": 1,
                  "dispatchIntervalTo": 288,
                  "unconstrainedInjectionForecast": 0,
                  "unconstrainedWithdrawalForecast": 0,
                  "maxInjectionCapacity": 100,
                  "maxWithdrawalCapacity": 0,
                  "inflexibleFlag": "NO",
                  "maxUpwardRampRate": 5,
                  "maxDownwardRampRate": 5,
                  "tranches": [
                    {
                      "tranche": 1,
                      "fuelType": "NON-LIQUID",
                      "quantity": 100,
                      "price": 300,
                      "capacityType": "AVAILABLE",
                      "noticeTime": 60
```


Variation submission with IN-SERVICE capacity


```
"facilityCode": "FACILITY_ALPHA",
"dispatchIntervals": [
  {
    "dispatchIntervalFrom": 71,
    "dispatchIntervalTo": 74,
    "unconstrainedInjectionForecast": 0,
    "unconstrainedWithdrawalForecast": 0,
    "maxInjectionCapacity": 100,
    "maxWithdrawalCapacity": 0,
    "inflexibleFlag": "NO",
    "maxUpwardRampRate": 5,
    "maxDownwardRampRate": 5,
    "tranches": [
      {
        "tranche": 1,
        "fuelType": "NON-LIQUID",
        "quantity": 100,
        "price": 150,
        "capacityType": "IN-SERVICE"
      },
```


12:30 Dispatch Schedule

Facility Data

Facility	:0	13:25	13:30	13:35	13:40	13:45	13:50	13:55	14:00	14:05	14:10
[redacted]		0	0	0	0	0	1	4	8	28	0

12:50 ..... ← Notice time

Start Decision Cutoff

Not In-Service Capacity

- Section 7.13A of the WEM Rules describes how AEMO calculated Not In-Service Capacity.
- This is used in the calculation of the Reserve Capacity Deficit refund (clauses 4.26.1A, 4.26.1B, 4.26.1D).
- AEMO published the Not In-Service Capacity values for all Facilities after each Dispatch Schedule run.

Co-Optimisation of Largest Contingency

Presenter	Sophie Burgess
Purpose	To provide Market Participants with a recent example of Energy and ESS co-optimisation and how WEMDE handles the largest contingency when it is made up of multiple Facilities.
Driver	• High wind on 2 October early morning led to high output from Yandin and Warradarge wind farms alongside low Karara load making them the largest contingency on the system. • These Wind Farms are part of the MARNET Defined Contingency meaning their output is considered together for the constraint.
Outcome	Dispatch Cap applied by WEMDE to restrict Yandin WF to maintain system security while preferencing to restrict the Facility with the higher loss adjusted price to co-optimise for a lower Market Clearing Price.

Defined Constraint - Largest Contingency

- Generally speaking, the higher the largest contingency is, the higher the amount of Contingency Raise required
  - Note: This is not a direct relationship, it also depends on the performance factor of facilities providing ESS services and behind the meter generation (e.g. Household PV)
- WEMDE may find that a more co-optimised solution is to restrict the largest contingency on the network to reduce the ESS services required
- Yandin and Warradarge Wind Farms are part of the MARNET Defined Contingency
  - Both facilities output are monitored to not exceed transmission capacity of nearby infrastructure and the defined contingency is invoked if there's a risk of overloading
  - When Karara load is high this helps to alleviate this constraint by consuming generation

Outcome

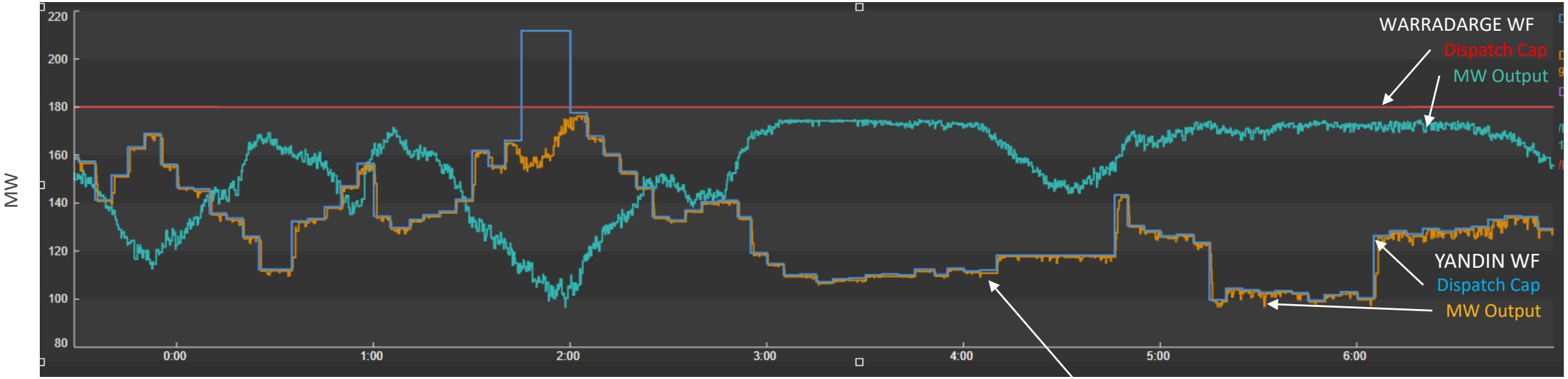
Where to find in the Solution file:


```
},
"contingencySolution": {
    "solvedInertia": 13250.0,
    "solvedContingency": 240.0,
    "contingencyRaiseRequirement": 180.273,
    "contingencyRaiseDeficit": 0.0,
    "demandLevel": 1400.0,
    "clearedContingencyRaise": 234.457,
    "largestContingency": 240.0,
    "contingencyRaiseOffset": 59.727,
    "contingencyLowerOffset": 54.633
```


Check contingencySolution section to see what the largestContingency is


```
"definedContingency": [
    {
        "id": "NIL * {KMP-KEM 91} [LargestContingency]",
        "valueOfContingency": 0.0
    },
    {
        "id": "NIL * {NBT-NT 91, SPS_MARNET} [LargestContingency]",
        "valueOfContingency": 240.0
    }
```


The facility or definedContingency value that matches this is the largest contingency for that dispatch interval



Facility	Loss Factor Adjusted Price
Warradarge WF	-$57.00/MW
Yandin WF	-$52.06/MW

Dispatch Cap applied to YANDIN_WF1 as this was the most economical way to co-optimise the largest contingency in this instance

SCED and Co-Optimisation

- As discussed, WEMDE will co-optimise the Energy and ESS markets, and reduce output from the largest contingency in the Energy market to reduce costs in the Contingency Raise market.
- This is a shift from the legacy Balancing Market where additional SRAS would have been procured to cover the largest contingency (where possible) in order to dispatch according to the BMO.
- There are many examples of this available for review, including the largest thermal generation contingency being reduced.

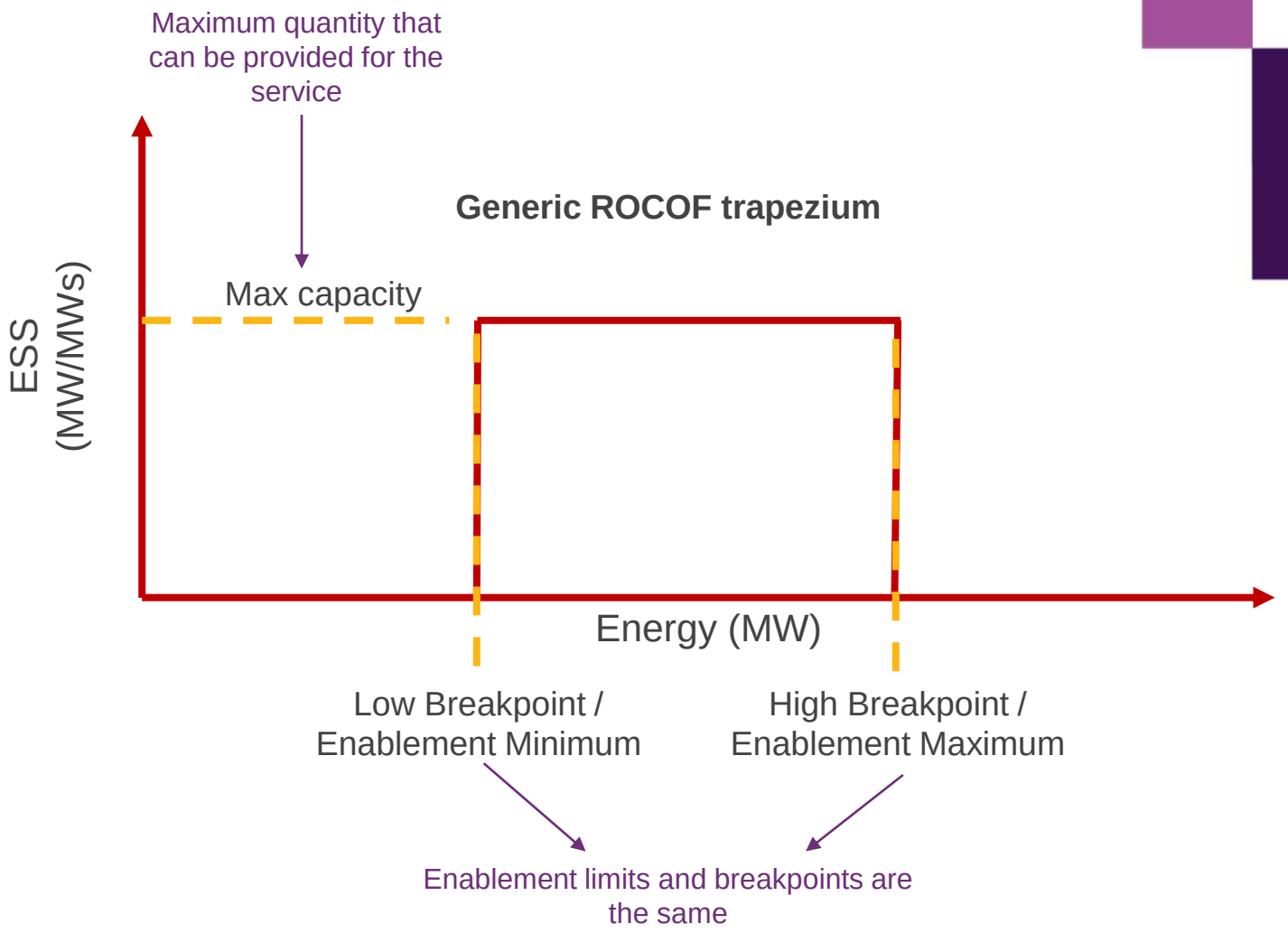
ESS Pre-processing Update

Presenter	Adrian Pearce
Purpose	Provide an overview to Market Participants of the drivers of ESS shortfalls over the first week of the RTM and detail actions AEMO are taking to mitigate this occurring.
Driver	Facilities mandatory droop response pushing Facilities outside of their ESS trapezia is causing facilities to not pass ESS pre-processing.
Outcome	This is causing some market shortfalls and erratic movements in dispatch as Facilities hop in and out of ESS trapezia.

ROCOF Control Service Trapezia

- ROCOF trapezia are squares
- Breakpoints and enablement limits are set at the same points – i.e. there is no trade-off
- Therefore there is a firm cut-off in pre-processing for the initialMW
- This issue applies whenever an ESS trapezium has:

  breakpoint = enablement limit



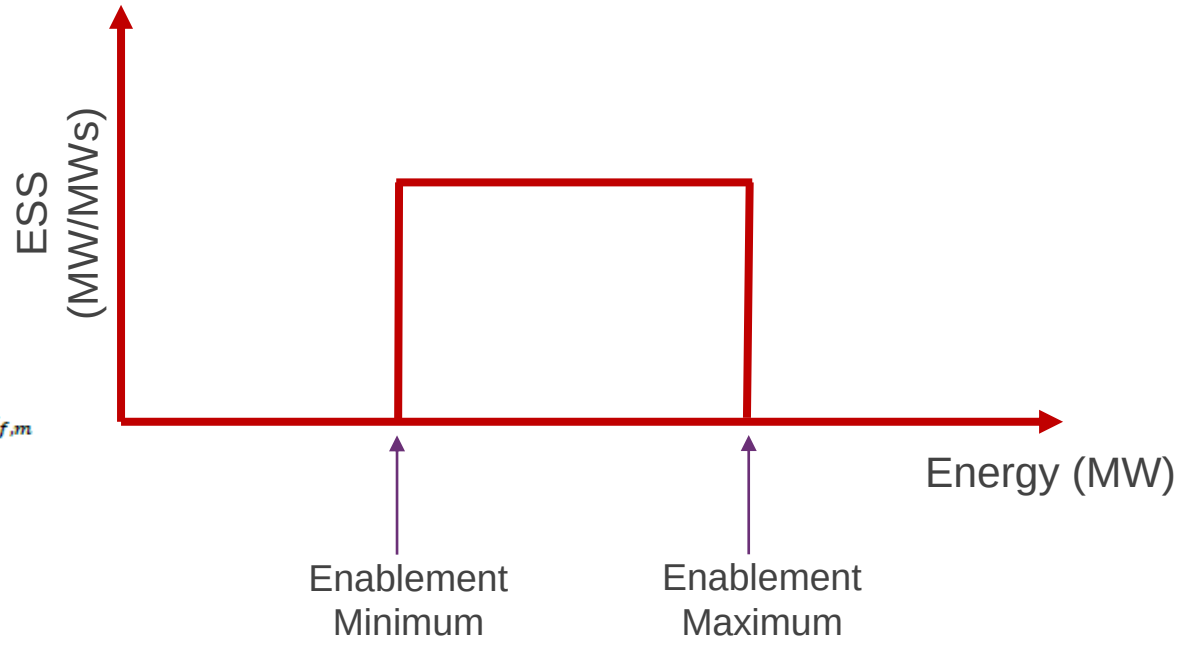
Conditions for ESS enablement

- ESS enablement is assessed in the pre-processor for each facility and each market service they're accredited for.
- Includes the following condition of being inside enablement limits:

2.5.3. ESS Flag Condition 1:

$$EnablementMin_{f,m} \leq EnergyInitialMW_f \leq EnablementMax_{f,m}$$

$$for\ f\ in\ \boldsymbol{F}, for\ m\ in\ \boldsymbol{M}\ where\ m\ \neq energy$$



Droop response

- Droop is the response of a generator to move up or down as the frequency moves.
- In the WEM it is mandatory for generators to provide 4% droop.
- I.e. for a change of frequency by 4% of nominal (2Hz), the generator would move by its rated output.

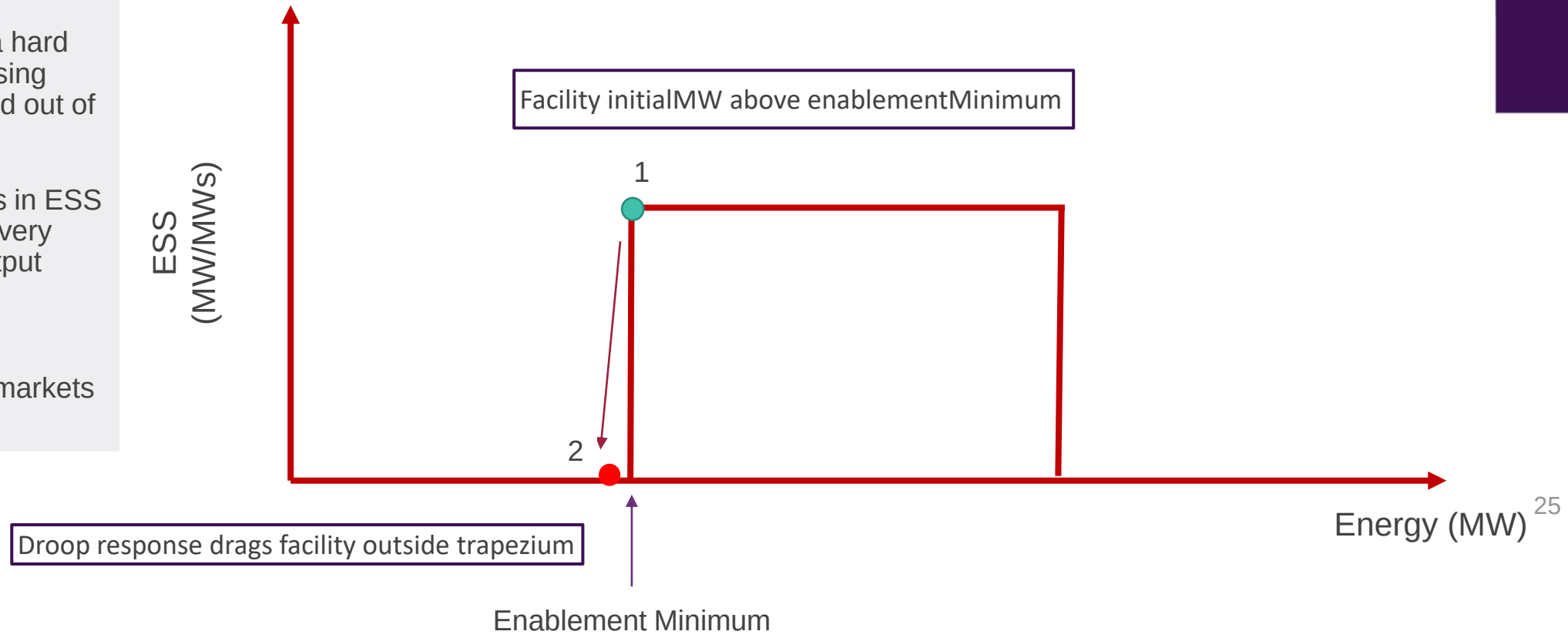
$$droop = \frac{\frac{\Delta f}{f_{nominal}}}{\frac{\Delta P}{P_{rated}}} = 4\%$$

E.g. If frequency moved from 50 Hz to 49.5 Hz and a generator was rated for 100 MW:

$$4\% = \frac{\frac{0.5\ Hz}{50\ Hz}}{\frac{\Delta P\ MW}{100\ MW}} = \frac{0.01 \times 100\ MW}{\Delta P\ MW} \rightarrow \Delta P = 25\ MW$$

Droop pushing facility outside enablement minimum

- Because the enablementLimit is a hard limit, droop was causing facilities to hop in and out of their trapezia
- Resulted in shortfalls in ESS markets because of very small changes in output (impacting prices)
- Resulted in erratic movements in ESS markets



Remedy

- New equations added to Dispatch Algorithm Formulation that provide a buffer to the ESS pre-processing flags regarding enablement limits.
- E.g. the first equation is saying in pre-processing, a buffer of 6% of the enablement min or 3 MW (whatever is greater), will be included in the enablement min.
- Intention is to reduce the amount of excluded ESS capacity caused by small MW changes in output during an interval.

2.5.3. For the purpose of paragraph 2.5.4:

$$IF\ EnablementMin_{f,m} \geq 0$$

$$EnablementMinPreProcessing_{f,m} = EnablementMin_{f,m} - MAX(0.06 * EnablementMin_{f,m}, 3)$$

$$ELSE$$

$$EnablementMinPreProcessing_{f,m} = EnablementMin_{f,m} + MIN(0.06 * EnablementMin_{f,m}, -3)$$

and,

$$IF\ EnablementMax_{f,m} \geq 0$$

$$EnablementMaxPreProcessing_{f,m} = EnablementMax_{f,m} + MAX(0.06 * EnablementMax_{f,m}, 3)$$

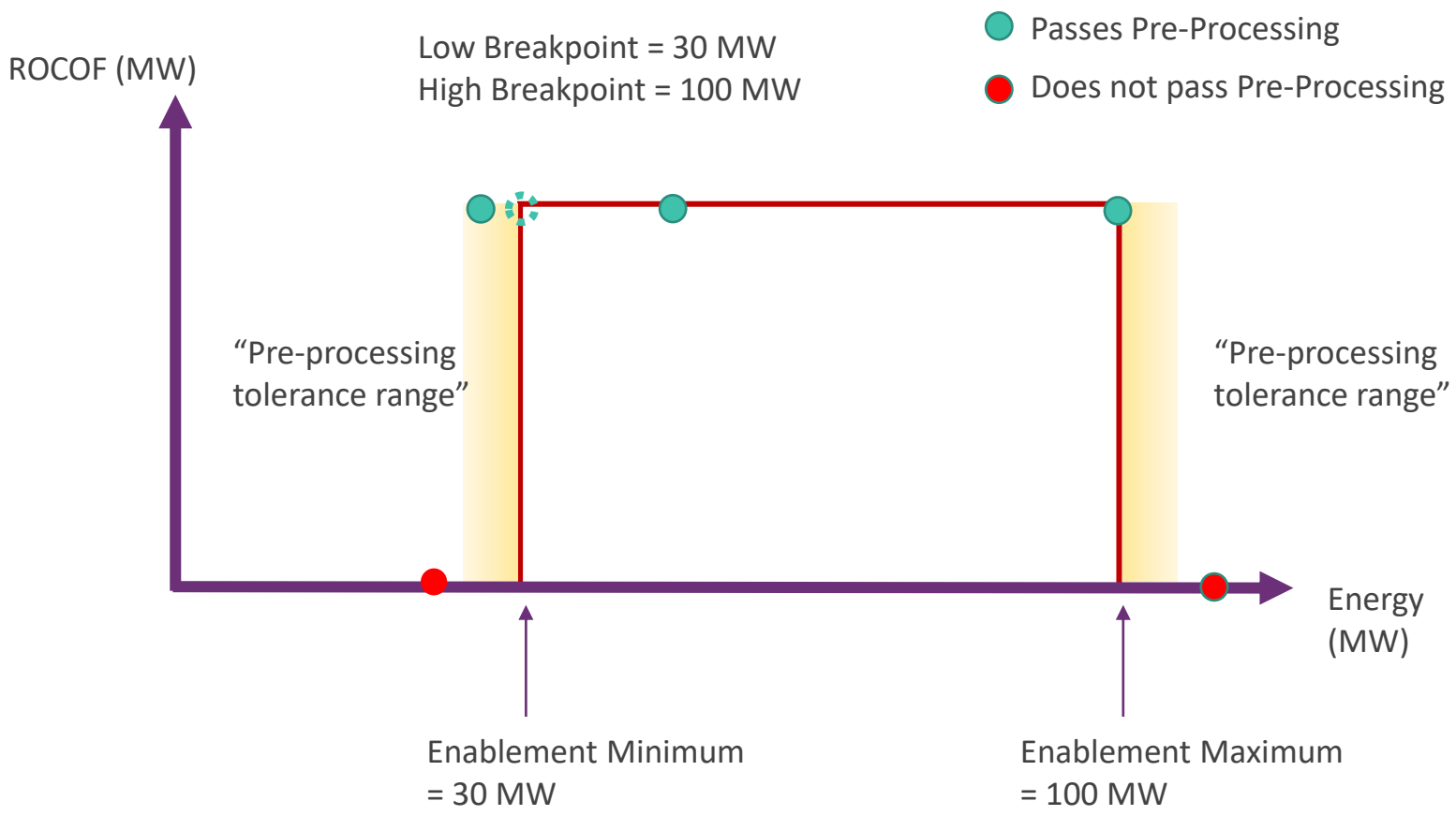
$$ELSE$$

$$EnablementMaxPreProcessing_{f,m} = EnablementMax_{f,m} - MIN(0.06 * EnablementMax_{f,m}, -3)$$

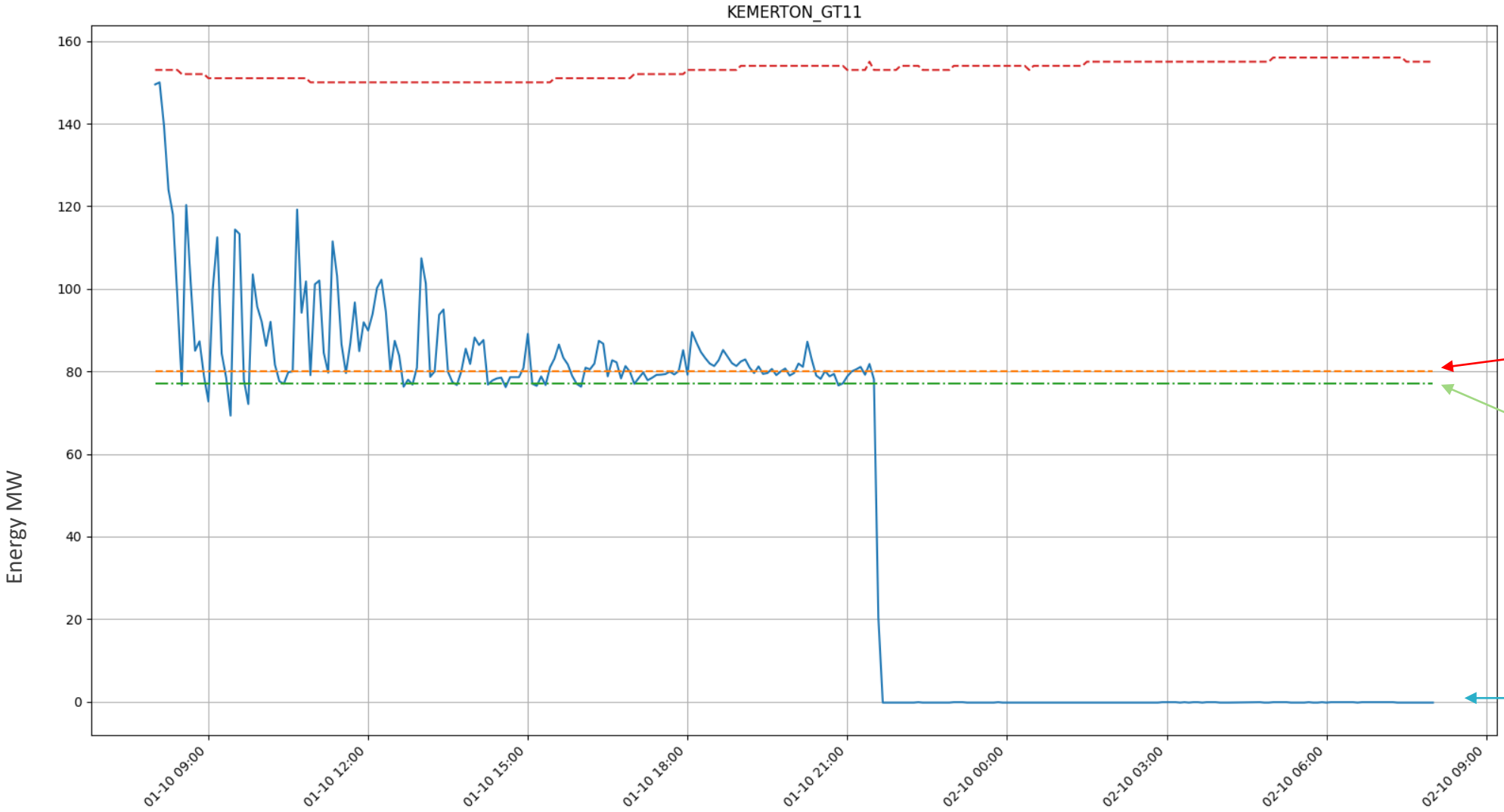
$$for\ f\ in\ \boldsymbol{F}, for\ m\ in\ \boldsymbol{M}\ where\ m\ \neq energy$$

Remedy

New equations provide a buffer zone so that small changes due to droop do not have outsized impacts on the market



Remedy



Pre-equation additions

Post-equation additions

sentOut MW

Affected Dispatch Interval Review

Presenter	Rachel Tandy
Purpose	To provide Market Participant with an overview of AEMO's operational processes around Affected Dispatch Intervals and a status of the analysis for the first week of the RTM.
Driver	Manifestly incorrect data inputs used in WEMDE during the stabilisation phase.
Outcome	38 Dispatch Intervals over Trading Days 1-2 October will be determined as Affected Dispatch Intervals.

Agenda

1. Background
2. Operational processes
3. Reporting and Data Revisions
4. Overview of Affected Dispatch Intervals since 1 October 2023

Background

Affected Dispatch Interval: *A Dispatch Interval for which the Dispatch Algorithm has been used to determine Dispatch Targets, Dispatch Caps and Market Clearing Prices, but the* ***Dispatch Inputs Included manifestly incorrect data*** *that AEMO reasonably considers have caused* ***material differences in Market Clearing Prices*****.** – [WEM Rules, Glossary]

- AEMO has obligations under the WEM Rules surrounding Affected Dispatch Intervals (DIs), including the requirement for:
  - Procedures and processes in place for the identification of Affected DIs
  - Publication and reporting on identified Affected DIs
  - WEM Procedure: Identification of Affected Dispatch Intervals

Identifying Affected Dispatch Intervals

- Current focus of Affected DI investigations is on finding and addressing intervals affected by the RoCoF Trapezium drift
- The primary indicator of a potential Affected Dispatch Interval is where dispatch outcomes do not align with actual system conditions
- Specifically, where dispatch outcomes indicate shortfalls in markets and these shortfalls are not considered true to reality
- Steps to identify these intervals are:

Reporting and Data Revisions

- Under the Rules AEMO:
  - Need to determine Affected DIs by noon the following Business Day, after the end of the relevant Trading Day;
  - release a report as soon as reasonably practical; and
  - include details of any revisions to the Dispatch Inputs that have been made as a result of the Affected DI
- Due to the volume of investigations that have been undertaken since 1 October 2023, AEMO has not published any reports on Affected DIs.
- However, reporting on Affected DIs identified since 1 October 2023 is imminent.

Preliminary Outcomes

- 1 October 2023 to 2 October 2023 *

	Contingency Raise	Contingency Lower	Regulation Raise	Regulation Lower	RoCoF	Total
Number of shortfall intervals	48	7	0	2	14	**71**
True shortfalls identified	16	7	0	2	8	**33**
Intervals deemed Affected Dispatch Intervals	32	0	0	0	6	**38**

* These numbers are approximate based on preliminary outcomes

Questions, Feedback, Ideas

Presenter	Rick Dolling
Purpose	To take questions and seek feedback / ideas from Market Participants on the first RIF.
Driver	-
Outcome	Send any question, feedback or ideas to wa.rtm@aemo.com.au

For more information visit

aemo.com.au