Real-Time Market Insights Forum

24 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	13:05 – 13:30	Verbal Update: Shortfall Pricing	Dora Guzeleva (EPWA)
2	13:30 – 13:50	Cost Allocation of ESS - Provide Market Participants with an understanding of the cost distribution of ESS markets.	Nicholas Nielsen
3	13:50 – 14:00	Inflexibility - Provide Market Participants with an understanding of the 'inflexibleFlag'.	Erika Canuti
4	14:00 – 14:10	Change to Regulation - Explain why Control Room are changing Regulation Market Requirements in real time	Lise Rule
5	14:10 – 14:30	Questions, Feedback, Ideas.	Attendees

Verbal Update: Shortfall Pricing

Presenter	Dora Guzeleva (EPWA)
Purpose	To provide Market Participants with an update on intended actions with respect to shortfall pricing in the ESS markets and seek feedback from Market Participants on implementation.
Driver	Questions from Market Participants with respect to settlement implications of shortfall pricing.
Outcome	1. Market Participants are aware of the intended actions to be undertaken by EPWA with respect to WEM Rules. 2. EPWA receive insight from Market Participants on implications of settlement and preferred approach.

ESS Cost Allocation

Presenter	Nicholas Nielsen
Purpose	Provide Market Participants with an understanding of the cost distribution of ESS.
Driver	Question at RIF on 17 October 2023.
Outcome	Deeper understanding of cost distribution mechanism of ESS.

Regulation Raise & Lower

- Regulation charges are calculated per *Trading Interval*

- Regulation charges are paid by:
  - *Semi-Scheduled Facilities*
  - *Non-Scheduled Facilities*
  - *Non-Dispatchable Loads*

- Costs are distributed in proportion to *absolute Metered Schedule*

Regulation Charges Example

Participant	Type	MS[1] (MWh)	RCQ[2] (MWh)		RCQ (%)	Total Market Reg. Cost ($)	Reg Charge ($)
A	NSF	+5	5	5	10	$1,000	$100
B	SF	+75	-	25	50		$500
	SF	-3	-				
	SSF	+20	20				
	SSF	-5	5				
C	NDL	-4	4	20	40		$400
	NDL	-5	5				
	NDL	-2	2				
	NDL	-6	6				
	NDL	+2	2				
	NDL	+1	1				

[1] MS = Metered Schedule

[2] RCQ = Regulation Contributing Quantity

Contingency Lower

- Contingency Lower charges are calculated per *Trading Interval*
- Contingency Lower charges are paid by:
  - *Registered Facilities*
  - *Non-Dispatchable Loads*
- Costs are distributed in proportion to metered *Withdrawal*.

CL Charges Example

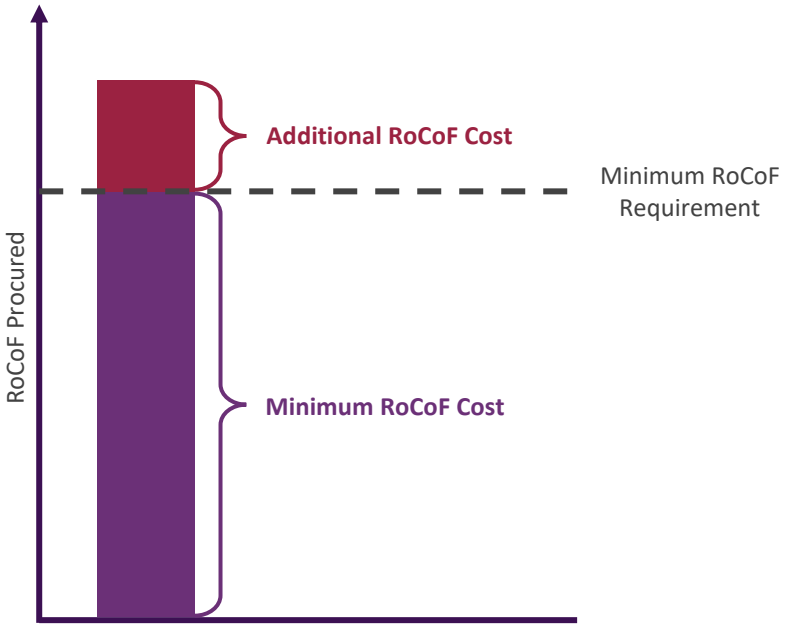
Participant	Type	MS[1] (MWh)	CCQ[2] (MWh)		CCQ (%)	Total Market CL Cost ($)	CLCharge ($)
A	NSF	+5	-	-	-	$1,000	$0
B	SF	+75	-	8	32		$320
	SF	-3	3				
	SSF	+20	-				
	SSF	-5	5				
C	NDL	-4	4	17	68		$680
	NDL	-5	5				
	NDL	-2	2				
	NDL	-6	6				
	NDL	+2	-				
	NDL	+1	-				

[1] MS = Metered Schedule

[2] CCQ = Consumption Contributing Quantity

RoCoF

- RoCoF charges are divided in two components:
  - *Minimum RoCoF Cost*
  - *Additional RoCoF Cost*
- AEMO sets a Minimum RoCoF Requirement.
- Minimum RoCoF Cost is the cost of procuring the RoCoF to meet this requirement, and is recovered from:
  - *Network Group*
  - *Injection Group*
  - *Offtake Group*
- Procuring additional RoCoF can offset Contingency Raise requirements while resulting in a lower overall cost from the market.
  - *Therefore, Additional RoCoF Costs are shared in the same manner as Contingency Raise Costs.*



Minimum RoCoF Costs

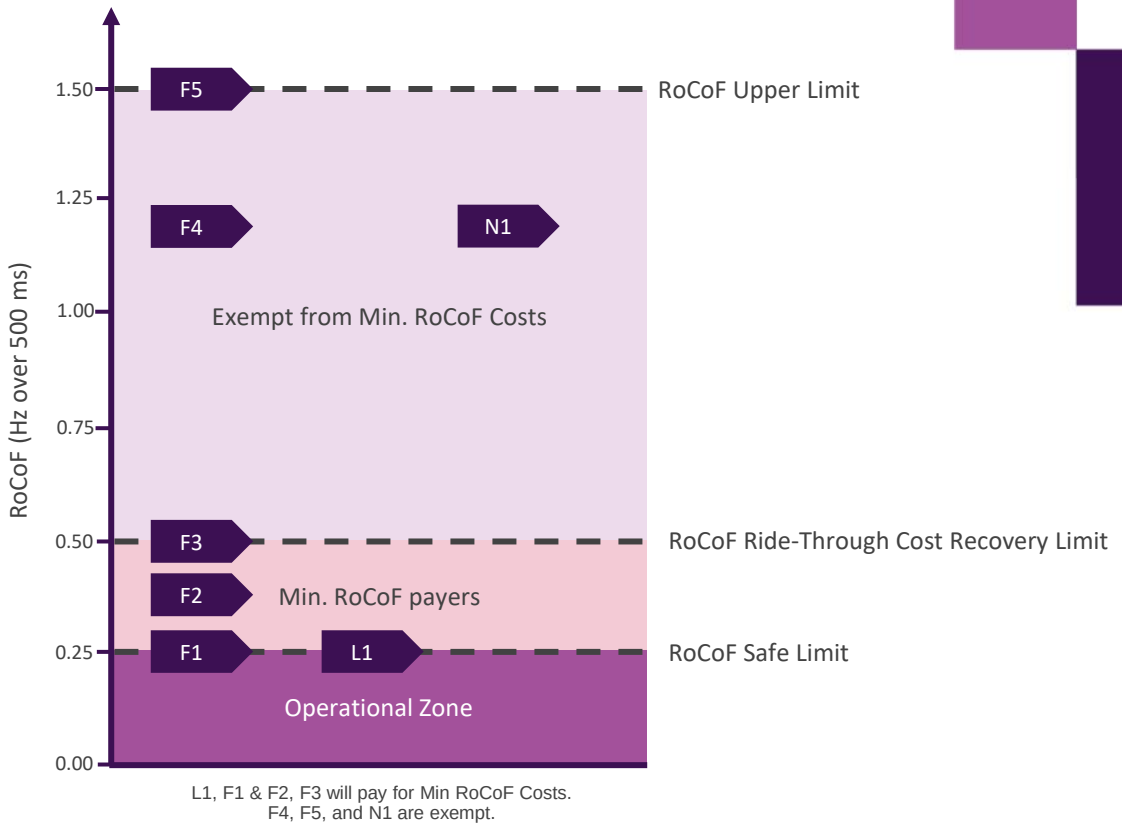
- Min. RoCoF Cost charges are calculated per *Trading Interval*.

- Costs are recovered from three groups:
  - *Network Group:* Networks
  - *Injection Group:* Scheduled, Semi-Scheduled, & Non-Scheduled Facilities, that aren't Pure Loads
  - *Offtake Group:* Non-Dispatchable Loads & Pure Loads

- However, some Facilities are exempt from these charges.

Min. RoCoF Cost Exemption

- Facilities' RoCoF Ride-Through Capability are by default set at the Safe Limit, but Facilities may be accredited with higher capabilities by applying to AEMO.
  - For information, see our website or contact wa.operations@aemo.com.au
- AEMO determines a RoCoF Ride-Through Cost Recovery Limit.
- Facilities (including Loads) are exempt from Min RoCoF Costs if:
  - Their accredited *RoCoF Ride Through Capability* is higher than the *RoCoF Ride-Through Cost Recovery Limit*



Min RoCoF Charge Example (1)

Step 1: Group Share

- Costs are recovered *equally* from the Network, Injection, and Offtake groups.
- If the Network or Injection groups include no Facilities at or below the Cost Recovery Limit, then that group pays no costs.

Example 1	Network	Injection	Offtake
Contains at least one non-exempt Facility:	Y	Y	Y
Group Share:	0.3333	0.3333	0.3333
Market Cost:		$3,000	
Group Share ($):	$1,000	$1,000	$1,000

Example 2	Network	Injection	Offtake
Contains at least one non-exempt Facility:	N	Y	Y
Group Share:	0	0.5	0.5
Market Cost:		$3,000	
Group Share ($):	-	$1,500	$1,500

Min RoCoF Charge Example (2)

Step 2: Network Share

- All of the Network Group's costs are assigned to Western Power.

Participant	Network Share	Charge (Example 1)	Charge (Example 2)
Western Power	100%	$1,000	$0
All Others	0%	$0	$0
	Total Market Cost	**$1,000**	**$0**

Min RoCoF Charge Example (3)

Step 3: Injection Share

- Injection Share is proportional to the absolute Metered Schedule of the Participant's Scheduled, Semi-Scheduled, and Non-Scheduled Facilities.

Part.	Type	MS[1] (MWh)	ICQ[2] (MWh)		ICQ (%)	Charge (Example 1)	Charge (Example 2)
A	NSF	+5	5	5	4.8	$48	$72
B	SF	+75	75	75	71.4	$714	$1,071
	SF	-3	3				
	NDL	-4	-				
	NDL	-5	-				
C	SSF	+20	20	25	23.8	$238	$357
	SSF	-5	5				
	NDL	-2	-				
	NDL	-6	-				
	NDL	+2	-				
	NDL	+1	-				
Total Market Cost (Injection Group):						**$1,000**	**$1,500**

[1] MS = Metered Schedule

[2] ICQ = Injection Contributing Quantity

Min RoCoF Charge Example (4)

Step 4: Offtake Share

- Injection Share is proportional to the absolute Metered Schedule of the Participant's Non-Dispatchable Loads & Pure Loads.

Part.	Type	MS[1] (MWh)	OCQ[2] (MWh)		OCQ (%)	Charge (Example 1)	Charge (Example 2)
A	NSF	+5	-	-	-	$0	$0
B	SF	+75	-	9	45	$450	$675
	SF	-3	-				
	NDL	-4	4				
	NDL	-5	5				
C	SSF	+20	-	11	55	$550	$825
	SSF	-5	-				
	NDL	-2	2				
	NDL	-6	6				
	NDL	+2	2				
	NDL	+1	1				
Total Market Cost (Offtake Group):						**$1,000**	**$1,500**

[1] MS = Metered Schedule

[2] OCQ = Offtake Contributing Quantity

Min RoCoF Total Charge

Participant	Network Share Charge	Injection Share Charge	Offtake Share Charge	Min RoCoF Charge
A	$0	$48	$0	$48
B	$0	$714	$450	$1,164
C	$0	$238	$550	$788
Western Power	$1,000	$0	$0	$1,000

Participant	Network Share Charge	Injection Share Charge	Offtake Share Charge	Min RoCoF Charge
A	$0	$72	$0	$72
B	$0	$1,071	$675	$1,746
C	$0	$357	$825	$1,182
Western Power	$0	$0	$0	$0

Contingency Raise (& Add. RoCoF)

- Contingency Raise & Additional RoCoF charges are calculated per *Dispatch Interval*.
- Costs are assigned in accordance with the Total Runway Share, which is based on Facility Risk.
- Costs are recovered from:
  - *Scheduled, Semi-Scheduled and Non-Scheduled Facilities, and*
  - *Energy Producing Systems serving Intermittent Loads*

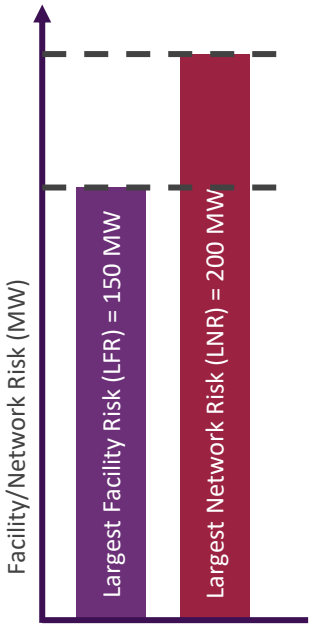
  with Facility Risk >= 10 MW
- Facility Risk is equal to:
  - For most Facilities, the quantity cleared in the Real-Time Market for Energy + Regulation Raise
  - For some Energy Producing Systems suppling Intermittent Loads, the average MW output measured by SCADA

Total Runway Share

- Total Runway Share has two components:
  - *Facility Runway Share*
  - *Network Runway Share*

- The total weighting of the Network Runway Share is proportionate to how much the largest Network Risk exceeds the largest Facility Risk by.
  - A Network Runway Share is not calculated if the largest Network Risk does not exceed the largest Facility Risk.

- The Network Risk of a Network Contingency is equal to the sum of the Facility Risks associated with the Network Risk, less any associated forecast load consumption.



$$Network\ Share = \frac{max(0, LNR - LFR)}{LNR}$$

$$= \frac{max(0,50)}{200}$$

$$= 25\%$$

In this example, when calculating the Total Runway Share, the Network Runway Share will be given 25% weighting while the Facility Runway Share will be given 75% weighting.

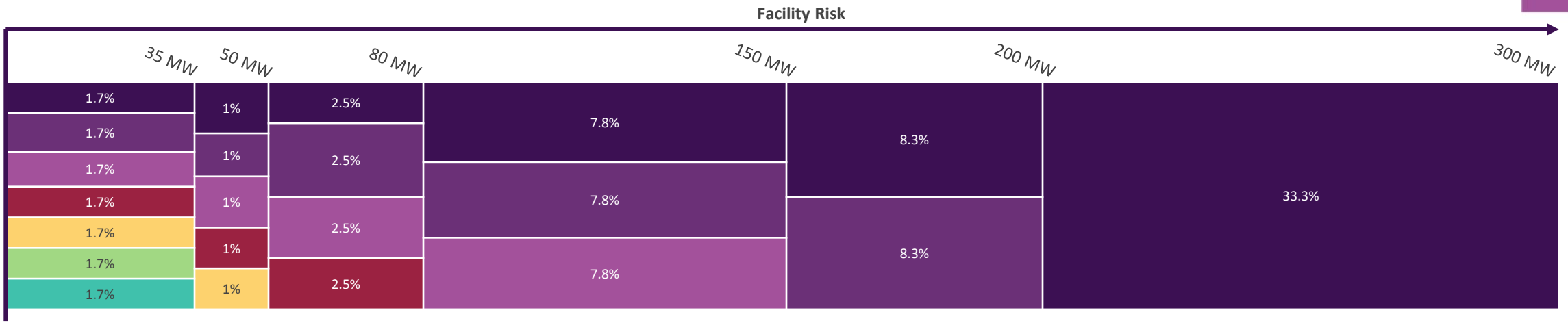
Runway Methodology

- Both Network & Facility Runway Shares are calculated following the same runway methodology.
  - Note Facilities with Facility Risk < 10 MW are excluded from the runway.

- The methodology assigns proportionately higher costs to Facilities with higher Facility Risk, reflecting the higher risk they pose to the system if they trip.

- The following slide visualises the runway methodology which is applicable to both Network & Facility Runway shares.

Runway Methodology



Facility:	A	B	C	D	E	F	G
Share:	54.6%	21.3%	13.0%	5.2%	2.7%	1.7%	1.7%

- This methodology is carried out twice using different sets of Facilities:
  - *Facility Runway Share:* All Scheduled, Semi-Scheduled and Non-Scheduled Facilities, and Energy Producing Systems serving Intermittent Loads with a Facility Risk >= 10 MW
  - *Network Runway Share:* A subset of the above set, containing only the Facilities that are associated with the Network Contingency with the largest Network Risk.

Total Runway Share

Participant	Facility	Facility Runway Share	FRS Weighting	Weighted FRS	Network Runway Share[1]	NRS Weighting	Weighted NRS	Total Runway Share
A	A	54.6%	75%	40.9%	100%	25%	25%	65.9%
B	B	21.3%		15.9%	-		-	15.9%
C	C	13%		9.7%	-		-	15.6%
	D	5.2%		3.9%	-		-	
	E	2.7%		2.0%	-		-	
D	F	1.7%		1.3%	-		-	2.6%
	G	1.7%		1.3%	-		-	

[1] For this example, we have assumed that only Facility A was associated with the Network Contingency with the highest Network Risk

CR & Add. RoCoF Cost Allocation

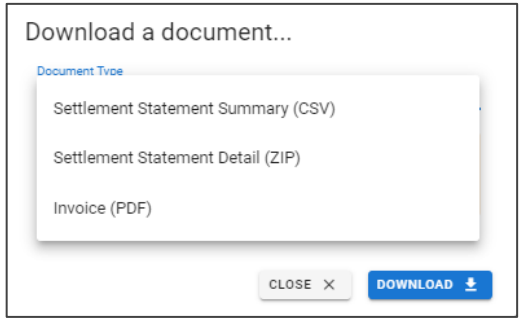
Participant	TRS	Market Total Contingency Raise Cost	Contingency Raise Charge	Market Total Add. RoCoF Cost	Add. RoCoF Charge
A	65.9%	$1,000	$659	$1,000	$659
B	15.9%		$159		$159
C	15.6%		$156		$156
D	2.6%		$26		$26

More Information

- For more general information, consult:
  - The WEM Rules, available on EPWA's website
  - The WEM Metering Settlement and Prudential Calculations handbook, available on AEMO's Settlement Technical Guides web page

More Information

- Participants can view their payments and charges in *WEMS MPI* > *Settlement* > *Prudentials-Settlements*:
  - For Settlement Data, go to Settlements > WEM > Select Dates > Click the relevant invoice value > Download ‘Settlement Statement Detail’ or ‘Settlement Statement Summary’.



  - For Prudential estimate data, go to Prudentials > ‘Download Summary’ or ‘Download Details’

- Variable name definitions are available in the WEM Metering Settlement and Prudential Calculations handbook

Contact

Questions relating to settlements outcomes, payments and prepayments, prudential estimates, and Credit Support may be directed to wa.settlements@aemo.com.au

Inflexibility (general inflexibility)

Presenter	Erika Canuti
Purpose	Provide Market Participants with an understanding of the ‘inflexibleFlag’.
Driver	Participant query.
Outcome	Increased understanding of what it does, when to use and how it is used by WEMDE.

Inflexible Facility

- A Facility is Inflexible when it is only able to be dispatched in a Dispatch Interval for a fixed level of Injection or Withdrawal (Rules definition).
- This is achieved by declaring the Inflexibility in the Real-Time Market Submission through the Inflexible flag.
- When a Facility offers Energy capacity as Inflexible:
  - only 1 tranche is allowed (clause 7.6.31(a)ii);
  - a submission reason must be provided (clause 7.6.31(b)).


```
{
  "variation": {
    "submissionCode": "COMMISSIONING_TEST",
    "submissionReason": "Commissioning test requires fix level of injection",
    "allowGateClosureViolation": "NO",
    "tradingDays": [
      {
        "dateFrom": "2023-10-05",
        "dateTo": "2023-10-05",
        "energy": {
          "facilities": [
            {
              "facilityCode": "FACILITY",
              "dispatchIntervals": [
                {
                  "dispatchIntervalFrom": 100,
                  "dispatchIntervalTo": 150,
                  "unconstrainedInjectionForecast": 50.0,
                  "unconstrainedWithdrawalForecast": 0.0,
                  "maxInjectionCapacity": 50.0,
                  "maxWithdrawalCapacity": 0.0,
                  "inflexibleFlag": "YES",
                  "maxUpwardRampRate": 7.0,
                  "maxDownwardRampRate": 7.0,
                  "tranches": [
                    {
                      "tranche": 1,
                      "fuelType": "NON-LIQUID",
                      "quantity": 50.0,
                      "price": 0.0,
                      "capacityType": "IN-SERVICE",
                      "noticeTime": 0
                    }
                  ]
```

When to use the Inflexible Flag in submission

- The Inflexible flag must be used when a Market Participant reasonably expects that its Scheduled Facility or Semi-Scheduled Facility will be unable to comply with a Dispatch Instruction for the Registered Facility in a future Dispatch Interval (clause 7.6.31)
- Examples:
  - The facility needs to operate at a specific level for a period for technical reasons
  - The facility is undertaking a test or is experiencing a temporary fault that requires the facility to generate a specific quantity for specific intervals.

How WEMDE treats Inflexibility

- WEMDE takes the Inflexibility of Facilities into account in the Dispatch Algorithm and dispatch in a Dispatch Interval in accordance with their inflexible capacities (clause 7.6.32).
- Where a Facility offers its capacity as Inflexible, the submitted price for the facility in the RTMS for that facility **does not** form part of the calculation of the Market Clearing Price for that Market Service in the relevant Dispatch Interval (7.11A.1(d)).
- When a Facility offers capacity as Inflexible does not pass ESS pre-processing for all ESS Market Services (except for RoCoF), hence cannot be dispatched for ESS (section 2.5.1(a)ii of the WEM Procedure: Dispatch Algorithm Formulation).

Example

Submission with Inflexible Flag ON


```
"tradingDays": [
  {
    "dateFrom": "2023-10-11",
    "dateTo": "2023-10-11",
    "energy": {
      "facilities": [
        {
          "facilityCode": "NEWGEN_KWINANA_CCG1",
          "dispatchIntervals": [
            {
              "dispatchIntervalFrom": 187,
              "dispatchIntervalTo": 234,
              "unconstrainedInjectionForecast": 0,
              "unconstrainedWithdrawalForecast": 0,
              "maxInjectionCapacity": 164,
              "maxWithdrawalCapacity": 0,
              "inflexibleFlag": "YES",
              "maxUpwardRampRate": 6,
              "maxDownwardRampRate": 6,
              "tranches": [
                {
                  "tranche": 1,
                  "fuelType": "NON-LIQUID",
                  "price": -1000,
                  "quantity": 164,
                  "noticeTime": 0,
                  "capacityType": "IN-SERVICE"
                }
```


Submission with Inflexible Flag OFF


```
{
  "dateFrom": "2023-10-11",
  "dateTo": "2023-10-11",
  "energy": {
    "facilities": [
      {
        "facilityCode": "NEWGEN_KWINANA_CCG1",
        "dispatchIntervals": [
          {
            "dispatchIntervalFrom": 235,
            "dispatchIntervalTo": 288,
            "unconstrainedInjectionForecast": 0,
            "unconstrainedWithdrawalForecast": 0,
            "maxInjectionCapacity": 334.8,
            "maxWithdrawalCapacity": 0,
            "inflexibleFlag": "NO",
            "maxUpwardRampRate": 6,
            "maxDownwardRampRate": 6,
            "tranches": [
              {
                "tranche": 1,
                "fuelType": "NON-LIQUID",
                "price": -1000,
                "quantity": 130,
                "noticeTime": 0,
                "capacityType": "IN-SERVICE"
              },
              {
                "tranche": 2,
                "fuelType": "NON-LIQUID",
                "price": 57.79,
                "quantity": 20,
                "noticeTime": 0,
                "capacityType": "IN-SERVICE"
              },
              {
                "tranche": 3,
                "fuelType": "NON-LIQUID",
```


	PrimaryDispatchInterval	FacilityCode	Energy_schedule	essFlag_CR	essFlag_RegR	essFlag_CL	essFlag_RegL	essFlag_rocof
1	2023-10-12 03:20:00.000	NEWGEN_KWINANA_CCG1	164.000	0	0	0	0	1
2	2023-10-12 03:25:00.000	NEWGEN_KWINANA_CCG1	164.000	0	0	0	0	1
3	2023-10-12 03:30:00.000	NEWGEN_KWINANA_CCG1	180.000	0	1	0	1	1

Changes to Regulation

Presenter	Lise Rule
Purpose	Explain why Control Room are changing Regulation Market Requirements in real time.
Driver	Observed behaviour and Market Participant questions on changes in Regulation.
Outcome	Increased understanding of ESS in real time

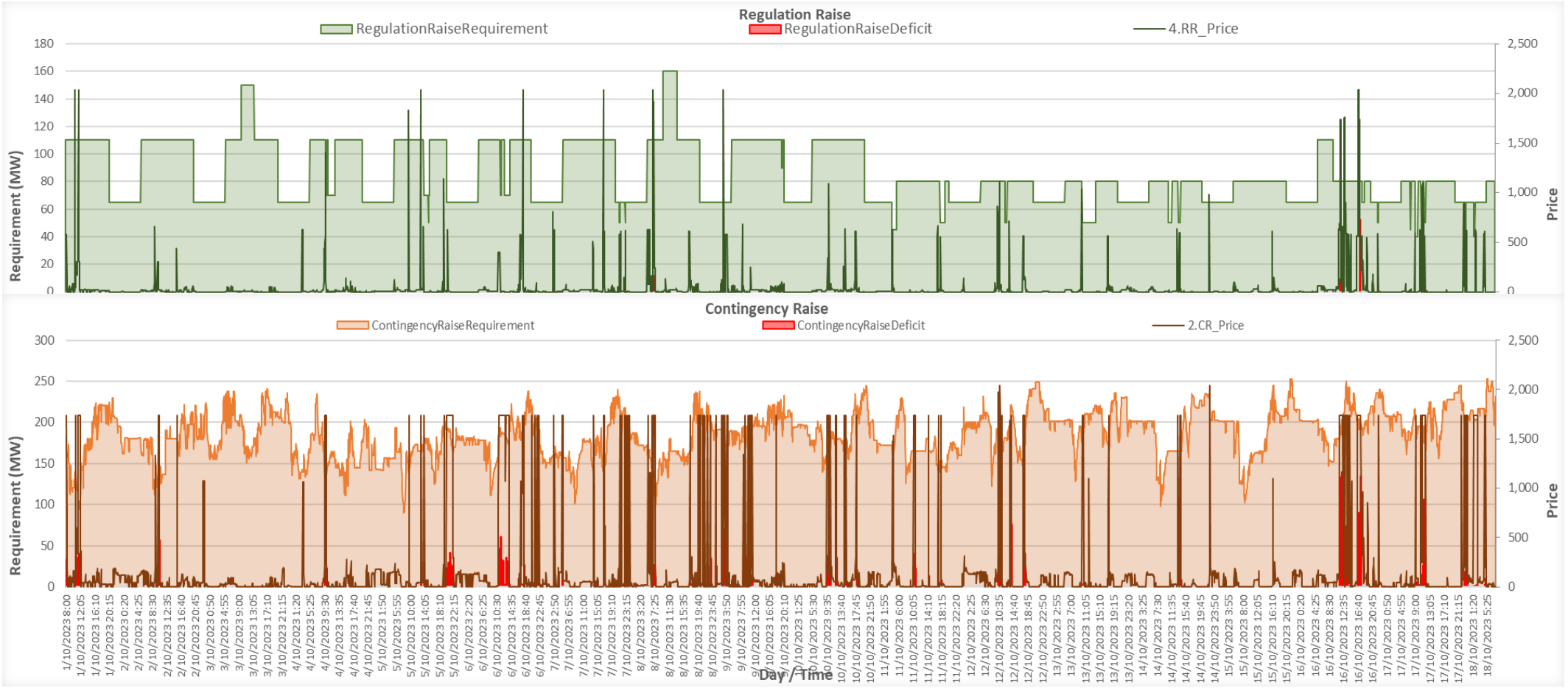
Constraint Violation Penalties

- Constraint Violation Penalties are used in WEMDE to assign a relative “cost” to each constraint when solving the objective function.
- A higher CVP will cost relatively more than a lower CVP.
- WEMDE has a Constraint Violation Penalty for Regulation of 10 and for Contingency of 8. This means that, with everything else being equal, WEMDE will solve with a Contingency deficit before a Regulation deficit.

Constraint Violation Quantity variable name	Section references	Set membership	CVP Value
NSFDeficit	2.4.44	Registered Facility	1175
NSFSurplus	2.4.44	Registered Facility	1175
RampRateDownDeficit	2.4.15, 2.4.16	Registered Facility	1155
RampRateUpSurplus	2.4.13, 2.4.14	Registered Facility	1155
StorageSurplus	2.4.27	Registered Facility	1150
TrancheUBDeficit	2.4.2	Registered Facility, Market Service	1135
TrancheLBDeficit	2.4.3	Registered Facility, Market Service	1135
FSProfileDeficit	2.4.28, 2.4.29, 2.4.30, 2.4.31	Registered Facility	1130
FSProfileSurplus	2.4.28, 2.4.29, 2.4.30, 2.4.31	Registered Facility	1130
UIFSurplus	2.4.41	Registered Facility	385
UWFDeficit	2.4.42	Registered Facility	385
InflexibleFlagDeficit	2.4.32	Registered Facility, Market Service	380
InflexibleFlagSurplus	2.4.32	Registered Facility, Market Service	380
GCDeficit	2.4.27	Generic Constraint Set	300
GCSurplus	2.4.27	Generic Constraint Set	300
DefinedContingencyDeficit	2.4.8	Defined Contingency	160
DefinedContingencySurplus	2.4.8	Defined Contingency	160
JointRampDeficit	2.4.21	Registered Facility, Market Service	155
JointRampSurplus	2.4.20	Registered Facility, Market Service	155
JointCapacityDeficit	2.4.22	Registered Facility, Market Service	155
JointCapacitySurplus	2.4.23	Registered Facility, Market Service	155
ERDeficit	2.4.25	Registered Facility, Market Service	155
ERSurplus	2.4.24	Registered Facility, Market Service	155
EnergySurplus	2.4.1	-	150
EnergyDeficit	2.4.1	-	150
EnablementMinDeficit	2.4.18	Registered Facility, Market Service	70
EnablementMaxSurplus	2.4.19	Registered Facility, Market Service	70
RCSDeficit	2.4.6	-	12
RegulationRaiseDeficit	2.4.10	-	10
RegulationLowerDeficit	2.4.10	-	10
ContingencyRaiseDeficit	2.4.10	-	8
ContingencyLowerDeficit	2.4.10	-	8
MaxESSProvisionPercentageSurplus	2.4.9	Registered Facility	4
TBSlack1	2.4.33, 2.4.34	Tie-Break Set(s)	1e-9
TBSlack2	2.4.33, 2.4.34	Tie-Break Set(s)	1e-9

Contingency Raise Shortfalls

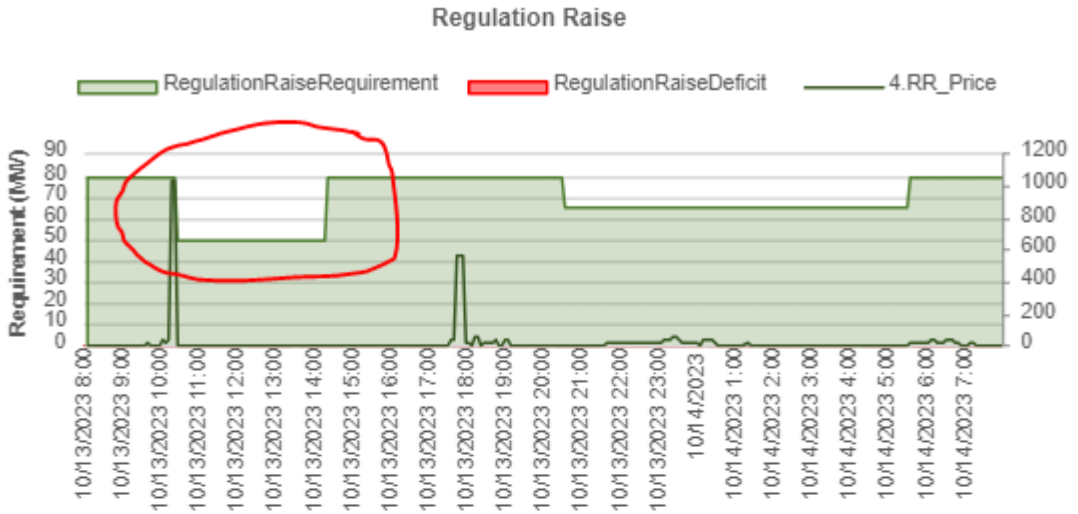
This can be observed when looking at the outcomes in the Regulation Raise (green) vs Contingency Raise (orange) markets.

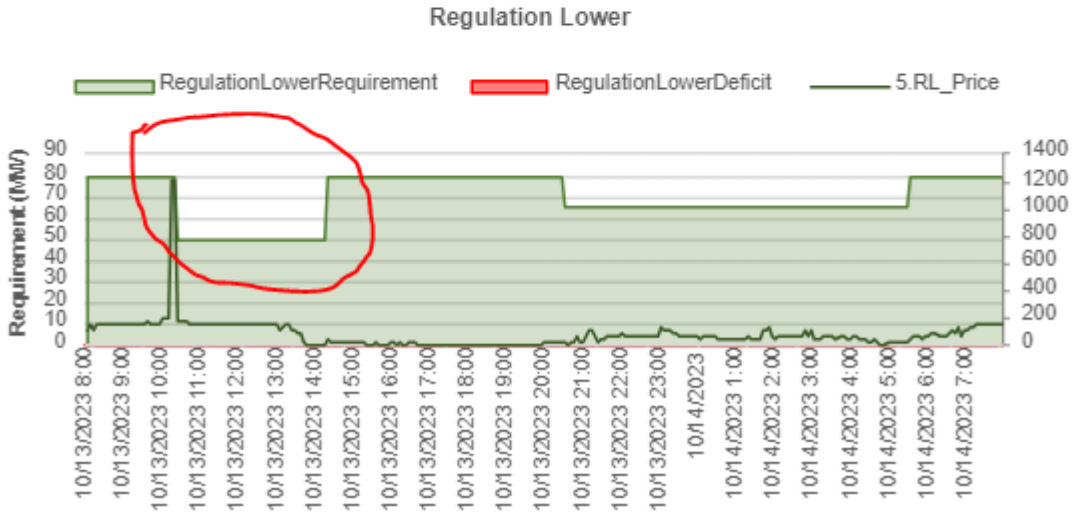


Note – AEMO are still conducting the Affected Dispatch Interval review for Trading Day 5 October onwards.

Regulation Management

- AEMO currently procure up to 110 MW of Regulation Raise during the day, this means AEMO can reduce the Regulation requirements to resolve shortfalls in the Contingency markets where the full amount of regulation is not required due to stable conditions on the power system.
- This could be one from one or multiple Dispatch Intervals.
- This results in:
  - Reduction in Contingency Shortfalls.
  - Improves the mix of ESS and therefore benefits power system security.
  - Avoid needing to turn on another Facility to provide Contingency





Regulation Requirement

- Changes to Regulation are only considered if the power system is stable and trends are showing that less Regulation is being used than required so it won't result in a Regulation shortfall or any risk in real-time.
- In some cases, the full amount of Regulation is required, therefore this action is not available to AEMO. AEMO is in the process of reviewing its "standard" Regulation requirements and may adjust these at some point in future.

Questions, Feedback, Ideas

For more information visit

aemo.com.au