AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

# Reliability and Emergency Reserve Trader (RERT) Quarterly Report Q2 2021

**August 2021**

A report for the National Electricity Market

# Important notice

## PURPOSE

AEMO publishes the Reliability and Emergency Reserve Trader (RERT) Quarterly Report under clause 3.20.6 of the National Electricity Rules.

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# Executive summary

The Reliability and Emergency Reserve Trader (RERT) is an intervention mechanism under the National Electricity Rules (NER) that allows AEMO to contract for emergency reserves, such as generation or demand response, that are not otherwise available in the market. AEMO uses RERT as a safety net in the event that a critical shortfall in reserves is forecast. RERT is activated when all market options have been exhausted, typically during periods when the supply demand balance is tight.

The second quarter of 2021 saw a single RERT activation event, in Queensland on 25 May 2021, to reduce the potential need for post-contingent load shedding in Queensland in the evening after a significant sequence of power system events involving the tripping of multiple generating units and operation of under frequency load shedding (UFLS). RERT was procured in response to a forecast Lack of Reserve 2 (LOR2) condition[1] that developed into an actual LOR2 condition and a forecast LOR3 condition[2]. AEMO instructed the activation of 15 megawatts (MW) of RERT for 2 hour 45 mins (with a volume of 39.25 megawatt hours (MWh)).

The total cost payable by AEMO for the activation in Queensland on 25 May 2021 was $461,017.98. The cost per MWh for this RERT event was $10,676.02, which is less than the average Value of Customer Reliability[3] (VCR) of $40,030 per MWh for Queensland.

AEMO's contracting and activation of RERT was consistent with the principles of having the least distortionary effect on the market, while improving reliability of the system and minimising cost to consumers.

This report is published under clause 3.20.6 (b) of the NER, and accounts for reserve contracts entered into and activated by AEMO in the period from 1 April 2021 to 30 June 2021.

[1] LOR2 signals a tightening of electricity supply reserves. This condition exists when reserve levels are lower than the single largest supply resource in a state. At this level, there is no impact to the power system, but supply could be disrupted if a large incident occurred. Once a forecast LOR2 is declared, AEMO has the power to direct generators, cancel network outages, or activate the RERT mechanism to improve the supply demand balance.

[2] LOR3 signals a deficit in the supply/demand balance. This condition exists when the available electricity supply is equal to or less than the operational demand. This means there are no reserve supplies available. Controlled load shedding may be required as a last resort to protect system security and prevent long-term damage to system infrastructure.

[3] See https://www.aer.gov.au/system/files/AER%20-%20Values%20of%20Customer%20Reliability%20Review%20-%20Final%20Report%20-%20December%202019.pdf.

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# Tables

# 1. RERT activity in Q2 2021

## 1.1 Procurement

The 2020 Electrical Statement of Opportunities (ESOO) presented a reliability forecast against the existing 0.002% reliability standard[4], and against the Interim Reliability Measure[5] (IRM) of 0.0006%.

For summer 2020-21, the 2020 ESOO did not forecast expected unserved energy (USE) to exceed the reliability standard nor to exceed the IRM in any NEM region. As a result no Long Notice[6] Reserve or Interim Reserve[7] was contracted in the National Electricity Market (NEM).

AEMO established a panel of providers for the provision of reserves at Short Notice. At the start of Q2 2021, up to 1,728 megawatts (MW) of potential reserve capacity was in place through panel agreements. Under the panel agreements no capacity is contracted, or payments made, until a reserve shortfall arises.

In Q2 2021, Short Notice Reserve was contracted on 25 May 2021 prior to Reliability and Emergency Reserve Trader (RERT) activation as detailed below in response to a forecast Lack of Reserve 2 (LOR2) condition[8] which developed into an actual LOR2 and a forecast LOR3 condition[9].

## 1.2 Activation

AEMO intervened in the market by activating RERT on one occasion during the reporting period, on 25 May 2021, due to a forecast LOR2 condition which developed into an actual LOR2 and forecast LOR3 condition in Queensland.

## 1.3 Costs incurred

The total amount payable by AEMO under RERT in Q2 2021 was $461,017.98. Table 2 shows a breakdown of the amounts payable in Queensland including payment type for all contracts activated in Q2 2021. No other RERT costs were incurred in Q2 2021.

**Table 1 AEMO's average amount payable under reserve contracts, Q2 2021**

| NEM region | Availability costs ($)* | Pre-activation costs ($) | Activation costs ($) | Intervention costs($) | Total cost ($) |
|---|---|---|---|---|---|
| Queensland | - | $103,000 | $332,698.69 | $25,319.29 | $461,017.98 |
| **Total cost** | | | | | **$461,017.98** |

* Availability payments do not apply for Short Notice contracts. NER 3.20.6(d)(1) requires average values per region, which in the case of a single event in a region are the same values as calculated for that event.

[4] The reliability standard specifies that expected USE should not exceed 0.002% of total energy consumption in any region in any financial year.

[5] The IRM is a new interim reliability measure, agreed to at the March 2020 COAG Energy Council and introduced by the *National Electricity Rules (Interim Reliability Measure) Rule 2020*, that sets a maximum expected USE of no more than 0.0006% in any region in any financial year. It is intended to supplement the existing reliability standard for a limited period of time and allows AEMO to procure reserves if the ESOO reports that this measure is expected to be exceeded.

[6] Long Notice situations occur between 12 months and 10 weeks before a projected shortfall in reserves.

[7] Interim Reserve contracted by AEMO in respect to an interim reliability exceedance.

[8] LOR2 signals a tightening of electricity supply reserves. This condition exists when reserve levels are lower than the single largest supply resource in a state. At this level, there is no impact to the power system, but supply could be disrupted if a large incident occurred. Once a forecast LOR2 is declared, AEMO has the power to direct generators, cancel network outages, or activate the RERT mechanism to improve the supply demand balance.

[9] LOR3 signals a deficit in the supply/demand balance. This condition exists when the available electricity supply is equal to or less than the operational demand. This means there are no reserve supplies available. Controlled load shedding may be required as a last resort to protect system security and prevent long-term damage to system infrastructure.

# 2. Reserve procurement

## 2.1 Long Notice and Interim Reserves

The 2020 ESOO determined that in 2020-21 expected USE was not forecast to exceed the reliability standard nor to exceed the IRM in any NEM region. As a result, no Long Notice Reserve or Interim Reserve was contracted in the NEM for 2020-21.

The 2020 ESOO reported that, although expected USE in Victoria had declined substantially since the 2019 ESOO, some risks of load shedding remained, particularly if peak demand reached 10% probability of exceedance (POE)[10] levels and coincided with low renewable generation, or prolonged generation or transmission outages. AEMO noted that these risks could be mitigated through the use of Medium Notice[11] and Short Notice reserve panel agreements.

## 2.2 Panel arrangements

Through open tendering processes under the National Electricity Rules (NER), by the end of Q1 2021 AEMO had established a panel of providers representing estimated additional reserves of up to 1,728 MW in total across the NEM under Short Notice panel agreements. These agreements enable potential RERT providers to offer reserves in Short Notice situations on pre-negotiated contract terms, to enable AEMO to manage risks such as demand exceeding forecast expectations, and unplanned events resulting in a reduction in generation and/or network capacity. Short Notice reserve agreements were entered into in South Australia, Victoria, New South Wales, and Queensland.

In consultation with relevant state governments, and as required by the RERT guidelines[12], AEMO entered into panel agreements with potential reserve providers that met detailed cost, technical, and verification criteria.

RERT resources can have different response lead times, activation conditions, costs and response capability; as a result, not all resources will necessarily be activated for a given shortfall event.

Under the panel agreements utilising Short Notice contracts, there are no fixed costs incurred, and payments will only be made based on pre-activation and/or actual megawatt hours (MWh) activated. There is no cost to consumers unless this reserve is required[13].

AEMO did not enter into panel arrangements for Medium Notice Reserve in Q2 2021.

## 2.3 Short Notice Reserves contracted

AEMO may enter into reserve contracts at short notice when the probability of load shedding (other than the reduction or disconnection of interruptible load) is, or is forecast to be, more than remote, which is when AEMO expects a LOR condition may occur[14].

The Reserve Level Declaration Guidelines[15] provide details for determining the term and quantity associated with a reserve shortfall.

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[10] POE is the probability a forecast will be met or exceeded. The 10% POE forecast is mathematically expected to be met or exceeded once in 10 years and represents demand under more extreme weather conditions than a 50% POE forecast.

[11] Medium Notice situations occur between 10 weeks and seven days before a projected reserve shortfall.

[12] At https://www.aemc.gov.au/sites/default/files/2020-08/Updated%20Amended%20Panel%20RERT%20Guidelines%20-%2018%20August%202020%20-%20Final%20for%20publication_0.pdf.

[13] For more information on RERT costs, please refer to the AEMO website at https://aemo.com.au/en/energy-systems/electricity/emergency-management/reliability-and-emergency-reserve-trader-rert.

[14] Declarations of LOR conditions are made under NER clause 4.8.4(b).

[15] At https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Reserve-Level-Declaration-Guidelines.pdf.

Forecast or actual LOR2 and/or LOR3 conditions are the main criteria for contracting Short Notice Reserve. Under AEMO's panel arrangements, AEMO can contract for Short Notice Reserve once a forecast or actual LOR2 and/or LOR3 condition is identified, with no cost to consumers (unless the reserve is pre-activated or activated). As the event descriptions in Section 3.1 and Section 3.3 show, RERT contracting occurs in the context of highly uncertain and complex power system conditions, where actual and projected reserve levels can change at short notice.

AEMO contracted for Short Notice Reserve once in Q2 2021, on 25 May 2021. This was in response to a forecast LOR2 condition which developed into a forecast LOR3 and an actual LOR2 condition in Queensland. AEMO contracted 15 MW of Short Notice Reserve to reduce the need for post-contingent load shedding in Queensland following a significant sequence of power system events, including trip of multiple generating units and operation of under frequency load shedding (UFLS).

AEMO contracted all available Short Notice Reserves in Queensland, which was less than required to address the lack of reserve condition. No costs were incurred in doing so because panel agreements utilise Short Notice contracts that have no ongoing fixed costs and payments are only made based on pre-activation and/or actual MWh activated.

Table 2 below shows Short Notice Reserve contracts entered into by AEMO in Q2 2021. The term of each contract, as identified in Table 2, covered the period of the forecast LOR conditions (see Section 3.2), subject to activation periods, deactivation periods, and minimum contract durations.

**Table 2 Term of Short Notice Reserve contracts**

| Provider | Term start | Term end | Term duration | Capacity (MW) | Region | Basis for contract |
|---|---|---|---|---|---|---|
| EnergyAustralia Pty Ltd | 25 May 2021 17:00 | 25 May 2021 19:30 | 2 hrs 30 mins | 8 | Queensland | Forecast LOR2 |
| Visy Industries Australia Pty Ltd | 25 May 2021 17:00 | 25 May 2021 19:45 | 2 hrs 45 mins | 7 | Queensland | Forecast LOR2 |

## 2.4 AEMO's methodology for contracting RERT

AEMO's Procedure for the Exercise of the Reliability and Emergency Reserve Trader[16] sets out the methodology which it follows in determining the triggers for RERT, as well as the quantity and term of reserves contracted.

AEMO followed its procedures and the NER in contracting for Short Notice RERT, including:

- RERT Panel recruitment.
- Publication of notices.
- Requiring that unscheduled reserves are not otherwise offered to the market or engaged.
- Determining the term and quantity of reserves to be contracted.
- The basis for determining the estimated Value of Customer Reliability (VCR).

Under NER clause 3.20.2(b), AEMO must have regard to the RERT principles in exercising the RERT. These principles stipulate that AEMO is to take actions that have the least distortionary effect on the operation of the market, and actions taken should aim to maximise the effectiveness of reserve contracts at the least cost to end use consumers of electricity.

When entering into reserve contracts, AEMO factored these RERT principles into its decision-making:

[16] At https://www.aemo.com.au/-/media/files/electricity/nem/emergency_management/rert/procedure_for_the_exercise_of_reliability_and_emergency_reserve_trader_rert.pdf.

- To minimise distortionary effects on the operation of the market, AEMO categorises RERT into the following three types based on their pre-activation and activation times:
  - Type 1 – capacity that can be pre-activated and activated in less than 30 minutes. These contracts are pre-activated and activated post-contingency when an actual LOR3 occurs.
  - Type 2 – capacity where the sum of the pre-activation and activation lead times is greater than 30 minutes, but the activation lead time alone is less than 30 minutes. This means that for this capacity to be activated post-contingency (when an actual LOR3 occurs), it must be pre-activated in advance of the actual LOR3.
  - Type 3 – capacity whereby activation requires more than 30 mins. This capacity need to be pre-activated and activated in advance to ensure RERT is delivered on time.
- The use of these categories allows for minimal pre-activation and activation, since Type 1 and 2 categories can be activated post-contingent (during LOR3). This not only minimises impacts on the market, but also maximises the effectiveness of reserve contracts at the least cost to end use consumers of electricity.
- During the RERT procurement process, AEMO implemented the use of VCR as the maximum for assessing offers by potential RERT providers. As a result, no RERT contract AEMO entered into exceeds VCR.

# 3. Intervention on 25 May 2021

## 3.1 Decision to intervene

From 1333 hrs on 25 May 2021, a significant sequence of power system events began that remains under active investigation. AEMO has published a preliminary power system incident report[17] and will provide further detailed reports in due course. A detailed sequence of significant market notices is provided in Appendix A.

### 3.1.1 Day-ahead forecast expectations

Prior to the events of the afternoon of 25 May 2021, there were no identified reliability or security concerns in the NEM relevant to the activation of RERT in Queensland.

- A ridge of high pressure over Queensland and north-eastern New South Wales was expected to maintain settled conditions throughout Tuesday 25 May 2021. As such the forecasts were reflecting:
  - A mostly sunny day with a maximum temperature of 24°C forecast at Archerfield in Brisbane, resulting in moderate demand forecasts.
  - Moderate wind generation expected to drop to low levels during the evening.
  - Some patchy cloud present along the Queensland and New South Wales coastlines creating some potential variability in both large-scale and rooftop solar generation throughout the day.
- The peak day-ahead operational demand forecast for Queensland was 7,430 MW at 1800 hrs.

[17] See https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2021/preliminary-report--trip-of-multiple-generators-and-lines-in-queensland-and-associated-underfrequenc.pdf.

- There was forecast to be up to 926 MW of non-scheduled and semi-scheduled solar generation and 1,318 MW of rooftop solar generation at their peaks during the middle of the day (although not at the time of peak operational demand) in Queensland.
- Up to 393 MW of wind generation was forecast day-ahead, with generation expected to drop to 94 MW at time of forecast peak operational demand at 1800 hrs expected in Queensland.

### 3.1.2 Pre-event conditions – Queensland region

- Temperatures peaked at 24˚C as per forecast at Archerfield at approximately 1300 hrs. By 1400 hrs they had reduced slightly to 22.5°C.
- Throughout the morning, large-scale solar generation exceeded day-ahead forecasts, peaking at 1,066 MW at 1000 hrs before some patchy cloud reduced output. Total non-scheduled and semi-scheduled generation was 752 MW at 1400 hrs, just prior to the event.
- Similarly, rooftop solar generation exceeded day-ahead expectations, reaching an estimated 1,894 MW at 1200 hrs, before beginning to reduce. It was estimated to be generating 1,40 6MW at 1400 hrs, just prior to the event.

### 3.1.3 Significant event

At 1344 hrs and 1406 hrs the trip of Queensland generating units Callide C3 and Callide B2 occurred, in connection with a reported fire in the turbine hall of Callide C4 which ceased generating at 1333 hrs but remained connected to the grid.

At 1406 hrs, an escalation of the situation occurred with the near-simultaneous trip-to-house-load of Stanwell units 1, 3 and 4, and the trip of Gladstone units 2, 3 and 4 and several smaller Queensland generating units. The immediate ensuing generation deficit in Queensland was initially met by a rapid increase in power flow from New South Wales which quickly triggered a protective trip of the Queensland – New South Wales Interconnector (QNI) and operation of UFLS in the subsequent Queensland island to prevent widespread collapse of the Queensland system. QNI automatically reclosed shortly after the formation of the Queensland island to reconnect Queensland to the mainland NEM.

AEMO notes there was considerable uncertainty introduced into the forecast of anticipated maximum demand to be met in Queensland over the evening peak of 25 May 2021, due to the widespread operation of UFLS and subsequent uncertainty surrounding when this load would be reconnected.

Following the initial UFLS, the 1430 hrs forecast adapted the near-term demand forecast to track the actual demands more closely. From 1500 hrs, the automatic forecast began to reduce expectation of peak demand due to actual demands continuing to track below expectations. Following AEMO's instruction to restore load and demands beginning to increase, AEMO adjusted the 1600 hrs demand forecast to restore the day-ahead expectation of peak demand at 7,428 MW at 1800 hrs. This adjustment aligned with the expectation that all load was being restored and would be restored in time for peak demand at 1800 hrs.

Furthermore, the forecast availability of generation over that period was substantially less certain than prior to the event, due to the amount of time each affected generating unit required to stabilise, assess, and recover its plant operations. At this time approximately 4,500 MW of scheduled generation was expected to be unavailable in Queensland at 1730 hrs, including:

- Callide B1 (350 MW) – on long-term outage.
- Callide B2 (350 MW).
- Callide C3 (420 MW).
- Callide C4 (420 MW).
- Darling Downs Power Station (660 MW) – on long-term outage
- Gladstone 1 (280 MW) – on long-term outage.

- Gladstone 2 (280 MW).
- Gladstone 3 (280 MW).
- Gladstone 4 (280 MW).
- Milmerran 2 (426 MW) – on long-term outage.
- Stanwell 2 (365 MW) – on long-term outage.
- Swanbank E (365 MW) – out of service since 21 May 2021.
- Tarong 1 (350 MW) – on long-term outage.

At 1530 hrs, 91 MW of semi-scheduled generation was forecast to be available at 1730 hrs in Queensland, based on the 2-hour ahead forecast. Transmission outages at this time are detailed in Table 3.

**Table 3 Transmission outages affecting interconnectors to Queensland on 25 Mar 2021**

| Reqion | Equipment | Outage start date | Ouatge end date | Recall time | Constraints invoked |
|---|---|---|---|---|---|
| Queensland | Halys – Braemar 8814 275 kV line | 25/05/2021 10:02 | 03/06/2021 17:00 | Day: 4 hrs<br>Night: 4 hrs | Q-BRHA |
| New South Wales | Lismore No.1 330 kV Bus | 25/05/2021 06:01 | 25/05/2021 16:15 | Day: 2 hrs<br>Night: NA | N-CHLS_89<br>N-DLETS_OS |

## 3.2 RERT procurement

At 1521 hrs on 25 May 2021, AEMO issued Market Notice (MN) 85952[18], declaring a forecast LOR2 condition in Queensland from 1730 to 1900 hrs, seeking a market response, and noting that the latest time to intervene had not yet been determined.

The forecast capacity reserve requirement was 443 MW, but the minimum capacity reserve available was 367 MW. This meant AEMO needed up to 76 MW of additional reserves in Queensland to remove the threat of load shedding between 1730 hrs and 1900 hrs if the largest credible contingency in Queensland eventuated (in this case, a trip of Tarong North generating unit with a max available capacity of 443 MW).

To maintain power system reliability, AEMO determined that contracting of reserves would be required on the basis of the forecast LOR2 condition, with a substantial estimated reserve shortfall of 76 MW.

At 1613 hrs, AEMO advised the market[19] of its intention to commence RERT contract negotiations for the period from 1730 to 2000 hrs. At 1613 hrs, AEMO issued invitations to tender for the provision of 15 MW of Short Notice Reserve for the period from 1730 hrs to 2000 hrs. AEMO contracted all available Short Notice Reserves in Queensland, which was less than required to address the lack of reserve condition. No costs are incurred in contracting Short Notice Reserves. By 1630 hrs two reserve contracts had been entered for the provision of 15 MW RERT.

## 3.3 Assessment of market response and latest time to intervene

Where market mechanisms are not successful in alleviating a reserve shortfall and the latest time to intervene has been reached, AEMO may intervene in the market by issuing a direction or a clause 4.8.9 instruction or by exercising the RERT in accordance with NER clause 3.20.

[18] All market notices are published at https://aemo.com.au/Market-Notices.

[19] MN 85976.

AEMO's approach to determining its choice of supply scarcity mechanism when the need for intervention arises (RERT, direction, or clause 4.8.9 instruction) is detailed in the Interim Supply Scarcity Procedure[20].

In making this decision, AEMO must use reasonable endeavours to choose the mechanism, or combination of mechanisms, that is effective in addressing the supply scarcity conditions while minimising the associated direct and indirect costs.

On 25 May 2021, AEMO complied with NER clause 3.8.14 and followed its procedures in determining that RERT was the appropriate mechanism to address the conditions of supply scarcity[21], since:

- No scheduled plant was available for direction.
- The cost of activating RERT was less than that of issuing a clause 4.8.9 instruction, determined as the average aggregate VCR for Queensland as published by the Australian Energy Regulator (AER).

The 1700 hrs Pre Dispatch Projected Assessment of System Adequacy (PD PASA) run[22] indicated the forecast LOR2 condition had developed into an actual LOR2 condition and a forecast LOR3 condition, following receipt of the latest supply and demand information in the affected Queensland region.

At 1644 hrs, AEMO issued MN 85992, declaring an actual LOR2 condition in the Queensland region from 1640 hrs to 1700 hrs. At 1707 hrs, AEMO issued MN 85990, declaring a forecast LOR3 condition from 1700 hrs to 2100 hrs. The maximum forecast load to be interrupted was 1,043 MW at 1730 hrs.

Owing to this update, by 1640 hrs AEMO determined the latest time to intervene was effectively the present moment. In consultation with the available RERT providers in Queensland, it was mutually agreed to activate the contracted Short Notice Reserves earlier than intended, beginning now from 1700 hrs which reflected the required activation lead time on both reserve contracts, so as to maximise the effectiveness of their provision of reserve to the Queensland power system.

## 3.4 Intervention event

RERT contracts vary in terms of pre-activation and activation lead times, as well as response times (for example, an industrial load responding to a request to reduce load under RERT may need several hours to prepare plant or undertake a safe shutdown) and minimum continuous run times.

On 25 May 2021, in response to an actual LOR2 condition in Queensland, AEMO pre-activated and activated two contracts (RERT 1[23] – 8 MW, RERT 2 – 7 MW) at 1640 hrs. Both contracts required 30 minutes pre-activation lead time and 30 minutes activation lead time. With the agreement of both providers, these activation lead times were reduced to ensure the delivery of each contract began from 1700 hrs.

The 1730 hrs PD PASA run[24] continued to forecast a significant supply demand balance shortfall in Queensland over the evening. The forecast capacity reserve requirement was 443 MW, but the minimum capacity reserve forecast to be available at 1800 hrs was -918 MW. The LOR3 condition was forecast to remain until 2100 hrs and the LOR2 condition was forecast to remain until 2130 hrs. With agreement of both RERT providers, at 1739 hrs the RERT activation period was extended from 2000 hrs to 2130 hrs, as advised in MN 86007.

The eventual maximum demand in Queensland on 25 May 2021 was lower than forecast expectations due to a number of factors[25]. By 1800 hrs, the forecast was re-adjusted to a lower expectation of peak demand, as

[20] At https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/power_system_ops/procedures/so_op_3703-short-term-reserve-management.pdf.

[21] Indicating conditions in which the available supply may become insufficient to securely meet demand for energy. This is different from the concept of 'supply scarcity' as defined in the Frequency Operating Standard.

[22] Published shortly after 1630 hrs.

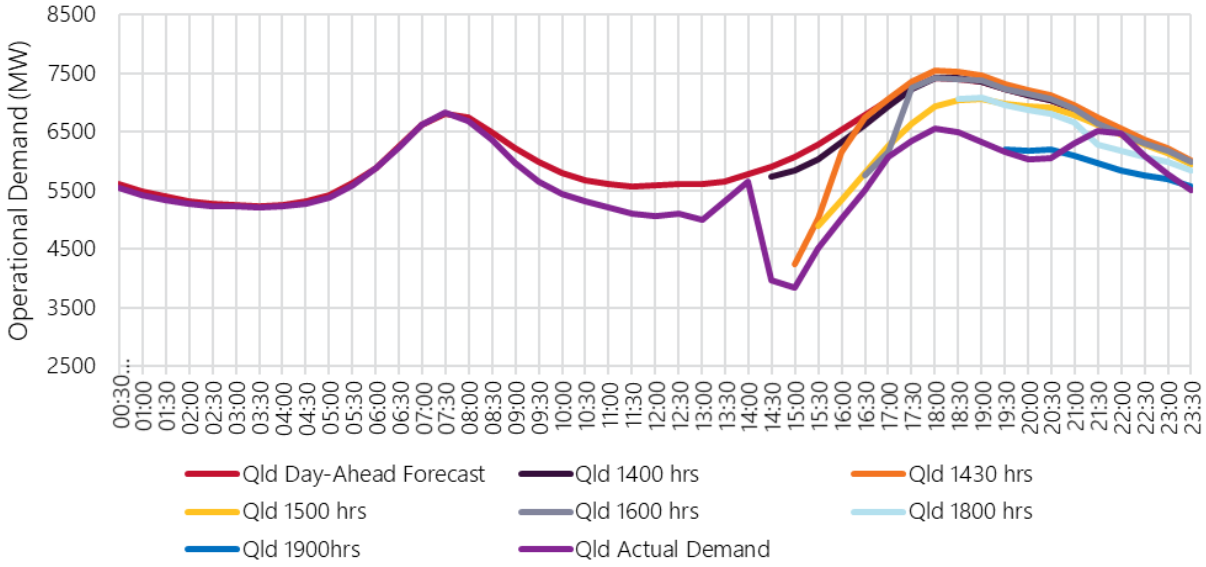
[23] Under the Reliability Panel's RERT guidelines, AEMO is required to publish the name of the counterparty to the contract and the volume and timing of reserves procured under the contract, however AEMO must treat other information on panel membership as confidential.

[24] Published shortly after 1700 hrs

[25] Further information to be available in AEMO power system incident reports on 25 May 2021, at https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-events-and-reports/power-system-operating-incident-reports.

restored load had not recovered to expected capacity. Subsequently the 1900 hrs forecast was again adjusted down as demand continued to track below expectation, as seen in Figure 1.

**Figure 1 Queensland operational demand sequence of forecasts**




The 1930 hrs PD PASA run[26] reflected this lower estimate of operational demand and indicated Queensland was no longer in an LOR condition as of 1900 hrs, due to the improved outlook on the supply demand balance. AEMO issued MN 86029, MN 86038, and MN 86039 at 1913 hrs, 1923 hrs, and 1924 hrs, cancelling all LOR conditions in Queensland.

AEMO determined the provision of RERT was no longer required and requested both activated reserve contracts be deactivated, which was completed as of 1945 hrs to reflect the deactivation lead time required by the RERT providers. At 1926 hrs AEMO issued MN 86037 to declare the dispatch of RERT and AEMO intervention event had ended.

On 25 May 2021, AEMO instructed the activation of a 39.25 MWh volume of RERT. Where the volume of RERT delivered by a RERT provider is greater than the amount set out in the activation instruction, the payment is only for the volume activated. Table 4 shows a breakdown of RERT activated per trading interval.

**Table 4 RERT activation instructions in Queensland on 25 May 2021**

| Trading Interval ending | RERT activated capacity (MW) | RERT activated volume (MWh) |
|---|---|---|
| **25/05/2021 17:30** | 15 | 7.5 |
| **25/05/2021 18:00** | 15 | 7.5 |
| **25/05/2021 18:30** | 15 | 7.5 |
| **25/05/2021 19:00** | 15 | 7.5 |
| **25/05/2021 19:30** | 15 | 7.5 |
| **25/05/2021 20:00** | 7[A] | 1.75 |
| **Total (MWh)** | | **39.25** |

A. Activation ended at 1945 hrs.

[26] Published shortly after 1900 hrs.

## 3.5 Intervention pricing

Intervention pricing[27] was applied for this event in accordance with NER 3.9.3(b) for the intervention periods from the dispatch intervals (DIs) ending 1715 hrs to 1930 hrs on 25 May 2021.

Intervention pricing began three DIs after activation of the RERT 1 and RERT 2 contracts began, and ended three DIs before final deactivation of the RERT 2 contract (between DIs ending 1935 hrs to 1945 hrs). This occurred due to the need for AEMO to invoke intervention constraints manually, due to a technical issue with the RERT dispatch tool which prevented the automated scheduling of intervention constraints. The manual method employed resulted in misaligned timing of intervention constraints with intervention requirements.

Two intervention constraints are used when RERT is applied, a physical run constraint and a pricing run constraint. The expected outcome is that the physical constraint would dispatch the RERT load to zero in the physical run and the pricing constraint would dispatch the RERT load to 15 MW in the pricing run to cause a different price outcome for intervention pricing.

During intervention pricing on 25 May, AEMO invoked these two intervention constraints manually. Both manual intervention constraints were incorrect because they contained the wrong constraint violation penalty (CVP) values[28] and were violated due to these relatively low CVP values. The violation of both constraints resulted in no additional MW of RERT load applied in the pricing run. Therefore the intervention pricing on 25 May reflects no additional RERT load applied throughout the RERT intervention pricing period. AEMO is developing changes to training to mitigate against the issues encountered above.

There was an unrelated minor impact on intervention pricing outcomes which is described in the next section.

## 3.6 Changes in dispatch outcomes

The dispatch of RERT resulted in minor changes in dispatch outcomes. These discrepancies were not related to the RERT intervention constraints due to the issues identified in Section 3.5.

Table 5 shows the difference in generation between the physical and pricing runs, and Table 6 compares the variation in total interconnector flows between the physical and pricing runs. The power system conditions in the NEM at the time were dynamic with load and generation being restored to service in Queensland. As no additional RERT load was applied to the pricing run as discussed in Section 3.5, the difference in dispatch outcomes during the restoration were due to the intervention pricing methodology which assumes the units follow their dispatch instructions in the pricing run[29].

**Table 5 Summary of total energy generation during 25 May 2021 RERT event (MWh)**

| | NSW | QLD | SA | TAS | VIC |
|---|---|---|---|---|---|
| **Physical run** | 23,042 | 15,169 | 4,933 | 3,694 | 15,656 |
| **Pricing run** | 23,105 | 15,160 | 4,931 | 3,647 | 15,651 |
| **Change** | -63 | 10 | 2 | 47 | 6 |

[27] AEMO sets the energy or ancillary service prices at the value that would have applied had the intervention not occurred, using the intervention pricing methodology developed by AEMO under clause 3.9.3(e) – see https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2019/dispatch/guide-to-intervention-pricing.pdf?la=en&hash=4EB7C0EA39AB0103A5674182F58C64B8.

[28] The physical run constraint should have a RHS of 0 with a CVP value of 1145, instead the error constraint had a RHS of 15 with a CVP of 55. For the pricing run, the constraint should have a RHS of 15 with a CVP value of 1140, the error constraint had a correct RHS of 15 but with an error CVP of 50.

[29] The intervention pricing methodology uses two runs of ther NEM Dispatch Engine (NEMDE) – physical and pricing. The pricing run assumes units achieve their targets and use these as initial MW for the next dispatch interval. Where units don't achieve this, there can be a deviation between the physical and pricing runs, even where the inputs are the same.

**Table 6 Summary of total interconnector flows during 25 May 2021 RERT event (MWh)**

| | Terranora | QNI | VIC-NSW | Heywood | Murraylink | Basslink |
|---|---|---|---|---|---|---|
| Physical run[A] | 70 | 789 | 1,030 | -515 | -197 | 225 |
| Pricing run[A] | 76 | 793 | 977 | -520 | -188 | 177 |
| Change | -6 | -4 | 53 | 5 | -8 | 47 |

A. Positive numbers are for flows flowing north or west, negative for flows flowing south or east.

## 3.7 Impact on reliability

For the 25 May 2021 RERT event, there was no manual load shedding. AEMO activated RERT on the basis of a forecast LOR2 condition which developed into a forecast LOR3 condition and an actual LOR2 condition, according to AEMO operating procedures.

The activation of 15 MW RERT assisted in removing the reserve shortfall and reducing the risk of manual load shedding if a credible contingency was to occur.

# 4. Cost of exercising RERT

NER clause 3.20.2(b)(2) requires that when AEMO activates RERT, it should aim to maximise the effectiveness of the activation at the least cost to end-use consumers of electricity. Accordingly, AEMO activated reserve contracts based on location, cost, capacity, time to activate, minimum activation time, and the profile of the forecast lack of reserve.

Table 7 shows a breakdown of the costs associated with exercising RERT during Q2 2021, which were included in the 25 May 2021[30] final statements, as per NER clause 3.20.6(f)(1). The total cost of exercising RERT was $461,017.98, which includes pre-activation, activation, and intervention costs. The cost per MWh has been calculated based on the total cost divided by the MWh delivered[31] for the activation event. The total cost per MWh associated with exercising RERT in Q2 2021 is $10,676.02.

**Table 7 Costs associated with activating RERT in Q2 2021**

| | State | Pre-activation costs ($) | Activation costs ($) | Intervention costs ($)* | Total cost ($) | Cost per megawatt hour ($/MWh) |
|---|---|---|---|---|---|---|
| 25 May 2021 | QLD | $103,000 | $332,698.69 | $25,319.29 | $461,017.98 | $10,676.02 |

* Intervention costs represent the compensation paid to Market Participants due to the intervention event (for example, to compensate for energy generation which is displaced by RERT capacity), and to Eligible Persons (SRA holders) due to changes in interconnector flows, and therefore changes in the value of Settlement Residues. Note that these costs are subject to change under clause NER 3.12.1(a).

Table 8 presents the cost recovery for the activation event, including a breakdown of the cost recovery from Market Customers as per NEM clause 3.20.6(f)(2).

[30] 25 May 2021 activation is detailed in Final Statement for 2021 Week 22.

[31] RERT MWh delivered is the amount of RERT actually delivered (as opposed to activated) including any over-delivery, noting that RERT providers have not been paid for over-delivery.

**Table 8 Recovery of costs associated with activating RERT in Q2 2021**

| Region | Participant category | Payment type | Recovery period start | Recovery period end | Amount | Energy (MWh) | Recovery rate ($/MWh) |
|---|---|---|---|---|---|---|---|
| QLD | Market Customer | Usage | 25 May 5:00pm | 25 May 7:30pm | $208,137.48 | 18,227.31 | $11.42 |
| QLD | Market Customer | Usage | 25 May 5:00pm | 25 May 8:00pm | $149,880.50 | 21,114.61 | $7.10 |
| QLD | Market Customer | Other* | 23 May 12:00am | 30 May 12:00am | $103,000.00 | 914,838.92 | $0.11 |
| Total | | | | | **$461,017.98** | | |

*Charges other than usage charges, amounts payable under intervention events, and independent expert costs.

Activation of reserves on 25 May 2021 did not avoid manual load shedding, since an LOR3 condition did not arise.[32] However if the largest credible contingency had occurred, the cost of avoided manual load shedding would have been $1.50m[33]. Table 9 presents the estimated avoided cost of manual load shedding on 25 May 2021, if the largest credible contingency had occurred.

**Table 9 Estimated avoided cost of load shedding**

| Event | Queensland, 25 May 2021 ($ million) |
|---|---|
| Estimated cost of load shedding avoided based on VCR | 1.50 |

# 5. AEMO's intervention process

AEMO's general process for deploying RERT is documented in SO_OP_3717 - Procedure for the Exercise of the Reliability and Emergency Reserve Trader[34].

AEMO considers that it followed all relevant provisions under NER clause 4.8 and procedures in SO_OP_3717 in the exercising of RERT in Q2 2021, to the extent it was able to do so. AEMO notes that no Market Notice specifying the latest time to intervene could reasonably be published due to the rapidly changing power system circumstances. These made the process of determining to exercise the RERT and activate reserves particularly challenging in the circumstances.

[32] For completeness AEMO notes that the earlier operation of UFLS resulted in significant automatic load shedding but the activation of RERT was not responding to that event.

[33] Calculated based on the volume of RERT delivered (37.53 MWh) multiplied by the relevant VCR ($40,030).

[34] At https://www.aemo.com.au/-/media/files/electricity/nem/emergency_management/rert/procedure_for_the_exercise_of_reliability_and_emergency_reserve_trader_rert.pdf.

# Appendix A

Table 10 below provide a summary timeline for 25 May 2021 RERT event (which was the only RERT event in Q2 2021) and the actions taken.

**Table 10 Timeline of key events on 25 May 2021**

| Date | Event/comment |
|---|---|
| 1410 hrs | • MN 85926 – AEMO advised of a non-credible contingency event in the Queensland region. At 1344 hrs the Callide C Power station generating units C3 and C4 tripped. |
| 1421 hrs | • MN 85928 – AEMO advised of a significant power system event, with multiple transmission lines tripped including all 275 kV lines out of H24 Calvale. |
| 1521 hrs | • MN 85952 – forecast LOR2 declared for Queensland from 1730 to 1900 hrs. The forecast capacity reserve requirement was 443 MW.<br>• The minimum capacity reserve available was 367 MW.<br>• AEMO sought a market response, but had not yet estimated the latest time to intervene. |
| 1529 hrs | • MN 85955 – forecast LOR1 declared for Queensland from 1530 hrs to 2130 hrs. The forecast capacity reserve requirement was 863 MW. AEMO advised that the minimum capacity reserve available was 367 MW[35]. |
| 1613 hrs | • MN 85976 – AEMO advised intention to commence RERT contract negotiations in the Queensland region, for the period 1730 hrs to 2000 hrs. |
| 1616 hrs | • MN 85978 – AEMO advised of an update to the significant power system event. All 275 kV lines out of H24 Calvale were returned to service. |
| 1644 hrs | • MN 85992 – actual LOR2 declared for Queensland from 1640 hrs to 2130 hrs. The forecast capacity reserve requirement was 863 MW.<br>• The minimum capacity reserve available was 240 MW. |
| 1707 hrs | • MN 85990 – forecast LOR3 declared for Queensland from 1700 to 2100 hrs. The maximum load forecast to be interrupted was 1,043 MW at 1730 hrs.<br>• AEMO sought a market response but had not yet determined the latest time to intervene. |
| 1739 hrs | • MN 86007[36] – AEMO advised RERT contracts activated in Queensland at 1700 hrs and were forecast to apply until 2130 hrs. |
| 1913 hrs | • MN 86029 – actual LOR2 cancelled in Queensland at 1910 hrs. |
| 1923 hrs | • MN 86038 – forecast LOR3 cancelled in Queensland at 1910 hrs. |
| 1924 hrs | • MN 86039 – forecast LOR1 cancelled in Queensland at 1910 hrs. |
| 1926 hrs | • MN 86037 – RERT services de-activated. Reserve activation was from 1700 hrs to 1930 hrs. |

[35] MN 85955 incorrectly stated the LOR1 minimum capacity reserve available in Queensland as 367 MW. The forecast minimum capacity reserve available was actually 456 MW.

[36] MN 86007 incorrectly declared RERT activation in New South Wales rather than Queensland. This was corrected in MN 86034 at 1845 hrs.