Australian Energy Market Commission

RULE DETERMINATION

National Electricity Amendment (Managing the rate of change of power system frequency) Rule 2017

Rule Proponent

South Australian Minister for Mineral Resources and Energy

19 September 2017

Inquiries

Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

E: aemc@aemc.gov.au
T: (02) 8296 7800
F: (02) 8296 7899

Reference: ERC0214

Citation

AEMC 2017, Managing the rate of change of power system frequency, Rule Determination, 19 September 2017, Sydney

About the AEMC

The AEMC reports to the Council of Australian Governments (COAG) through the COAG Energy Council. We have two functions. We make and amend the national electricity, gas and energy retail rules and conduct independent reviews for the COAG Energy Council.

Executive Summary

The Australian Energy Market Commission (AEMC or Commission) has made a final rule to place an obligation on Transmission Network Service Providers (TNSPs) to procure minimum levels of inertia or procure other services such as frequency control services that reduce the minimum level of inertia required.

The widespread deployment of non-synchronous generating technologies, such as wind farms and solar panels, is impacting on the operation of the power system. These technologies have low or no physical inertia. Currently, they are limited in their ability to dampen rapid changes in power system frequency, which is needed in order to maintain a secure power system.

The Commission considers that a secure power system demands the availability of minimum levels of inertia at all times and an obligation on TNSPs to provide this service will help establish confidence that system security can be maintained in all regions of the National Electricity Market (NEM).

The rule change request

The final rule has been made in response to a rule change request received from the South Australian Government. The South Australian Government considers that less synchronous generation in the NEM is leading to a lack of system inertia. This is increasing the susceptibility of the system to rapid changes in frequency that arise as a result of system disturbances. On that basis, the rule change request proposed that the Australian Energy Market Operator (AEMO) should be provided with powers to determine the services necessary to manage sudden changes in frequency and procure these services through an efficient and competitive process to maintain power system security.

Historically, most generation in the NEM has been synchronous and bringing with it inertia, which has not been separately valued. As the generation mix shifts to smaller and more non-synchronous generation however, inertia is not provided as a matter of course giving rise to increasing challenges for the AEMO in maintaining the power system in a secure operating state.

The shift to newer types of generation has been more pronounced in some regions of the NEM than others. South Australia, in particular, has experienced a substantially faster change than other regions as an increasing volume of non-synchronous generation has come into service. Flows on the interconnector with Victoria allow power system security to be maintained in normal circumstances because of inertia provided by generators in other parts of the NEM. Where there is an outage of this interconnector, the risks to system security in South Australia increase significantly because it must rely on inertia provided by generators within the region. This makes it harder to arrest the frequency change and restore the frequency to normal operating levels. As the generation mix changes in a similar way across the NEM these risks may become more widespread.

Minimum required levels of inertia

Under the National Electricity Rules (NER), AEMO must operate the power system such that, to the extent practicable, it is and will remain in a secure operating state.[1] In terms of frequency control, this means that system frequency must stay within the bounds specified in the Frequency Operating Standards (FOS) following the occurrence of a credible contingency event[2] or protected event.[3]

Prior to the occurrence of such an event, there are two actions that could be taken to minimise the initial frequency change that would result from the event occurring:

- constrain the power system to minimise the impact of the contingency; and/or
- increase the level of inertia in the system to resist the initial frequency change.

However, short of constraining all generation and network flows - and therefore demand - to zero, there is a minimum level of inertia required even to operate the system in a heavily constrained manner. Such a level would provide:

- time for frequency control ancillary services to respond and recover the frequency to normal operating levels;
- time for emergency frequency control schemes to operate effectively; and
- a higher probability of generators remaining online following the occurrence of the contingency event.

Acknowledging the issues raised in the rule change request, the Commission has decided on a different solution to that identified by South Australia.

With increasingly less synchronous generation in the NEM, the Commission has established an obligation on TNSPs to meet the minimum inertia requirements associated with maintaining a secure operating system.

This role sits suitably with TNSPs for the following reasons:

- The existing incentive based economic regulatory framework will provide an incentive for the TNSP to assess the least-cost approach to meeting the obligation with oversight by the Australian Energy Regulator (AER). In this framework cost savings made by the TNSPs will be shared with consumers.
- TNSPs are best placed to provide the required levels of inertia within each sub-network and to coordinate the location of inertia with other network support

1 Clause 4.2.6(a) of the NER.

2 A credible contingency event is a contingency event which AEMO considers to be reasonably possible in the surrounding circumstances. Generally, such events would involve the loss of one generating unit or network element.

3 A protected event is a non-credible contingency that, following a declaration by the Reliability Panel, must be managed in a similar manner to credible contingencies.

services, including obligations related to minimum system strength. This co-optimisation of services will assist in minimising the overall costs to consumers.

The final rule

The final rule, which is a more preferable rule, made by the Commission is attached to and published with this final rule determination. The key features of the more preferable final rule are as follows.

- An obligation on AEMO to determine sub-networks in the NEM that are required to be able to operate independently as an island and, for each sub-network, to:
  - determine the minimum required levels of inertia; and
  - assess whether a shortfall in inertia exists or is likely to exist in the future.
- Where an inertia shortfall exists in a sub-network, an obligation on the relevant TNSP[4] to make continuously available minimum required levels of inertia, determined by AEMO. The TNSP can provide the inertia itself or procure inertia services from third parties such as generators.
- An ability for TNSPs to invest in or contract with third-party providers of alternative frequency control services ("inertia support activities"), including fast frequency response (FFR) services, as a means of reducing the minimum required levels of inertia, with approval from AEMO.
- An ability for AEMO to enable the inertia network services provided by TNSPs and third-party providers under specific circumstances in order to maintain the power system in a secure operating state.[5]

The Commission considers that the more preferable final rule will contribute to the achievement of the national electricity objective (NEO) for the following reasons.

- The existing economic regulatory framework will provide an incentive for the TNSP to assess the least-cost approach to meeting the obligation with oversight by the AER. The final rule will allow the TNSP to meet the obligation in the short-term by contracting with existing third-party providers of inertia or investing in network assets, while concurrently assessing the most efficient means of meeting the obligation over the long term.

4 AEMO is responsible for planning, authorising and directing augmentation of the declared shared network in Victoria. Different arrangements for the provision of shared transmission services, including inertia network services, will apply to AEMO in its role as the Inertia Service Provider for Victoria.

5 An inertia network service is enabled when AEMO has selected the relevant inertia network service and the service is providing inertia to an inertia sub-network.

- The periodic review of the minimum required level of inertia that a TNSP is required to provide, and an obligation on the TNSP to identify and procure the least cost option or combination of options to meet its inertia obligation,[6] will assist in making sure that investments are efficient and reflective of changing market conditions.

- The obligation on TNSPs to provide inertia network services will only apply to sub-networks where AEMO has identified that an inertia shortfall exists. This will promote efficient investment and use of services by:

  — maintaining system security where it is needed while not imposing undue market or compliance costs on other areas; and

  — providing for future shortfalls in inertia to be identified in a timely manner.

- Placing the obligation on TNSPs to provide inertia network services will provide a greater ability to coordinate the provision of inertia network services with other network support requirements for the relevant sub-network, such as system strength. This should result in a more efficient outcome for consumers in the long term by minimising the potential duplication of investment.

- The ability for the TNSP to make available inertia support activities through contracts with third-party providers of services other than the provision of inertia will promote efficiency in investments by expanding the range of options available to manage the secure operation of the system.

New obligations stemming from the final rule in relation to the ongoing obligation for TNSPs to provide minimum required levels of inertia will commence on 1 July 2018. By this date AEMO must have developed and published the methodology it will use to determine minimum inertia requirements, determine minimum inertia requirements for each sub-network in the NEM and whether there will be an inertia shortfall. If a shortfall is declared in a sub-network, the relevant TNSP will be given notice by AEMO of this shortfall by this time and will then need to have inertia services available to meet the minimum requirements by 1 July 2019.

Changes from the draft rule

The Commission has considered stakeholder submissions on the draft rule and has made the following key changes, which are reflected in the final rule and explained in this final determination.

- The Commission has determined that the development and updating of the inertia requirements methodology will be undertaken through the National Transmission Network Development Plan (NTNDP) consultation process, rather than through a separate process conducted under the Rules consultation

6 Final Rule clause 5.20B.4(f).

procedures. This will provide AEMO with a greater level of flexibility to adjust the inertia requirements methodology as circumstances change.[7]

- If AEMO assesses that there is, or is likely to be, an inertia shortfall in any inertia sub-network, it must publish and give to the relevant TNSP a notice of that assessment that includes the date by which the inertia network services must be available. Under the draft rule, AEMO was restricted to notifying the TNSP of an inertia shortfall at the time of publication of the NTNDP.

- The Commission has included additional matters in the final rule that AEMO is required to take into account when determining the inertia requirements for an inertia sub-network. These additional matters include any constraints that could reasonably be applied to the inertia sub-network when islanded to achieve a secure operating state and any unserved energy that might result from the constraints, as well as any other matters AEMO considers appropriate.

- The final rule requires the relevant TNSP to use 'reasonable endeavours' to make the inertia network services available by the date specified by AEMO. In some circumstances, there may be a limited number of parties with whom to contract for the provision of services, or potential providers of inertia may not wish to enter into contracts with the TNSP.

- In order to make clear that the determination of an inertia shortfall during the course of a regulatory control period constitutes a pass through event under chapter 6A of the NER, the final rule adds a new category of pass-through event - an 'inertia shortfall event'. An inertia shortfall event occurs where a TNSP is required to provide, or cease providing, inertia network services and meeting this requirement materially increases or decreases the TNSP's costs of providing prescribed transmission services. The addition in the final rule of a new category of pass through event should provide greater certainty to the TNSP that the efficient costs of meeting the obligation can be recovered.

- Under the final rule TNSPs are not required to apply the Regulatory Investment Test for Transmission (RIT-T) to proposed expenditure on "inertia service payments" (payments to third parties for the provision of inertia or inertia support activities) or to network investments undertaken by the TNSP to meet the inertia obligation where:

  - an inertia shortfall is declared in the inertia sub-network;

  - prior to the declaration the TNSP is not under an obligation to provide inertia network services; and

  - the time for making the inertia network services available to meet the relevant shortfall is less than 18 months after the notice is given by AEMO.

7 AEMO must publish an initial inertia requirements methodology by 30 June 2018. In producing the first methodology, AEMO is not required to comply with the NTNDP consultation process.

The objective of the RIT-T exemption is to provide the TNSP with a practical ability to meet the obligation in a reasonable time in the first instance that a shortfall is declared within the sub-network. It will still be necessary for the TNSP to undertake a RIT-T for any subsequent ongoing adjustments to the required levels of inertia as the Commission expects that there will be a reasonable level of foresight in the projection of inertia shortfalls into the future.

The Commission considers that a requirement to conduct a RIT-T has the potential to limit the options available to TNSPs to efficiently meet inertia obligations in the short to medium term. However, TNSPs will still be required to undertake a process of screening of potential third-party providers of services to improve the efficiency of the contracting solution. The exemption to conducting a RIT-T for network investments will increase the competitive pressure on third-party providers of services and will make sure that potentially more efficient network investments are not precluded from meeting the obligation.

- The draft rule defined the minimum inertia requirements as two separate levels of inertia - a minimum threshold level of inertia and a higher secure operating level of inertia. The final rule extends the use of inertia support activities to reduce the minimum threshold level of inertia in addition to the secure operating level of inertia. The Commission considers that, under the proposal in the draft rule, limiting the use of inertia support activities to reducing only the secure operating level of inertia may preclude the development of potentially lower cost options. The final rule maintains the requirement for the TNSP to seek approval from AEMO in order to use any inertia support activities to reduce the minimum required levels of inertia.

- The final rule also excludes from the definition of a "NSCAS need" any requirement for inertia network services to address an inertia shortfall. The Commission considers that it is undesirable to have two frameworks in the NER for the provision of equivalent services, that is, both inertia services provided under the existing NSCAS framework and under the new framework for managing minimum levels of inertia.

Additional inertia for market benefit

The final rule relates to the provision by TNSPs of the minimum level of inertia required to maintain secure operation of the power system. This can be distinguished from additional levels of inertia that may increase economic benefits by allowing for greater power transfers on the network, such as greater energy flows on interconnectors.[8]

The final rule does not provide a mechanism to realise the market benefits that could be obtained through the provision of inertia at levels above the minimum level of inertia required to maintain secure operation of the power system.

8 See: AEMC, *System security market frameworks review - final report*, 27 June 2017, pp. 31-38.

The AEMC has been assessing a rule change request received from AGL, which proposes the establishment of an inertia ancillary services market. Through its assessment of this rule change request, the AEMC is considering the benefits of a mechanism to guide the provision of additional inertia for market benefit. The Commission will make a draft determination on this rule change request by 7 November 2017.

The ability to maintain power system security in an efficient manner would be enhanced by the development and introduction of a mechanism to obtain and pay for inertia and that this would further contribute to the NEO. However, such a mechanism will need careful design due to the potential impacts on the operation of the energy and ancillary services markets. On 5 September 2017, the Commission published a consultation paper to facilitate stakeholder feedback and input to assist with the development of the proposed approach.[9]

A market mechanism will complement and build on the certainty created through the TNSP obligation by providing the ability to continuously adjust the level of service provision in real time to maximise efficiency. Ultimately, the combined TNSP obligation and market mechanism will form an enhanced framework which efficiently balances certainty and flexibility for the management of system frequency in the long term interests of consumers.

9 AEMC, *Inertia ancillary service market - consultation paper*, 5 September 2017.

Contents

1 The South Australian Government's rule change request

1.1 The rule change request

On 12 July 2016, the South Australian Minister for Mineral Resources and Energy made a request to the Australian Energy Market Commission (AEMC or Commission) to make a rule regarding the management of potential fast rates of change of frequency in the power system.

The South Australian Government considers that less synchronous generation in the National Electricity Market (NEM) is leading to a lack of system inertia.[10] Lower levels of inertia increase the susceptibility of the system to rapid changes in frequency that arise as a result of system disturbances.

The rule change request proposes that the Australian Energy Market Operator (AEMO) should be provided with powers to determine the services necessary to manage sudden changes in frequency and procure these services through an efficient and competitive process.

1.2 Approach to the final determination

The rule change request has been considered concurrently with, and informed by the broader system security work programme of the AEMC, and technical work undertaken by AEMO as part of its Future Power System Security Program (FPSS).

This final determination effectively implements a key recommendation made in the Commission's final report on the *System security market frameworks review*.[11]

The report made a number of recommendations, both for immediate measures to address priority issues and a further program of work to develop robust market frameworks for the longer term.

The Commission has been assessing a number of rule change requests relating to a number of the priority issues that were considered as part of the *System security market frameworks review*. It is also undertaking further reviews into other critical aspects of system security including the *Frequency control frameworks review*, and working collaboratively with AEMO and other key stakeholders.

AEMO has identified and prioritised current and potential future challenges to maintaining system security. These challenges all stem from greater levels of non-synchronous generation in the NEM.

10 Synchronous generating units contain large spinning turbines that are electro-magnetically coupled with the power system and synchronised to the frequency (50 Hertz) of the power system.

11 AEMC, *System security market frameworks review - final report*, 27 June 2017.

This final determination specifically addresses the potential for high rates of change of frequency to occur following a sudden change in supply or demand as a result of reduced levels of system inertia.

The final rule relates to the provision by transmission network service providers (TNSPs) of the minimum level of inertia required to maintain the power system in a secure operating state. This can be distinguished from additional levels of inertia, or alternative frequency control services, that may increase economic benefits by allowing for greater power transfers on the network, such as higher flows on interconnectors.

The final rule does not provide a mechanism to realise the market benefits that could be obtained through the provision of inertia at levels above the minimum level of inertia required to maintain secure operation of the power system.

The Commission considers that a mechanism that guides the provision of additional inertia for market benefit could further contribute to the achievement of the national electricity objective (NEO). However, such a mechanism will need careful design due to the potential impacts on the operation of the energy and ancillary services markets. The AEMC intends to continue its assessment of AGL's rule change request with a view to implementing a mechanism to guide the provision of additional inertia for market benefits. The AEMC published a consultation paper on AGL's rule change request on 5 September 2017.[12] Stakeholders are encouraged to provide submissions on this consultation paper by 3 October 2017.

1.3 Rationale for the rule change request

The ability of the power system to resist large changes in frequency arising from the loss of a generator, transmission line or large industrial load is initially determined by the inertia of the power system. Inertia is naturally provided by conventional electricity generators, operating with large spinning turbines and alternators that are synchronised to the frequency of the grid. These generators have significant physical inertia and support the stability of the power system by working together to maintain a constant operating frequency.

Newer types of electricity generators connected to the national electricity system, such as wind and rooftop solar, are not synchronous machines, have low or no physical inertia, and are, therefore, currently limited in their ability to dampen rapid changes in frequency. Some of these technologies have the capability to rapidly respond to changes in electricity supply or consumption, and are likely to play a key role in providing these rapid response services to manage the future security of the power system.

Historically, most generation in the NEM has been synchronous and, as such, the inertia provided by these generators has not been separately valued. As the generation mix shifts to smaller and more non-synchronous generation however, inertia is not

12 AEMC, *Inertia ancillary service market - consultation paper*, 5 September 2017.

provided as a matter of course giving rise to increasing challenges for AEMO in maintaining the power system in a secure operating state.

In addition, the majority of existing contingency frequency control ancillary services (FCAS) is also provided by synchronous generators. Generators that wish to be available to provide contingency FCAS typically need to reduce energy output, which entails an opportunity cost. This has meant that the revenue provided by these services has typically been seen as supplementary to the principal source of revenue from energy. To date, these services have been provided by the existing stock of generators and significant investment in these services has not been necessary. However, the existing FCAS spot market arrangements, while providing an effective means for efficiently prioritising and dispatching these services, provide little in the way of revenue certainty that would be sufficient for significant investment in FCAS facilities to occur.

The South Australian Government's rule change request suggests that less synchronous generation in the NEM is leading to a lack of system inertia, which is increasing the susceptibility of the system to rapid changes in frequency and reducing system stability.

The shift to newer types of non-synchronous generation has been more pronounced in some regions of the NEM than others. South Australia, in particular, has experienced a substantially faster change than other regions as an increasing volume of renewable energy has come into service. Flows on the interconnector with Victoria allow power system security to be maintained because of inertia provided by generators in other parts of the NEM. Where there is an outage of this interconnector, the risks to system security in South Australia increase significantly because it must rely on inertia provided by generators within the region. If there is minimal generation capacity online at the time of the interconnector outage that has the ability to provide inertia in that region, the frequency could be subject to very rapid changes. This makes it harder to arrest the frequency change and restore the frequency to normal operating levels. As the generation mix changes in a similar way across the NEM these risks may become more widespread.

1.4 Solution proposed in the rule change request

The South Australian Government proposed two principal changes to establish a more effective framework for the management of increased risks to system security arising from rapid changes in frequency:

1. AEMO should be provided with the powers to:

    (a) determine the types and amount of ancillary services that may assist in addressing the potential for high rates of frequency change; and

    (b) procure the necessary ancillary services via ancillary services agreements and to develop guidelines for the efficient and competitive procurement of these services.

2. A system standard for the rate of change of frequency (RoCoF) should be established to guide the procurement of the services and to clarify responsibilities of AEMO, TNSPs and market participants. The level of this standard should be determined by the Reliability Panel in accordance with a process prescribed in the National Electricity Rules (NER).

1.5 The rule making process

On 8 September 2016, the Commission published a notice advising of its commencement of the rule making process and consultation in respect of the rule change request.[13] A consultation paper identifying specific issues for consultation was also published. Submissions closed on 13 October 2016.

On 15 December 2016, the Commission published its interim report to the COAG Energy Council on the *System security market frameworks review*. The interim report set out the Commission's preliminary findings and canvassed a number of options to obtain system security services to address the potential for high rates of change of frequency arising from reduced levels of inertia. Submissions closed on 9 February 2017.

On 23 March 2017, the Commission published a directions paper on the *System security market frameworks review*. The directions paper presented the Commission's proposed approach to address the management of system frequency with reduced levels of synchronous generation. Submissions closed on 20 April 2017.

On 27 June 2017, the Commission published a draft determination with respect to this rule change request. The draft rule proposed to place an obligation on TNSPs to procure minimum required levels of inertia or alternative services to reduce the minimum required levels of inertia. Submissions on the draft determination closed on 8 August 2017.

The Commission received 18 submissions in response to the draft determination. A summary of the issues raised in submissions and the Commission's response to each issue is contained in Appendix A.

The Commission has considered all issues raised by stakeholders in submissions received in response to all of the above published reports with respect to this rule change request. Issues raised in submissions are discussed and responded to throughout this final rule determination.

1.6 Structure of the final rule determination

This final rule determination is set out as follows:

13 This notice was published under s. 95 of the National Electricity Law (NEL).

- Chapter 2 provides an overview of the Commission's final rule determination, including its assessment framework and summary of reasons for making the final rule.
- Chapter 3 explores the concept of the minimum level of inertia required to maintain a secure operating system and sets out further detail on the Commission's final rule to place an obligation on AEMO to define inertia sub-networks and to determine minimum required levels of inertia.
- Chapter 4 describes the Commission's final rule to place an obligation on the relevant TNSP to make continuously available the minimum required levels of inertia and explores the specific conditions under which AEMO may enable inertia to be provided to the system.
- Chapter 5 describes the Commission's final rule to allow TNSPs to contract with third-party providers of alternative frequency control services, including fast frequency response services, as a means of reducing the minimum levels of inertia the TNSP is required to provide.
- Chapter 6 sets out the process of transitioning to the commencement of the final rule.
- Appendix A provides the Commission's response to stakeholder comments that are not addressed elsewhere in the final rule determination.
- Appendix B sets out the relevant legal requirements under the National Electricity Law (NEL) for the Commission to make this final rule determination.

2 Final rule determination

The Commission's final rule determination is to make a more preferable final rule. The more preferable final rule places an obligation on TNSPs that are Inertia Service Providers to provide, and make continuously available, minimum required levels of inertia, or in some cases alternative services, to allow AEMO to maintain the system in a secure operating state.

This chapter outlines:

- the key features of the final rule;
- the rule making test for changes to the NER;
- the more preferable rule making test;
- the assessment framework for considering the rule change request; and
- the Commission's consideration of the more preferable final rule against the national electricity objective.

Further information on the legal requirements for making this final rule determination is set out in Appendix B.

2.1 The Commission's final rule determination

The more preferable final rule made by the Commission is attached to and published with this final rule determination. The key features of the more preferable final rule are as follows. Differences between the final rule and the draft rule are set out in the remaining chapters of this final rule determination.

AEMO determines inertia requirements

- An obligation on AEMO to:
  - determine the boundaries of inertia sub-networks in the NEM taking into account, among other things, the synchronous connections between the proposed inertia sub-network and adjacent parts of the national grid and the likelihood of the proposed inertia sub-network being islanded;[14]
  - publish as part of the National Transmission Network Development Plan (NTNDP) consultation process an inertia requirements methodology setting out the process it will use to determine the inertia requirements for each inertia sub-network, having regard to matters specified in the NER;[15]

14 Final Rule clause 5.20B.1(d).

15 Final Rule clause 5.20.1(a)(3).

- determine, generally no more than once in any 12-month period, the "inertia requirements" for each inertia sub-network, being:
    - the minimum level of inertia required to operate the sub-network in a satisfactory operating state when the sub-network is islanded (the minimum threshold level of inertia);[16] and
    - the minimum level of inertia required to operate the sub-network in a secure operating state when the sub-network is islanded (the secure operating level of inertia).[17]
- publish the inertia requirements for each inertia sub-network in the NTNDP.[18]

AEMO determines and provides notice of any inertia shortfall

- An obligation on AEMO to:
    - assess whether, in its reasonable opinion, there is or is likely to be an inertia shortfall in an inertia sub-network, taking into account matters specified in the final rule.[19] An inertia shortfall is a shortfall in the level of inertia typically provided in an inertia sub-network compared to the secure operating level of inertia most recently determined by AEMO for the sub-network;[20]
    - where there is, or is likely to be, an inertia shortfall in an inertia sub-network, publish and give to the Inertia Service Provider for the inertia sub-network a notice of the assessment.[21] The Inertia Service Provider is the TNSP for the inertia sub-network or, if there is more than one TNSP for the inertia sub-network, the jurisdictional planning body for the relevant jurisdiction;[22]
    - give notice of the date that the Inertia Service Provider must provide for the availability of inertia network services, which must not be earlier than 12 months after the date that the notice of the assessment is published unless an earlier date is agreed with the Inertia Service Provider;[23]

16 Final Rule clause 5.20B.2(b)(1).

17 Final Rule clause 5.20B.2(b)(2). In practice, the secure operating level of inertia will always be higher than the minimum threshold level of inertia.

18 Final Rule clause 5.20B.2(c).

19 Final Rule clause 5.20B.3(a).

20 Final Rule, new Chapter 10 definition of "inertia shortfall".

21 Final Rule clause 5.20B.3(c).

22 Final Rule clause 5.20B.4(a). The Inertia Service Provider will be AEMO in Victoria.

23 Final Rule clause 5.20B.3(c).

- provide five-year projections of inertia shortfalls in the NTNDP.[24]

- The final rule excludes from the definition of a "NSCAS need" any requirement for inertia network services to address an inertia shortfall.[25]

Services that qualify as inertia network services

- The final rule specifies the types of services that can be provided by Inertia Service Providers to meet an inertia shortfall. These services must be for the provision of inertia[26] and are called "inertia network services" under the final rule.

- The inertia network services that qualify to provide inertia up to the minimum threshold level of inertia are:[27]

  - services made available by the Inertia Service Provider investing in synchronous condensors; and

  - services made available to the Inertia Service Provider by a Registered Participant and provided by means of a synchronous generating unit or synchronous condensor.

- The inertia network services that qualify to provide inertia beyond the minimum threshold level of inertia and up to the secure operating level of inertia are those services that can be used for the minimum threshold level of inertia and other types of inertia network services provided by the Inertia Service Provider or a Registered Participant.[28]

- Other types of activities ("inertia support activities") may be used by the Inertia Service Provider to reduce the secure operating level of inertia or the minimum threshold level of inertia, with approval from AEMO.[29]

Inertia Service Provider makes inertia network services available

- In sub-networks of the NEM where an inertia shortfall has been identified by AEMO there is an obligation on the TNSP[30] that is the Inertia Services Provider to:

---

24 Final Rule clause 5.20.2(c)(13).

25 Final Rule, new Chapter 10 definition of "NSCAS need".

26 Final Rule, new Chapter 10 definition of "inertia" - Contribution to the capability of the *power system* to resist changes in *frequency* by means of an inertial response from a *generating unit*, *network element* or other equipment that is electro-magnetically coupled with the *power system* and *synchronised* to the *frequency* of the *power system*.

27 Final Rule clause 5.20B.4(d).

28 Final Rule clause 5.20B.4(e).

29 Final Rule clause 5.20B.5(a). Inertia support activities may include, but are not limited to, installing or contracting for the provision of frequency control services, installing emergency protection schemes or contracting with generators in relation to the operation of their generating units in specified conditions

- make "inertia network services" available to AEMO that when enabled will provide inertia:
  - up to the secure operating level of inertia determined by AEMO for that sub-network;[31] or
  - an amount of inertia less than the secure operating level of inertia, or the minimum threshold level of inertia, if AEMO has approved other activities (inertia support activities) that may contribute to the operation of the inertia sub-network in a secure operating state.[32]
- use reasonable endeavours to make the inertia network services available by the date specified by AEMO in the notice provided to the Inertia Service Provider;[33]
- identify and procure the least cost option or combination of options that will satisfy its obligation in the time required.[34] In planning to meet the requirement to provide inertia network services, the TNSP must prepare and publish information to enable potential providers of inertia network services to develop non-network options. This information should include a description of the requirement for inertia network services, the technical characteristics that a non-network option would be required to deliver, a summary of potential options to make the inertia network services available, and information to assist non-network providers wishing to present proposals to the TNSP.[35]

Inertia Service Provider provides information on inertia network services

- In sub-networks of the NEM where an inertia shortfall has been identified by AEMO there is an obligation on the TNSP that is the Inertia Services Provider to:
  - provide information in its Transmission Annual Planning Report (TAPR) about the activities undertaken to meet its obligations to provide inertia network services or inertia support activities;[36]

30 If there is more than one TNSP in a region then the Inertia Service Provider is the jurisdictional planning body.

31 Final Rule clause 5.20B.4(b)(1); clause 4.3.4(j).

32 Final Rule, new Chapter 10 definition of "inertia support activity" - An activity approved by AEMO under clause 5.20B.5(a); Final Rule clause 5.20B.4(b)(2), 5.20B.5(a); clause 4.3.4(j). Inertia support activities that may be approved may include provision of frequency control services or emergency protection schemes.

33 Final Rule clause 5.20B.4(c)(1).

34 Final Rule clause 5.20B.4(f).

35 Final Rule clause 5.20B.4(g).

36 Final Rule clause 5.20B.4(h).

- give AEMO a schedule setting out the inertia network services it has available and the Inertia Service Provider's proposed order of priority for those services to be enabled by AEMO;[37]

- give AEMO information about inertia support activities made available by the Inertia Service Provider and update AEMO if there is a material change to that information;[38]

- register any synchronous generating unit from which it is procuring inertia network services as an inertia generating unit with AEMO and specify that the generating unit must be constrained on when the generating unit is providing inertia under clause 3.9.7(c) of the final rules;[39] and

- provide specified details of the inertia network services it is making available to AEMO and seek AEMO's approval for the technical specifications and performance standards for those services and for the information necessary for AEMO to enable or cease the provision of those services. AEMO must approve this information or advise the Inertia Service Provider of its concerns and the changes it requires to this information.[40]

Recovery of Inertia Service Provider's costs of making inertia network services available

- The obligation to make inertia network services available is a regulatory obligation or requirement imposed on the relevant TNSP in connection with the provision of prescribed transmission services. The Inertia Service Provider will be entitled to seek a revenue allowance that includes forecast operating expenditure or capital expenditure for its efficient costs of meeting the requirement.

- The final rule amends the definition of "network support payment" to include payments made by a TNSP under an inertia services agreement (inertia service payments). This means that the TNSP can use a network support pass through under clause 6A.7.2 of the existing Rules to recover the difference between inertia service payments included in its operating expenditure allowance for a regulatory year and its actual inertia service payments provided that the relevant inertia service payment was not included in the calculation of a pass through amount approved by the AER under clause 6A.7.3 of the rules.[41]

- The final rule adds a new category of pass through event - an "inertia shortfall event". An inertia shortfall event occurs where a TNSP is required to provide, or cease providing, inertia network services, and meeting this requirement

37 Final Rule clause 5.20B.6(a); clause 4.3.4(k).

38 Final Rule clause 4.3.4(k).

39 Final Rule clause 5.20B.6(b).

40 Final Rule clause 5.20B.6(c) to (h); clause 4.3.4(k).

41 Final Rule amendment to chapter definition of "network support payment", clause 5.20B.4(j).

materially increases or materially decreases the TNSP's costs of providing prescribed transmission services.[42]

TNSP planning investments to meet requirement to provide inertia network services

- Under the final rule TNSPs are not required to apply the Regulatory Investment Test for Transmission (RIT-T) to proposed expenditure on "inertia service payments" or to network investment undertaken by the TNSP where:
  - an inertia shortfall is declared in the inertia sub-network;
  - prior to the declaration the TNSP is not under an obligation to provide inertia network services for that inertia sub-network; and
  - the time for making the inertia network services available to meet the relevant shortfall is less than 18 months after the notice is given by AEMO.[43]
- If the TNSP proposes network investment to meet the requirement to provide inertia network services then it must provide information in its TAPR setting out the date when the proposed relevant network investment became or will become operational, the purpose and total cost of the proposed network investment, and the indicative total cost of any non-network options considered.[44]

Obligations on AEMO to enable inertia network services

- AEMO may enable a range and quantity of inertia network services up to:
  - the minimum threshold level of inertia where a contingency event that would result in the islanding of an inertia sub-network has been classified as a credible contingency event or defined as a protected event; and
  - the secure operating level of inertia where an inertia sub-network is islanded.
- AEMO may enable or cease inertia network services by giving instructions to the TNSP who is providing inertia network services or to a Registered Participant who has contracted with the TNSP to provide inertia network services.[45]
- A TNSP or Registered Participant providing an inertia network service must comply with an instruction given by AEMO to enable or cease inertia network services.[46]

42 Final Rule, new Chapter 10 definition of "inertia shortfall event"; Final Rule clause 6A.7.3.

43 Final Rule clause 5.16.3(a)(9)-(10).

44 Final Rule clause 5.20B.4(i).

45 Final Rule clause 4.4.4(d) or (e).

46 Final Rule clause 4.4.4(g).

Further detail on each aspect of the more preferable final rule referred to above can be found in the remaining chapters of this final determination. The arrangements for the transitional period before the commencement of the final rule are set out in chapter 6.

The final rule introduces a number of new terms and concepts. These terms and concepts, explained in Box 2.1, are used throughout this final determination.

Box 2.1 Definitions introduced in the final rule

Inertia: Contribution to the capability of the power system to resist changes in frequency by means of an inertial response from a generating unit, network element or other equipment that is electro-magnetically coupled with the power system and synchronised to the frequency of the power system.

Inertia network service: A service for the provision of inertia to a transmission system.

Inertia requirements: The minimum threshold level of inertia and the secure operating level of inertia for an inertia sub-network determined by AEMO.

Inertia requirements methodology: Methodology published by AEMO setting out the process AEMO will use to determine the inertia requirements for each inertia sub-network.

Inertia service payment: A payment by a TNSP made under an inertia services agreement.

Inertia Service Provider: The TNSP for the inertia sub-network or, if there is more than one TNSP for the inertia sub-network, the jurisdictional planning body for the relevant jurisdiction.

Inertia services agreement: An agreement under which a person agrees to provide one or more inertia network services to an Inertia Service Provider or to undertake an inertia support activity.

Inertia shortfall: A shortfall in the level of inertia typically provided in an inertia sub-network (having regard to typical patterns of dispatched generation in central dispatch) compared to the secure operating level of inertia most recently determined by AEMO for the inertia sub-network.

Inertia shortfall event: An assessment by AEMO that there is an inertia shortfall in a sub-network.

Inertia sub-network: A part of the national grid for which separate inertia requirements are to be determined, and the boundaries of which are determined by AEMO.

Inertia support activity: An activity undertaken by the Inertia Service Provider to reduce the inertia requirements for the sub-network with AEMO approval.

2.2 Rule making test

2.2.1 Achieving the national electricity objective

The Commission may only make a rule if it is satisfied that the rule will, or is likely to, contribute to the achievement of the national electricity objective (NEO).[47] This is the decision making framework that the Commission must apply.

The NEO is:[48]

> ""to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:
>
> (a) price, quality, safety, reliability and security of supply of electricity; and
>
> (b) the reliability, safety and security of the national electricity system""

2.2.2 Making a more preferable rule

Under s. 91A of the NEL, the Commission may make a rule that is different (including materially different) to a proposed rule (a more preferable rule) if it is satisfied that, having regard to the issue or issues raised in the rule change request, the more preferable rule will or is likely to better contribute to the achievement of the NEO.

2.3 Assessment framework

In assessing the rule change request against the NEO the Commission has considered the following principles:

- **Risk allocation**: System security is necessary for the efficient functioning of the power system and benefits all market participants as well as the wider community. However, there are costs associated with maintaining the secure operation of the power system.

  A trade-off exists between the level of costs that should be incurred in avoiding or minimising the impact on the system should a disturbance occur, and the probability of the level of costs that would likely be incurred as a result of the failure to maintain the system in a secure operating state.

  Costs of avoiding or minimising the impact on the system may include the application of limits on transmission lines or constraining off generation to limit the size of the impact should these generation or network elements suddenly fail.

47 Section 88 of the NEL.

48 Section 7 of the NEL.

It may also include the upfront costs of the provision of frequency response services to stabilise the system should a supply disruption occur.

Risk allocation and the accountability for investment decisions should rest with those parties best placed to manage them. Under a centralised planning arrangement, risks are more likely to be borne by customers. Solutions that allocate risks to market participants, such as businesses who are better able to manage them, are preferred where practicable.

- **Certainty versus flexibility**: Achieving a secure operating system in an economically efficient manner requires regulatory and market frameworks to be designed to encourage investment in system security services and to maximise flexibility in the provision of those services to achieve an economically efficient outcome.

  A secure power system demands the availability of system security services at all times. Regulatory frameworks must be designed to accommodate this requirement by providing certainty to prospective investors as well as existing providers. However, while greater investment certainty may help to make sure that the services are available when they are needed, this may come at the expense of the flexibility to continuously adjust the requirement under changing market conditions.

  Further, regulatory or policy changes should not be implemented to address issues that arise at a specific point in time or in a specific jurisdiction only. Solutions should be flexible enough to accommodate different circumstances at different times and in different jurisdictions. They should be effective in maintaining system security where it is needed while not imposing undue market or compliance costs on other areas.

- **Technology neutral**: Arrangements should be designed to take into account the full range of potential market and network solutions. They should not be targeted at a particular technology, or be designed with a particular set of technologies in mind. Technologies are changing rapidly and, to the extent possible, a change in technology should not require a change in arrangements.

  When considering how frameworks accommodate new technologies, it is the functions they perform that need to be the focus, not the technologies themselves. The relative immaturity and inherent delay in the operation time of fast frequency response technologies at present means that some level of system inertia is required to maintain a stable system frequency. However, fast frequency technologies may have an important future role in reverting frequency to normal operating levels following a contingency.

- **Competition**: Competition and market signals generally lead to better outcomes than prescriptive rules or centralised planning since they are more flexible to changing conditions and give businesses the ability to meet consumers' needs as efficiently as possible. Such outcomes should be less likely to change over time, creating regulatory certainty. Markets should be designed to maximise

opportunities for the provision of services in order to send the right price signals and lower the overall cost of achieving a secure electricity system.

However, requiring solutions that address issues in specific network locations may limit the ability to maximise opportunities for service provision. System frequency is a global issue while system strength issues tend to be locationally specific. The range of service providers that are available to address system frequency may narrow if the same service providers are also required to address issues of system strength.

2.4 Summary of reasons

The costs incurred as a result of the failure to maintain the system in a secure operating state are varied and include such things as damage to equipment, the opportunity costs of lost production, and the additional costs of restoring the system. Depending on the extent of failure, other societal costs may also be incurred.

The Commission considers that an obligation on TNSPs to make minimum levels of inertia continuously available will provide a high degree of confidence that system security can be maintained when separation and islanding of sub-networks occurs. The requirement for TNSPs to identify the least cost option, or combination of options, to provide the minimum levels of inertia, together with the existing economic regulatory framework for TNSPs, will provide discipline on the level of expenditure on inertia network services by enabling the Australian Energy Regulator (AER) to assess the efficiency of that expenditure.[49]

Having regard to the issues raised in the rule change request and during consultation during the *System security market frameworks review* and on the draft rule, the Commission is satisfied that the more preferable final rule will, or is likely to, better contribute to the achievement of the NEO than the proposed rule for the following reasons:

- Contracts entered into by the TNSPs to meet the obligation will provide certainty to prospective third-party investors in inertia and alternative frequency control services, thereby improving the security of the national electricity system for the benefit of consumers. The final rule will allow the TNSP to meet the obligation in the short-term by investing in inertia services or by contracting with existing third-party providers of inertia, while concurrently assessing the most efficient means of meeting the obligation over the long term.

- The periodic review of the level of the obligation on TNSPs to provide inertia network services, and the requirement for the TNSP to identify and procure the least cost option or combination of options to meet its inertia obligation, will

49 AEMO is responsible for planning, authorizing and directing augmentation of the declared shared network in Victoria. Different arrangements for the provision of shared transmission services, including inertia network services, will apply to AEMO in its role as the Inertia Service Provider for Victoria.

assist in making sure that further investments are efficient and reflective of changing market conditions.

- The obligation on TNSPs to provide inertia network services will only apply to sub-networks where AEMO has identified that an inertia shortfall exists. This will promote efficient investment and use of services by:
  - maintaining system security where it is needed while not imposing undue market or compliance costs on other areas; and
  - providing for future shortfalls in inertia to be identified in a timely manner.
- Placing the obligation on TNSPs to provide inertia network services will provide a greater ability to coordinate the provision of inertia network services with other network support requirements for the relevant sub-network, such as system strength. This should result in a more efficient outcome for consumers in the long term by avoiding the potential duplication of investment.
- The ability for the TNSP to make available inertia network services through contracts with third-party providers of services other than the provision of inertia will promote efficiency in investments by expanding the range of options available to manage the secure operation of the system.

The final rule relates to the provision by TNSPs of the minimum level of inertia required to maintain secure operation of the power system. This can be distinguished from additional levels of inertia, or alternative frequency control services, that may increase economic benefits by allowing for greater power transfers on the network. These matters are being considered separately.

2.5 Strategic priority

This rule change request relates to the AEMC's strategic priority relating to markets and networks.

This strategic priority relates to the flexibility and resilience of energy market frameworks to respond to changes in technology and new business models. This includes changes in the generation mix, such as the increased penetration of non-synchronous generation and the subsequent retirement of large synchronous units. This links to the development of a framework to provide services to manage the security of the national electricity system. This framework is designed to support the maintenance of a resilient and secure power system as the generation mix changes.

3 Determining the minimum required levels of inertia and inertia shortfalls

The time delay of frequency response services implies that there is a minimum level of inertia that must be provided to the system at any point in time to resist frequency changes caused by contingency events. The inertia slows the frequency change to provide time for the frequency response services to be activated.

This chapter explores the concept of the minimum level of inertia required to maintain the power system in a secure operating state and sets out further detail on the Commission's final rule to place an obligation on AEMO to:

- determine the boundaries of inertia sub-networks in the NEM;[50]
- publish as part of the NTNDP consultation process an inertia requirements methodology setting out the process it will use to determine the inertia requirements for each inertia sub-network, having regard to matters specified in the NER;[51]
- determine, generally no more than once in any 12 month period, the "inertia requirements" for each inertia sub-network;[52]
- assess whether, in its reasonable opinion, there is, or is likely to be, an inertia shortfall in an inertia sub-network, taking into account matters specified in the final rule;[53]
- where there is, or is likely to be, an inertia shortfall in an inertia sub-network, publish and give to the Inertia Service Provider for the inertia sub-network a notice of the assessment.[54] The Inertia Service Provider is the TNSP for the inertia sub-network or, if there is more than one TNSP for the inertia sub-network, the jurisdictional planning body for the relevant jurisdiction;[55]
- give notice of the date that the Inertia Service Provider must provide for the availability of inertia network services, which must not be earlier than 12 months after the date that the notice of the assessment is published unless an earlier date is agreed with the Inertia Service Provider;[56]

50 Final Rule clause 5.20B.1(b).

51 Final Rule clause 5.20B.2(c)

52 Final Rule clause 5.20B.2(a).

53 Final Rule clause 5.20B.3(a).

54 Final Rule clause 5.20B.3(c).

55 Final Rule clause 5.20B.4(a). The Inertia Service Provider will be AEMO in Victoria.

56 Final Rule clause 5.20B.3(c).

- publish the boundaries of sub-networks and the inertia requirements for each sub-network in the NTNDP and include projections of any inertia shortfall arising at any time within a planning horizon of at least five years.[57]

The Commission has considered stakeholder submissions on the draft rule and has made the following changes, which are reflected in the final rule:

- The Commission has determined that the development and updating of the inertia requirements methodology will be undertaken through the NTNDP consultation process, rather than through a separate process conducted under the Rules consultation procedure.[58] This will provide a greater level of flexibility and adaptability to the evolution of the inertia requirements methodology.

- The Commission has included additional matters in the final rule that AEMO will need to take into consideration when determining the inertia requirements for an inertia sub-network.[59] These additional matters include any constraints that could reasonably be applied to the inertia sub-network when islanded to achieve a secure operating state and any unserved energy that might result from the constraints, and any other matters as AEMO considers appropriate.

- If AEMO assesses that there is, or is likely to be, an inertia shortfall in any inertia sub-network, it must publish and give to the relevant TNSP a notice of that assessment that includes AEMO's specification of the date by which the inertia network services must be available. Under the draft rule, AEMO was restricted to notifying the TNSP of an inertia shortfall at the time of publication of the NTNDP.

- The final rule also excludes from the definition of a "NSCAS need" any requirement for inertia network services to address an inertia shortfall. The Commission considers that it is undesirable to have two frameworks in the NER for the provision of equivalent services, that is, both inertia services provided under the existing NSCAS framework and under the new framework for managing minimum levels of inertia.

3.1 Defining the sub-networks and levels of required inertia

The increased deployment of non-synchronous generation has been more pronounced in some areas of the NEM than others. The extent of this deployment is now at the point where levels of inertia typically dispatched in these areas are falling below the levels required to maintain system security should these areas be separated from the rest of the NEM.

57 Final Rule clauses 5.20B.1(f) and 5.20B.2(c).

58 AEMO must publish an initial inertia requirements methodology by 30 June 2018. In producing the first methodology, AEMO is not required to comply with the NTNDP consultation process.

59 The list of matters for AEMO to take into consideration are set out in the final rules and will be used as the basis for the development of the inertia requirements methodology.

This section sets out the Commission's approach to defining inertia sub-networks and the levels of inertia likely to be required to maintain these sub-networks in a secure operating state if they are islanded.

3.1.1 Defining inertia sub-networks

In order to maintain an islanded region in a secure operating state, a minimum level of inertia must be provided from within the region. Minimum required levels of inertia must therefore be prescribed to a specific region or other defined network area.

South Australia has experienced a substantially faster growth in new types of generation than other regions. Flows on the interconnector with Victoria allow power system security to be maintained because of inertia provided by generators in other parts of the NEM. Where there is an outage of this interconnector, the risks to system security in South Australia increase significantly because it must rely on inertia provided by generators within the region. If there is minimal generation capacity online at the time that has the ability to provide inertia in that region the frequency in that region could be subject to very rapid changes. This makes it harder to arrest the frequency change and restore the frequency to normal operating levels. As the generation mix changes in a similar way across the NEM these risks may become more widespread.

The NEM mainland and Tasmania operate as two separate synchronous systems. The two systems are separated by the Basslink DC interconnector which allows for energy transfer but does not require the two systems to operate synchronously. In order for Tasmania to operate as an island, inertia must be sourced locally. This would imply that separate required levels of inertia would be needed for Tasmania.

A requirement to source inertia locally may also be applied to other areas of the NEM where there is a possibility of separation and islanding. For example, the separation of South Australia from the rest of the NEM, caused by the unavailability or failure of the Heywood Interconnector, would require South Australia to source inertia locally to operate as an island and maintain system security.

Each area of the national network required to be able to operate independently as an island would need to source inertia locally. For each network area there would need to be a possibility of separation and a realistic prospect of continued operation after separation. While a comprehensive list of these areas would need to be developed, it is expected that separate levels of inertia may ultimately be needed for each of the NEM regions and potentially North Queensland and South Queensland individually.

3.1.2 Levels of inertia required to manage power system security

The level of system inertia in the islanded sub-network determines the size of the immediate rate of change of frequency (RoCoF) that would result when separation occurs for a given interconnector flow. Limiting the size of the RoCoF would provide:

- a higher probability of generators remaining online following the occurrence of the contingency event;
- time for emergency frequency control schemes to operate effectively; and
- time for frequency control ancillary services in the islanded sub-network to respond and recover the frequency to normal operating levels.

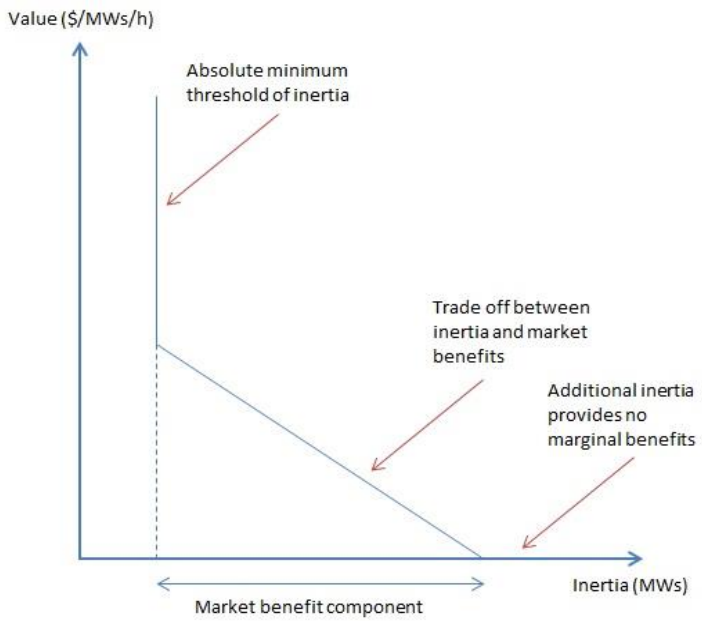
Each of these aspects contributes to the system frequency remaining within the bounds of the Frequency Operating Standards (FOS).

The level of inertia that is required to maintain the RoCoF to a given limit can be divided into two components:

1. **Minimum level of inertia** – The minimum level of inertia that is required to maintain the islanded system in a satisfactory operating state. The minimum level represents a lower bound on the level of inertia that is required to feasibly operate the system. Operating at this minimum level may require load shedding but would be sufficient to maintain the islanded system in a satisfactory operating state and avoid a system black condition. This minimum level might permit only limited interconnector flow, prior to separation.
2. **Market benefits** – Additional inertia above the minimum level of inertia would allow for a more unconstrained operation of the islanded system or additional interconnector flows when not islanded. This would provide benefits of improved reliability and a lower overall cost of energy provision by alleviating constraints on the system.

The split between these two components is illustrated in figure 3.1, which shows a theoretical demand curve for inertia.

Figure 3.1 Value of inertia and the amount of inertia provided

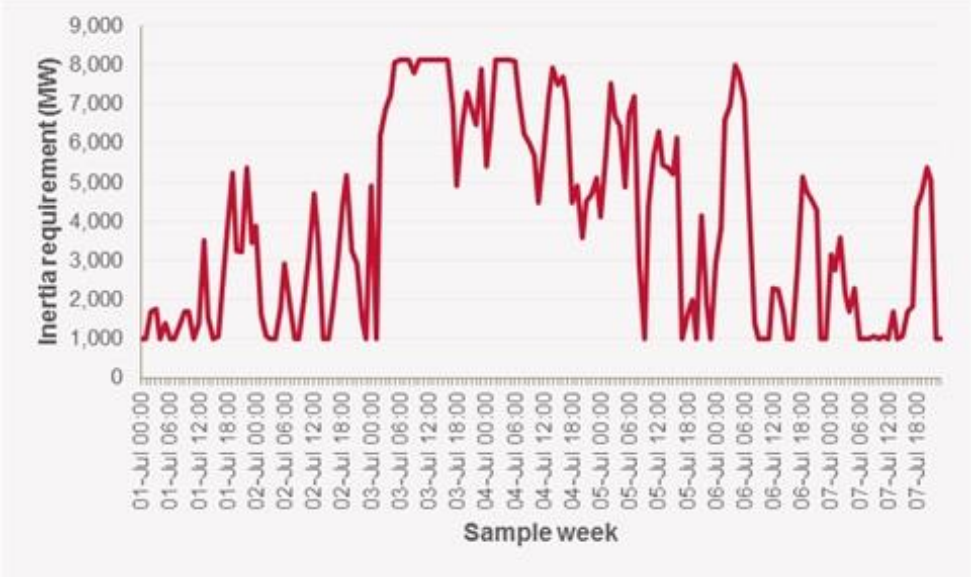


The vertical line on the left represents the minimum level of inertia that is required to maintain the islanded system in a satisfactory operating state. This vertical line is a lower bound on the level of inertia that could feasibly be required in order to operate the system within the FOS and maintain a satisfactory operating state when operating the system as an island. Beyond this level, the sloped line represents the trade-off that exists between the costs of supplying more inertia and other options for managing system security, such as constraining the system or obtaining FFR services. A continuation of the line shows that any additional inertia supplied to the market has no effect in further alleviating constraints on the system and so provides no additional benefit for either maintaining system security, improving reliability, or lowering the overall cost of energy production.

Figure 3.1 represents a theoretical trade-off between increasing levels of inertia and obtaining market benefits. This trade-off is unique to the specific set of operating conditions present in the system at a given point in time. In practice, the level of inertia required to limit RoCoF and maintain the secure operation of the power system varies with changing system conditions.

Figure 3.2 shows how inertia requirements can vary over time depending on the prevailing system and network conditions.

Figure 3.2 Potential variability in required inertia in South Australia[60]



Minimum required levels of inertia

Clause 4.2.2 of the NER defines the conditions under which a system is considered as being in a satisfactory operating state. There are a range of technical parameters that must be maintained within satisfactory limits, including a requirement that the system frequency is within the normal operating frequency band.

60 AEMO, Submission on the directions paper - *System security market frameworks review*, p. 7. Assumes a RoCoF limit of 2 Hz/s.

The minimum level of inertia is sufficient to maintain the islanded sub-network in a satisfactory operating state should it be separated from the rest of the NEM. However, it is not sufficient to maintain a satisfactory operating state should a further credible contingency occur. A credible contingency of even a moderate size would likely cause the system frequency to move outside the bounds of the FOS, potentially resulting in cascading loss of generation and a system black event.

Therefore, once separation has occurred, the continued operation of the islanded system requires a higher level of inertia to be provided. This level of inertia should be sufficient to enable AEMO to return the islanded system to a secure operating state.

The level of inertia required to maintain the islanded sub-network in a secure operating state would be based on a consideration of three different factors:

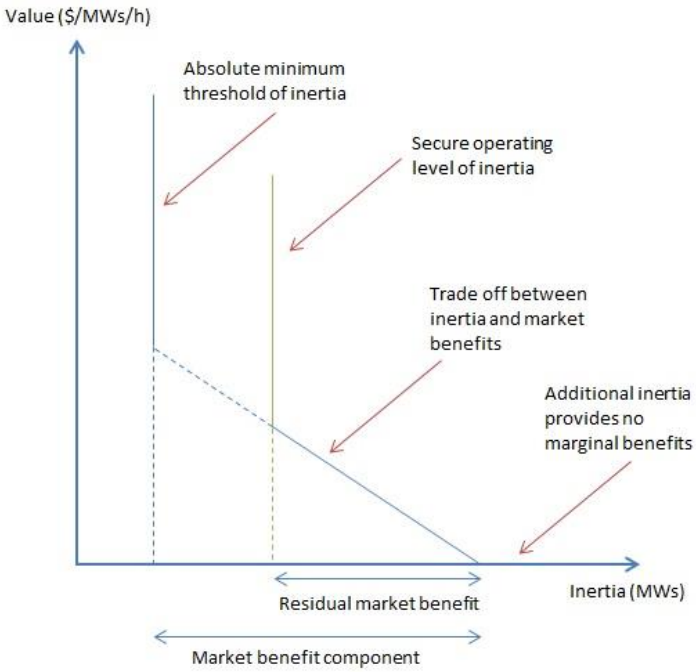
1. *Availability and capability of contingency FCAS* - The capabilities and expected response times of contingency FCAS in the islanded sub-network would determine the maximum RoCoF that could be managed without the frequency moving outside the bounds of the FOS. Inertia does not act to arrest the frequency drop entirely or revert frequency back to normal operating levels. Inertia slows the rate of frequency change and so provides time for contingency FCAS to operate.

2. *Maximum contingency size* - The maximum expected contingency size when operating as an islanded system would also influence the level of inertia required. A larger contingency size results in a higher RoCoF for a given level of inertia. It is likely that the operation of the system as an island would require the system to be operated in a specific highly constrained state, which would likely mean a lower potential contingency size as the majority of generating units would be operating at their minimum output.

3. *Possible further loss of inertia* - Additional inertia needed to account for the possible loss of a synchronous generating unit. The RoCoF that occurs as a result of a contingency event would be even higher if the contingency that occurs is the loss of a synchronous generating unit that is also providing inertia.

Figure 3.3 shows the secure operating level of inertia in relation to the minimum system threshold level of inertia.

Figure 3.3 The minimum threshold level and the secure operating level



The secure operating level of inertia can be determined through the following equation.

$$I = (25 \times \Delta P)/RoCoF' + I'$$

Where

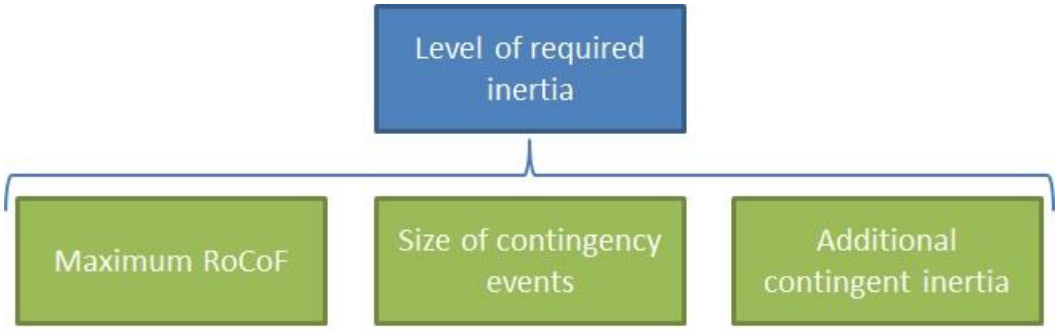
I = The secure operating level of inertia (MW.seconds)

ΔP = The size of the contingency (MW)

RoCoF′ = the maximum rate of change of frequency that would be permitted to provide sufficient time for existing contingency FCAS to operate (Hz/second)

I′ = the additional inertia needed to account for the possible loss of a synchronous generating unit as the contingency (MW.seconds)

Figure 3.4 Factors that affect the secure operating level of inertia



Maximum RoCoF

The level of inertia required to maintain the islanded sub-network in a secure operating state would depend on the availability and capability of other frequency control services in the islanded system. The RoCoF would need to be limited to provide sufficient time for the fastest FCAS to respond and maintain the system frequency within the bounds of the FOS.

Contingency FCAS is controlled locally by generators and consists of technologies designed to detect and respond to larger frequency deviations that occur following contingency events.

The fastest existing contingency FCAS operates within timeframes of less than six seconds. However, it is likely that most of this contingency FCAS could operate over shorter timeframes. Specific analysis would need to be undertaken to determine the exact range and magnitude of response times from frequency control services in each sub-network.

Faster response services, such as fast frequency response (FFR), could also increase the allowable RoCoF by providing much shorter response times. Less inertia would be needed to maintain the system frequency within the bounds of the FOS for a given contingency size.

Size of contingency events

The level of inertia required to limit the RoCoF is proportional to the size of the immediate shortfall in supply or demand arising from the contingency event. The larger the contingency event, the more inertia is required to limit the level of the RoCoF.

The maximum expected contingency size when operating the sub-network as an islanded system would influence the level of inertia required. It is likely that separation and islanding would require the sub-network to be operated in a highly constrained state. This would likely require some load shedding to occur and generating units to be constrained to their minimum operating output. As such, the maximum potential contingency size when operating as an island is likely to be substantially smaller than would be the case under normal operating conditions.

It is expected that the secure operating level of inertia would need to be large enough to account for a contingency equal to the largest minimum operating output from a single generating unit in the sub-network.

Additional contingent inertia

The secure operating level of inertia is intended to be able to maintain the sub-network in a secure operating state when islanded. This should mean that the islanded system can withstand the occurrence of a credible contingency within the sub-network and be able to maintain the system in at least a satisfactory operating state immediately following the contingency.

However, the likelihood of maintaining a satisfactory operating state would be greatly reduced if the contingency that occurs is the loss of a synchronous generating unit. Not only would the contingency event cause a change in the frequency but the ability of the system to dampen this change in frequency would be diminished by the loss of inertia from the synchronous generating unit.

Therefore, additional inertia will need to be provided to account for the possibility that the contingency that occurs is the loss of a synchronous generating unit. This additional inertia would be equal to the amount of inertia provided by an individual generating unit in the sub-network. This generating unit could be either:

- the generating unit providing the most amount of inertia to the system; or
- the generating unit with the highest minimum operating output, representing the largest contingency.

It is likely that the withstand capabilities of the generating units to high RoCoF would need to be taken into account in determining the specific individual generating unit.

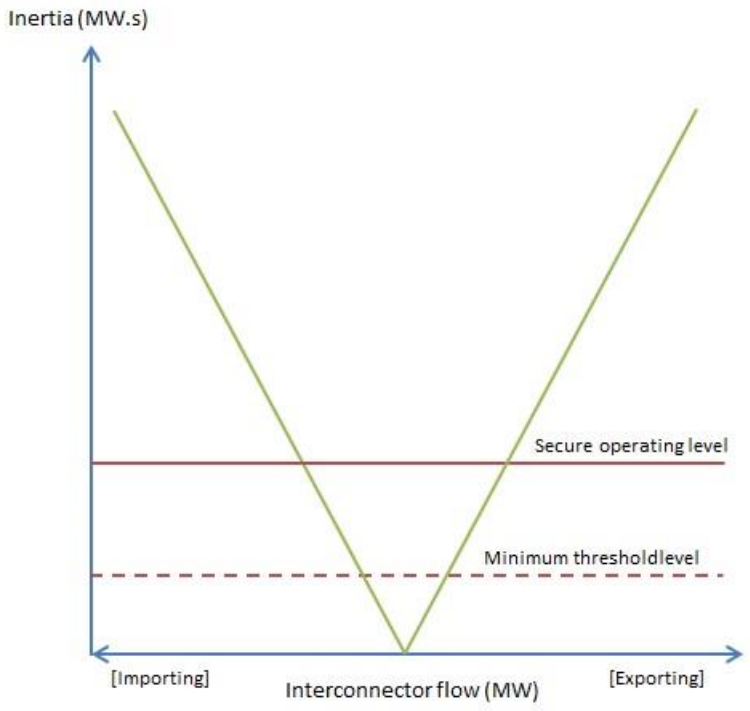
Additional inertia for market benefit

The secure operating level of inertia would only be sufficient to operate the islanded system under specific highly constrained conditions. A higher level of inertia would provide market benefits by either:

- enabling the secure operation of the islanded sub-network under a much larger range of system conditions; or
- when not operating as an island, allowing for greater flows on the interconnectors with adjacent sub-networks.

Figure 3.5 shows the absolute minimum threshold level of inertia (broken red line) and the secure operating level of inertia (solid red line) in comparison to the level of additional inertia that would allow for increased flows on the interconnector (green line). The minimum levels of inertia would limit the potential flows on the interconnector. Additional inertia would allow for the alleviation of constraints and higher flows on the interconnector for a given limit on the RoCoF that would occur from a sudden separation of the interconnector.

Figure 3.5 Comparison of minimum required levels of inertia and additional inertia for market benefit



This final rule does not provide a mechanism to realise the market benefits that could be obtained through the provision of inertia above the minimum obligation on TNSPs. However, the Commission considers that the ability to maintain power system security in an efficient manner would be enhanced by the development and introduction of a mechanism to obtain and pay for this additional inertia. The Commission is considering a mechanism to complement the TNSP obligation imposed through this final rule. A discussion on the potential design of this mechanism is set out in the consultation paper on the *Inertia ancillary service market* rule change request.[61]

3.2 The South Australian Government's view

The South Australian Government notes that there has been a downward trend in inertia in South Australia since 2012, due to the increased wind and rooftop PV generation and the removal from service of synchronous generation such as Northern Power Station in May 2016.[62] The South Australian Government suggests that these issues are likely to present themselves more broadly in the NEM as the generation mix continues to change.

The South Australian Government proposes that AEMO should be provided with powers to determine the types and amount of ancillary services that may assist in addressing the potential for high rates of change of frequency.

61 AEMC, *Inertia ancillary service market - consultation paper*, 5 September 2017.

62 South Australian Minister for Mineral Resources and Energy, *Managing the rate of change of power system frequency rule change request - attachment A*, 12 July 2016, pp. 1-2.

In support of this additional role, a system standard for RoCoF should be established to guide the required level of the services. The level of this standard should be determined by the Reliability Panel in accordance with a process prescribed in the NER. The South Australian Government considers that a RoCoF standard will give the market certainty over the most efficient level of services to be procured to ensure system security.[63]

3.3 The draft rule

The Commission made a draft rule in response to the South Australian Government's rule change request. In relation to the determination of inertia requirements, the draft rule placed an obligation on AEMO to:

- determine the boundaries of inertia sub-networks in the NEM taking into account, among other things, the connections between the proposed inertia sub-network and adjacent parts of the national grid and the likelihood of the proposed inertia sub-network being islanded;
- develop and publish an inertia requirements methodology setting out the process it will use to determine the inertia requirements for each inertia sub-network, having regard to matters specified in the NER;
- determine, generally no more than once in any 12-month period, the "inertia requirements" for each inertia sub-network, being:
  - the minimum level of inertia required to operate the sub-network in a satisfactory operating state when the sub-network is islanded (the minimum threshold level of inertia); and
  - the minimum level of inertia required to operate the sub-network in a secure operating state when the sub-network is islanded (the secure operating level of inertia).
- publish the inertia requirements for each inertia sub-network in the NTNDP.

In relation to the notice of inertia shortfalls, the draft rule placed an obligation on AEMO to:

- assess whether, in its reasonable opinion, there is or is likely to be an inertia shortfall in an inertia sub-network, taking into account matters specified in the draft rule. An inertia shortfall is a shortfall in the level of inertia typically provided in an inertia sub-network compared to the secure operating level of inertia most recently determined by AEMO for the sub-network;
- give notice of its assessment in the NTNDP including the identity of the TNSP that is the Inertia Service Provider for the inertia sub-network. The Inertia Service Provider is the TNSP for the inertia sub-network or, if there is more than one

63 South Australian Department of the Premier and Cabinet, Submission on the directions paper, p. 7.

TNSP for the inertia sub-network, the jurisdictional planning body for the relevant jurisdiction;

- give notice of the date that the Inertia Service Provider must provide for the availability of inertia network services, which must not be earlier than 12 months after the NTNDP providing notice of the assessment is published;
- provide projections of inertia shortfalls in its Electricity Statement of Opportunities (ESOO).

3.3.1 Stakeholder views on the draft rule

A number of stakeholders support the determination of sub-networks by AEMO as the basis for setting the minimum required levels of inertia.[64] AEMO agrees that it is appropriate to initially align the inertia sub-networks with the existing NEM regions.[65] AEMO will then undertake further analysis over time and specify smaller inertia sub-networks if appropriate.

Both Hydro Tasmania and TasNetworks highlight the importance of Tasmania being declared as a separate sub-network.[66]

A number of stakeholders support AEMO's role in determining the required minimum levels of inertia for each sub-network.[67] AEMO states that it can develop an inertia requirements methodology that can be used to determine the minimum inertia requirements for each sub-network.

However, AEMO suggests that, in order to maintain flexibility in the evolution of the inertia requirements methodology, the development and updating of processes for determining the inertia requirements could be managed through the existing NTNDP consultation process.[68] This would allow the inertia requirements procedure to be amended outside of the rule consultation procedures and on a more regular basis, which should allow methodologies to be updated as technical understanding and potential solutions evolve.

Hydro Tasmania also supports a more flexible approach to the development of the inertia requirements methodology and considers that there is likely to be value in enabling AEMO to recalculate the inertia requirements more frequently if required to be responsive to market changes.[69]

---

64 See submissions on the draft determination from: PIAC, p. 1; CEC, pp. 2-3; South Australian Department of the Premier and Cabinet, p. 4, AEMO, p.11.

65 AEMO, Submission on the draft determination, p.11.

66 See submissions on the draft determination from: Hydro Tasmania, p. 2; TasNetworks, p. 18.

67 See submissions on the draft determination from: Hydro Tasmania, pp. 1-2; South Australian Department of Premier and Cabinet, p. 4; AEMO, p. 11.

68 AEMO, Submission on the draft determination, p. 14.

69 Hydro Tasmania, Submission on the draft determination, p. 2.

AEMO also suggests additional factors that should be taken into consideration in the determination of the minimum required levels of inertia beyond those set out in the draft rule. AEMO suggests that the additional inertia needed to account for the possibility of a reduction in inertia should be broadened. If the contingency event that occurs is the loss of a scheduled generating unit then the loss of any synchronous generating unit in the contingency, or the loss or unavailability of any service that is material to managing the RoCoF in the islanded sub-network should also be considered.[70]

Finally, AEMO suggests that the possible application of significant constraints to the islanded sub-network should also be taken into consideration, including any unserved energy that might result from these constraints.

3.4 The final rule

The final rule relates to the provision by TNSPs of the services necessary to meet the minimum level of inertia required to maintain secure operation of the power system. This can be distinguished from additional levels of inertia that may increase economic benefits by allowing for greater power transfers on the network.

This section sets out further detail on the following elements of the Commission's final rule which places an obligation on AEMO to:

- determine the boundaries of inertia sub-networks in the NEM;[71]
- develop and publish an inertia requirements methodology setting out the process it will use to determine the inertia requirements for each inertia sub-network, having regard to matters specified in the NER;[72]
- determine, generally no more than once in any 12-month period, the "inertia requirements" for each inertia sub-network.[73]

3.4.1 Determining the sub-networks

Under the final rule, AEMO will be required to determine the boundaries of inertia sub-networks in the NEM for the purposes of determining the required levels of inertia for those sub-networks.[74] The process for determining the inertia sub-networks will be similar in concept to the process used by AEMO for defining the electrical sub-networks for the system restart standard.

70 AEMO, Submission on the draft determination, p. 12.

71 Final Rule clause 5.20B.1(b).

72 Final Rule clause 5.20.1(b)(4).

73 Final Rule clause 5.20B.2(a).

74 Final Rule clause 5.20B.1(b).

In determining the boundaries of the inertia sub-networks the final rule requires AEMO to take into account a number of matters, including:

- synchronous connections between the proposed inertia sub-network and adjacent parts of the national grid;
- the likelihood of the proposed inertia sub-network islanding;[75] and
- the criticality and practicality of maintaining the proposed inertia sub-network in a satisfactory operating state if it is islanded and being able to return to a secure operating state while islanded.[76]

The structure of the national transmission network is such that the highest risk of separation and islanding tends to be consistent with the boundaries of NEM regions. It is likely that the existing geographic boundaries of NEM regions would be a fair approximation of the likely sub-networks for the purposes of requiring minimum levels of inertia. However, there are also likely to be instances where an inertia sub-network could be defined within an existing NEM region. Northern Queensland would be a candidate that is likely to satisfy the criteria of an inertia sub-network based on the distance and extent of transmission connection with southern Queensland.

There may also be instances where the boundaries of an inertia sub-network could potentially encompass parts of two or more NEM regions. The limiting factor with these sub-networks would be the difficulty of assigning responsibility to procure the required levels of inertia to more than one TNSP.

Therefore, the Commission confirms its position in the draft rule that the boundaries of any inertia sub-network determined by AEMO must be consistent with the boundaries of an existing NEM region or wholly confined within an existing NEM region.[77]

AEMO may adjust the boundaries of any inertia sub-networks or establish any new inertia sub-networks having regard to the matters referred to above. The boundaries of the inertia sub-networks are required to be published in the NTNDP.[78]

In determining or adjusting the boundaries of the inertia sub-networks, AEMO will be required to follow the Rules consultation procedures.[79]

On a transitional basis, the final rule provides that AEMO is taken to have determined inertia sub-networks having the same boundaries as the boundaries of each region in the NEM.[80]

---

75 The final rule includes a proposed definition of "island" as being in relation to an inertia sub-network, or a combination of two or more inertia sub-networks, temporary loss of synchronous connection to all adjacent parts of the national grid.

76 Final Rule clause 5.20B.1(d).

77 Final Rule clause 5.20B.1(c).

78 Final Rule clause 5.20B.1(f).

79 Final Rule clause 5.20B.1(e).

3.4.2 Determining the minimum required levels of inertia

The Commission's final rule requires AEMO to determine separate required levels of inertia for each inertia sub-network.[81] The required levels of inertia are required to be determined periodically in accordance with an inertia requirements methodology made by AEMO.[82] Consistent with AEMO's feedback on the draft rule, the Commission has determined that the development and updating of the inertia requirements methodology will be undertaken through the NTNDP consultation process, rather than through a separate process conducted under the Rules consultation procedure. This will provide a greater level of flexibility and adaptability to the evolution of the inertia requirements methodology. An overview of the NTNDP consultation process is set out in Box 3.1.

AEMO will conduct the inertia process to determine the "inertia requirements" for each inertia sub-network. The inertia requirement is made up of two separate levels of inertia:

- The minimum threshold level of inertia - The minimum level of inertia required to operate the inertia sub-network in a satisfactory operating state when islanded.

- The secure operating level of inertia – The minimum level of inertia required to operate the inertia sub-network in a secure operating state when islanded.

The final rule requires AEMO to take into account certain matters when determining the inertia requirements for an inertia sub-network. These matters include the capability and expected response times of frequency control services in the islanded region and the maximum load shedding or generation shedding expected to occur on the occurrence of any credible contingency events, as set out in section 3.1.2.

As suggested by AEMO, the Commission has included additional matters in the final rule that AEMO, through the application of the inertia requirements methodology, will need to take into consideration when determining the inertia requirements for an inertia sub-network. These additional matters include any constraints that could reasonably be applied to the inertia sub-network when islanded to achieve a secure operating state and any unserved energy that might result from the constraints, and any other matters as AEMO considers appropriate.[83]

As the deployment of greater levels of non-synchronous generation continues, the required levels of inertia will need to remain reflective of the prevailing market and system conditions. Most FCAS is currently provided by synchronous generators. As synchronous generators become scarcer, the required levels of inertia will increase or

80 Final Rule clause 11.100.2.

81 Final Rule clause 5.20B.2(a).

82 Final Rule clause 5.20B.2(b).

83 Final Rule clause 5.20.7(a).

new sources of FCAS will need to be found for AEMO to be able to manage excursions in system frequency when they occur.

Under the transitional provisions in the final rule, AEMO must make an initial determination of inertia requirements by 30 June 2018.[84] After the initial determinations, the timing for determining inertia requirements is generally at AEMO's discretion subject to AEMO not making a determination more than once every 12 months.[85]

However, in order to make sure that the required levels of inertia remain reflective of changing market conditions, AEMO must determine inertia requirements for an affected inertia sub-network as soon as reasonably practicable after becoming aware of a material change to the power system likely to affect the inertia requirement where the timing, occurrence or impact of the change was unforeseen, such as the unexpected retirement of a large synchronous generator.[86] As discussed in section 3.4.3, any material change to the power system that is reasonably foreseeable should be reflected in AEMO's projections of inertia shortfalls in the NTNDP. AEMO is required to publish the required levels of inertia for each sub-network in the NTNDP.

Box 3.1 NTNDP consultation process[87]

In its role as National Transmission Planner, AEMO is required to prepare, maintain and publish a plan for the development of the national transmission grid, the NTNDP.

The development and publication of the NTNDP is a two-staged process which constitutes a preliminary consultation and the publication of the NTNDP.

By 30 January each year, AEMO is required to publish a document setting out the NTNDP inputs and a statement of the material issues to be considered in the NTNDP.

Following the publication of these documents, AEMO is required to invite submissions for at least 30 business days on:

- proposed inputs into the NTNDP (e.g. assumptions about generation costs and electricity demand forecasts);
- the material issues raised by AEMO to be considered in the NTNDP;
- the inertia requirements methodology;
- the contents of the most recent NTNDP.

84 Final Rule clause 11.100.4(a).

85 Final Rule clause 5.20B.2(a)(1).

86 Final Rule clause 5.20B.2(a)(2).

87 Clause 5.20.1 of the NER.

By 30 December, AEMO is required to publish the NTNDP. The NTNDP provides an overview of the development of the transmission network in the NEM over a 20 year planning horizon.

In preparing the NTNDP, AEMO must take into account the submissions made in response in the NTNDP consultation process.

3.4.3 Identifying shortfalls in inertia

The final rule requires AEMO to assess the levels of inertia being provided in each inertia sub-network and assess whether, in its reasonable opinion, there is, or is likely to be, an inertia shortfall in an inertia sub-network and AEMO's forecast of the period over which that shortfall will exist.

The final rule sets out the following factors that AEMO must take into account in making its assessment:

(a) over what time period and to what extent the inertia that is typically provided in the sub-network is likely to be below the secure operating level of inertia; and

(b) the levels of inertia that are typically provided in adjacent connected inertia sub-networks and the likelihood of the inertia sub-network becoming islanded;

(c) any other matters that AEMO reasonably considers to be relevant in making its assessment.

AEMO will be required to publish its projections of the levels of inertia in each inertia sub-network as part of the NTNDP.[88] The projections should include AEMO's forecast of any inertia shortfall arising at any time within a planning horizon of at least five years.

If AEMO assesses that there is, or is likely to be, an inertia shortfall in any inertia sub-network, it must publish and give to the relevant TNSP a notice of that assessment that includes AEMO's specification of the date by which the inertia network services must be available.[89] This must not be any earlier than 12 months after the notice is published unless an earlier date is agreed with the TNSP.

The Commission considers that this should provide a greater level of flexibility than the draft rule, which restricted AEMO to notifying TNSPs of an inertia shortfall at the time of publication of the NTNDP.

88 Final Rule clause 5.20B.2(c).

89 Final Rule clause 5.20B.3(c).

3.4.4 A new framework to replace the use of the Network Support and Control Ancillary Service framework

Network support and control ancillary services (NSCAS) are network support services designed to promote power system security and the reliability of the transmission network or to maintain or increase the power transfer capability of the transmission network in order to maximise net economic benefits. The NSCAS framework is explained in Box 3.2.

The existing NSCAS framework provides for the acquisition of services to maintain power system security, and this may include the provision of services that increase inertia within the power system.

The Commission understands that in practice the NSCAS framework has not worked as effectively as possible for a variety of reasons, often resulting in AEMO being required to act a procurer of last resort (see Box 3.2).

The Commission considers that it is preferable to have a framework that is better suited and targeted to managing low inertia than the NSCAS framework. The framework in the final rule achieves this for the following reasons:

- *Regular assessment of potential requirement*s – The new framework requires AEMO to consider minimum inertia requirements each year. Under the NSCAS framework, issues tend to be identified in a more ad-hoc fashion as there is no obligation on AEMO to explicitly consider NSCAS related requirements.

- *Transparent framework to assess requirements* - The new framework requires the development of an inertia requirements methodology in consultation with industry participants. There is limited transparency as to the assumptions that AEMO uses when declaring a NSCAS need.

- *Anticipates future requirements* – The NSCAS framework tends to address issues as they arise, whereas the new framework requires AEMO to provide projections of inertia shortfalls into the future.

- *Clearly defined obligation on TNSPs with regulatory oversight* – The new framework places a clear and well defined obligation on the relevant TNSP to meet inertia requirements. Under the NSCAS framework, TNSPs may elect not to address the requirements.

The Commission considers that it is undesirable to have two frameworks in the NER for the provision of equivalent services, that is, both inertia services provided under the existing NSCAS framework and under the new framework for managing minimum inertia.

Therefore, the final rule amends the existing NSCAS framework so that from 1 July 2018, when the final rule takes effect, a system security issue that could be addressed as an inertia shortfall cannot be declared as a NSCAS gap. Any inertia issue that is identified after 1 July 2018, when the final rule takes effect, will be declared as an

inertia shortfall under the new framework and the TNSP will need to meet the associated inertia requirement in accordance with the new framework. This provision of the final rule does not prevent AEMO taking other action in the interim, such as imposing network constraints or issuing system security directions.

The final rule also includes transitional arrangements to apply for any NSCAS gaps declared prior to 1 July 2018. These transitional arrangements are set out in chapter 6 of this final determination.

Box 3.2 Network Support and Control Ancillary Services

Network support and control ancillary services (NSCAS) are network support services designed to promote power system security and the reliability of the transmission network or to maintain or increase the power transfer capability of the transmission network in order to maximise net economic benefits.[90]

NSCAS requirements are identified by AEMO as part of its NTNDP after taking into account all activities which have been identified by the TNSP. As such, NSCAS requirements represent a gap between the level of services that have been identified by AEMO and those that have been identified by the TNSP. This is referred to as the NSCAS Gap.

AEMO is required in the NER to determine the different types of NSCAS.[91] AEMO has determined three types of NSCAS to be:

- Network loading ancillary service (NLAS): The purpose of NLAS is to allow an increase in the power transfer of a transmission network whilst ensuring that the network will still be in a secure operating state.
- Voltage control ancillary service (VCAS): The purpose of VCAS is to control the power flows of a transmission network for the control of voltage to be within defined operating limits and maintaining voltage stability.
- Transient and oscillatory stability ancillary service (TOSAS): The purpose of TOSAS is to increase power flows on a transmission network by increasing the transient or oscillatory stability limit of the network.

In summary, the NSCAS process involves the following steps:

- AEMO, in the NTNDP, may identify an NSCAS gap. If a gap is identified, AEMO may request the relevant TNSP to advise when the TNSP will have arrangements in place to meet that NSCAS gap, or provide reasons why the NSCAS gap will not be met.
- The TNSP's response to the identification of a NSCAS Gap can take the form of physically building assets or contracting a service to a third party.

90 Clauses 3.11.3 to 3.11.6 of the NER.

91 Clause 3.11.4(a1) of the NER.

The TNSP determines the most economically efficient option for addressing the NSCAS Gap by comparing expressions of interest from third party providers.

- The TNSP must respond to AEMO within 30 days.
- Following the TNSP's response, AEMO must consider whether it a NSCAS gap still exists (i.e. whether the TNSP proposal is sufficient to meet the gap).
- If AEMO determines the gap still exists, AEMO must use reasonable endeavours to meet the gap.
- As the procurer of last resort, AEMO can only acquire services to address system security or reliability NSCAS gaps, not market benefits.[92]

92 That is, AEMO cannot procure NSCAS services to maximise or increase the power transfer capability of the network to increase the economic benefits of those using the network.

4 Providing the minimum required levels of inertia

In sub-networks of the NEM where an inertia shortfall has been identified by AEMO, the final rule imposes an obligation on the TNSP that is the Inertia Services Provider to:

- make "inertia network services" available to AEMO that when enabled will provide inertia:
  - up to the secure operating level of inertia determined by AEMO for that sub-network;[93] or
  - an amount of inertia less than the secure operating level of inertia, or the minimum threshold level of inertia, if AEMO has approved other activities (inertia support activities) that may contribute to the operation of the inertia sub-network in a secure operating state.[94]
- use reasonable endeavours to make the inertia network services available by the date specified by AEMO in the notice provided to the Inertia Service Provider;[95]
- identify and procure the least cost option or combination of options that will satisfy its obligation in the time required;[96]
- provide information in its Transmission Annual Planning Report (TAPR) about the activities undertaken to meet its obligations to provide inertia network services or inertia support activities;[97]
- give AEMO a schedule setting out the inertia network services it has available and the Inertia Service Provider's proposed order of priority for those services to be enabled by AEMO;[98]
- register any synchronous generating unit from which it is procuring inertia network services as an inertia generating unit with AEMO and specify that the generating unit must be constrained on when it is providing inertia under clause 3.9.7(c) of the final rule;[99] and
- provide specified details of the inertia network services it is making available to AEMO and seek AEMO's approval for the technical specifications and

93 Final Rule clause 5.20B.4(b)(1); clause 4.3.4(j).

94 Final Rule, new Chapter 10 definition of "inertia support activity" - An activity approved by AEMO under clause 5.20B.5(a); Final Rule clause 5.20B.4(b)(2), 5.20B.5(a); clause 4.3.4(j). Inertia support activities that may be approved may include provision of frequency control services or emergency protection schemes.

95 Final Rule clause 5.20B.4(c)(1).

96 Final Rule clause 5.20B.4(f).

97 Final Rule clause 5.20B.4(h).

98 Final Rule clause 5.20B.6(a); clause 4.3.4(k).

99 Final Rule clause 5.20B.6(b).

performance standards for those services and for the information necessary for AEMO to enable or cease the provision of those services. AEMO must approve this information or advise the Inertia Service Provider of its concerns and the changes it requires to this information.[100]

The final rule also requires:

- AEMO to enable inertia network services to the levels, and in the circumstances, specified in the final rule.
- AEMO to enable or cease inertia network services by giving instructions to a TNSP providing inertia network services or a Registered Participant who has contracted with the TNSP to provide inertia network services.[101]
- A TNSP or Registered Participant providing an inertia network service to comply with an instruction given by AEMO to enable inertia network services.[102]

The Commission has considered stakeholder submissions on the draft rule and has made the following changes, which are reflected in the final rule:

- The final rule amends clause 5.20B.4(c)(1) to provide that the Inertia Services Provider must use 'reasonable endeavours' to make the inertia network services available by the date specified by AEMO. The Commission recognises that, in some circumstances, there may be a limited number of parties with whom to contract for the provision of services, or potential providers of inertia may not wish to enter into contracts with the TNSP.
- In order to make clear that the determination of an inertia shortfall during the course of a regulatory control period constitutes a pass through event under chapter 6A of the NER, the final rule adds a new category of pass-through event - an 'inertia shortfall event'. An inertia shortfall event occurs where a TNSP is required to provide, or cease providing, inertia network services and meeting this requirement materially increases or decreases the TNSP's costs of providing prescribed transmission services.[103] The addition in the final rule of a new category of pass through event should provide greater certainty to the TNSP that the efficient costs of meeting the obligation can be recovered.
- Under the final rule TNSPs will not be required to apply the Regulatory Investment Test for Transmission (RIT-T) to proposed expenditure on "inertia service payments" or to network investment undertaken by the TNSP where:

100 Final Rule clause 5.20B.6(c) to (h); clause 4.3.4(k).

101 Final Rule clause 4.4.4(d) or (e).

102 Final Rule clause 4.4.4(g).

103 The Chapter 10 definitions relevant to network support pass through under clause 6A.7.2 of the rules have also be amended so that if the AER approves a pass through amount for an inertia shortfall event under clause 6A.7.3 that relates to inertia services payments, the TNSP can recover any differences between that pass through amount and the actual amount of network services payments in following regulatory years as a network support pass through under clause 6A.7.2.

- an inertia shortfall is declared in the inertia sub-network;
- prior to the declaration the TNSP is not under an obligation to provide inertia network services; and
- an inertia shortfall is declared in the inertia sub-network and where the time for making the inertia network services available is less than 18 months after the notice is given by AEMO.

The Commission considers that a requirement to conduct a RIT-T for network investments has the potential to limit the options available to TNSPs to efficiently meet inertia obligations in the short to medium term. The exemption to conducting a RIT-T for network investments will increase the competitive pressure on third-party providers of services and will make sure that potentially more efficient network investments are not precluded from meeting the obligation.

- The final rule requires the TNSP undertake a process of screening of the cost and availability of potential third-party providers of services to improve the efficiency of the contracting solution and to make sure that the TNSP considers all options available to meeting the obligation beyond network investments. In planning to meet the requirement to provide inertia network services, the TNSP must prepare and publish information to enable potential providers of inertia network services to develop non-network options. This information should include a description of the requirement for inertia network services, the technical characteristics that a non-network option would be required to deliver, a summary of potential options to make the inertia network services available, and information to assist non-network providers wishing to present proposals to the TNSP.[104]
- If the TNSP proposes network investment to meet the requirement to provide inertia network services then it must provide information in its TAPR setting out the date when the proposed relevant network investment became or will become operational, the purpose and total cost of the proposed network investment, and the indicative total cost of any non-network options considered.[105]

4.1 The obligation on the TNSP

The draft rule proposed that the obligation for procuring the required levels of inertia would be placed on the relevant TNSP in each inertia sub-network. The TNSP would act as the provider of inertia network services so that the minimum required levels of inertia determined by AEMO are made continuously available to the system.

104 Final Rule clause 5.20B.4(g).

105 Final Rule clause 5.20B.4(i).

4.1.1 The TNSP as provider

Placing an obligation on the relevant TNSP to provide the required levels of inertia is supported by:

- the existence of an incentive based economic regulatory framework that can provide some discipline on the level of expenditure by TNSPs on inertia network services by enabling the AER to assess the efficiency of that expenditure;
- the ability to coordinate the provision of inertia with other network support services, such as system strength requirements.

An existing economic regulatory framework

The purpose of an obligation to provide a minimum level of inertia is to provide a high degree of confidence that system security can be maintained when separation and islanding of the sub-network occurs.

One of the key reasons the Commission considers that the obligations should be placed on TNSPs is that the existing economic regulatory framework provides and incentive for TNSPs to undertake efficient expenditure on services, such as inertia network services, by enabling the AER to assess the efficiency of that expenditure, including a consideration of how the services can also be used to deliver system strength.

Under the RIT-T, a detailed cost benefit analysis is undertaken to identify the investment option to meet an identified need (such as the need for inertia network services) which has the highest net benefits. TNSPs are required to consider all feasible network and non-network options and are required to seek submissions from registered participants, AEMO and interested parties on all credible options.

In Victoria, the obligation to make inertia network services available will be placed on AEMO as the jurisdictional planning body. AEMO is responsible for planning, authorizing and directing augmentation of the declared shared network in Victoria. Different arrangements for the provision of shared transmission services, including inertia network services, will apply to AEMO in its role as the Inertia Service Provider for Victoria.

Coordinating the location of services in the network

The location of sources of inertia in the system has implications for the management of system security. The location of the services may have an impact on the ability to manage frequency under some circumstances. Equally importantly, other aspects of system security including system fault levels and voltage control are likely to be substantially impacted by the network location of the provision of inertia.

Operating the power system in a secure operating state requires generating units and network components to be able to operate continuously following a major fault or disturbance to the power system, and this ability is diminished by declining system

strength. This is why the system strength at a point in the power system is often referred to as the fault level.

As compared to system frequency, system strength has much more localised impacts. The system strength at a point in the power system depends on how well it is connected to the synchronous generating units in that part of the power system. The system strength will be higher when:

- there are a number of large generating units nearby; and
- the point is connected to those generating units with more transmission (or distribution) lines and transformers.

Non-synchronous generators do not contribute to system strength as much as synchronous generating units, if at all.[106]

The final determination on the South Australian Government's rule change request relating to the management of power system fault levels has set out a number of obligations on TNSPs and generators in maintaining minimum levels of system strength.[107]

Procurement mechanisms for frequency control, which might lead to investments in new synchronous devices, should therefore consider the location of such investments in order to co-optimise this with any investment required to manage system strength.

The Commission considers that TNSPs are best placed to provide the required levels of inertia within each inertia sub-network and to coordinate the location of inertia with other network support services, including obligations related to minimum system strength.

4.1.2 Determining the level of inertia to be provided

The final rule establishes an obligation on the TNSP to make sure that the required levels of inertia are continuously available. However, the maintenance of system security is unlikely to necessitate that the full required level of inertia is continuously provided to the system. The variability in system conditions will mean that decisions will need to be made around the appropriate level of inertia to be provided to the system at any given time.

The minimum threshold level of inertia will be sufficient to maintain the islanded system in a satisfactory operating state should it be separated from the rest of the NEM. The power system is defined as being in a satisfactory operating state when a series of technical parameters, such as frequency and voltage, are within normal operating limits.[108] However, a credible contingency event, of even a moderate size,

106 Some modern inverter based generation can provide a limited contribution to system strength.

107 AEMC, *Managing power system fault levels - final determination*, 19 September 2017.

108 Clause 4.2.2 of the NER.

would likely cause the system frequency to move outside the bounds of the FOS, potentially resulting in cascading loss of generation and a system black event.

The minimum threshold level of inertia will not be sufficient to maintain a secure operating state, which requires the system to remain in at least a satisfactory operating state following the occurrence of a credible contingency event or a protected event.[109] Therefore, once separation has occurred, the continued operation of the islanded system will require the higher secure operating level of inertia to be provided. This level of inertia should be sufficient to enable AEMO to return the islanded system to a secure operating state.

Clause 4.2.6 in the NER requires AEMO to take all reasonable actions to return the system to a secure operating state within 30 minutes of the occurrence of a contingency event, in this case a separation contingency event.

The prevailing system conditions at any particular time may not necessitate that the full required levels of inertia are provided by the TNSP. The exact level of inertia to be provided will also be influenced by the amount of inertia being incidentally provided from other sources that are not under the control of the TNSP. Other factors may also be taken into consideration such as the RoCoF withstand capability of the generators online at the time or specific generators of a larger contingency size that are not online.

4.2 The South Australian Government's view

The South Australian Government considers that the rules should be amended to enable AEMO to procure inertia via ancillary services agreements.[110] In support of this obligation, AEMO would develop guidelines for the acquisition of inertia, similar to the guidelines developed for System Restart Ancillary Services (SRAS). The guidelines would contain technical information, information on the contracting process for AEMO to follow when contracting with a potential service provider, and guidance to registered participants on the factors that AEMO must take into account when making a decision to follow a particular type of procurement process.

The South Australian Government notes that clause 3.11 of the NER currently enables AEMO to instruct a person to provide a non-market ancillary service under an ancillary services agreement and that the person must use reasonable endeavours to comply with this instruction.[111] The South Australian Government proposed to extend the list of these services beyond system restart ancillary services and network support and control ancillary services (NSCAS) to include a broader range of ancillary services that can be used to manage high RoCoF.

109 A protected event is a non-credible contingency that, following a declaration by the Reliability Panel, must be managed in a similar manner to credible contingencies.

110 South Australian Minister for Mineral Resources and Energy, *Managing the rate of change of power system frequency rule change request - attachment A*, 12 July 2016, p. 2.

111 South Australian Minister for Mineral Resources and Energy, *Managing the rate of change of power system frequency rule change request – attachment A*, 12 July 2016, p. 2.

4.3 The draft rule

In sub-networks of the NEM where an inertia shortfall has been identified by AEMO, the draft rule imposed an obligation on the TNSP that is the Inertia Services Provider to:

- make inertia network services available that when enabled will provide inertia:
  - to the secure operating level of inertia determined by AEMO for that sub-network; or
  - an amount of inertia less than the secure operating level of inertia but at least the minimum threshold level of inertia if AEMO has approved other activities that may contribute to the operation of the inertia sub-network in a secure operating state when the inertia sub-network is islanded.
- make the inertia network services available by the date specified by AEMO in the NTNDP;
- identify and procure the least cost option or combination of options that will satisfy its obligation in the time required;
- provide information in its Transmission Annual Planning Report about the activities undertaken to meets its obligations to provide inertia network services;
- give AEMO a schedule setting out the inertia network services it has available (and any activities approved by AEMO that reduce the secure operating level of inertia) and the Inertia Service Provider's proposed order of priority for those services and activities to be enabled by AEMO;
- register any synchronous generating unit from which it is procuring inertia network services as an inertia generating unit with AEMO and specify that the generating unit must be constrained on when it is providing inertia under clause 3.9.7(c) of the rules; and
- provide specified details of the inertia network services it is making available to AEMO and seek AEMO's approval for the technical specifications and performance standards for those services and for the information necessary for AEMO to enable or cease the provision of those services. AEMO must approve this information or advise the Inertia Service Provider of its concerns and the changes it requires to this information.

In relation to the enablement of inertia network services, the draft rule provided that:

- AEMO may enable inertia network services to the levels, and in the circumstances, specified in clauses 4.4.4(a) and (b) of the draft rule;

- AEMO may enable or cease inertia network services by giving instructions to a Registered Participant who has contracted with the TNSP to provide inertia network services; and

- A Registered Participant providing an inertia network service must comply with an instruction given by AEMO to enable inertia network services.

4.3.1 Stakeholder views on the draft rule

The Commission received a range of responses from stakeholders relating to the role of the TNSP in making the inertia network services available. Responses focused on the following four key aspects of the obligation:

- The TNSP as the appropriate entity to make the inertia network services available.

- The implications of the time required to undertake a RIT-T process with respect to network investment.

- The extent of the circumstances under which the TNSP must meet the obligation.

- The ability of the TNSP to recover the costs of meeting the obligation.

The TNSP as the appropriate entity to make the inertia network services available

A number of stakeholders suggest that there are strong incentives on TNSPs to construct network assets over non-network solutions because capital expenditure attracts both a return on debt and a return on equity for the network business over the life of the asset.[112]

The South Australian Government also supports this view and suggests that placing obligation on TNSPs would likely lead to investments that are locked in for long periods of time for providing services that may vary considerably with changing system conditions.[113]

Origin Energy suggests that an effectively designed contract tendering process would avoid consumers paying additional charges through the TNSP's regulated asset base on stranded assets that are excess to requirements.[114]

An AEMO managed procurement process is also likely to drive lower cost outcomes for consumers by removing this potential conflict of interest and allowing all parties to compete effectively for contracts.[115]

---

112 See submissions on the draft determination from: EnergyAustralia, p. 2; Origin Energy, p. 1; AEC, p. 2.

113 South Australian Department of Premier and Cabinet, Submission on the draft determination, p. 6.

114 Origin Energy, Submission on the draft determination, pp. 1-2.

115 Origin Energy, Submission on the draft determination, p. 1.

EnergyAustralia considers that an AEMO procurement process would avoid any potential market distortions from allowing monopoly asset owners to be involved in a competitive element of the market.[116]

In support of the draft rule, the Public Interest Advocacy Centre (PIAC) suggests that the provision of inertia as a regulated service provides some degree of transparency in TNSP's planning and expenditure through measures such as the RIT-T and the revenue determination process by the AER.[117]

A number of other stakeholders also support this view and suggest that TNSPs are uniquely positioned to manage the minimum inertia required for their networks, given the strong link between delivering inertia and providing system strength.[118]

Hydro Tasmania and Meridian Energy support placing the obligation on TNSPs but suggest that care should be taken to ensure that investments made now do not subsequently lock out future investments that may provide a more cost effective solution for customers.[119]

The implications of the time required to undertake a RIT-T process with respect to network investment

ElectraNet and TransGrid suggest that a minimum response time of 12 months to respond to a notification from AEMO will bias the response to third-party contracts away from TNSP capital investment even when this may be the most efficient option.[120] They argue that the bias towards a non-network solution will occur because, under the draft rule:

- third-party contract costs are to be recoverable as 'inertia support payments'[121] that will not be subject to the RIT-T while capital expenditure will still be subject to the full RIT-T process; and
- the procedures for conducting a full RIT-T are lengthy and it is unlikely that a RIT-T could be completed in 12 months.

TransGrid suggests that this could preclude assessment of feasible and potentially efficient investment options.[122]

116 EnergyAustralia, Submission on the draft determination, p. 2.

117 PIAC, Submission on the draft determination, p. 1.

118 See submissions on the draft determination from: AEMO, p. 11; Spark Infrastructure, p. 1; SACOME, p. 1; S&C Electric, p. 2.

119 See submissions on the draft determination from: Hydro Tasmania, p. 1; Meridian Energy, p. 1.

120 See submissions on the draft determination from: ElectraNet, p. 11; TransGrid, pp. 1-2.

121 Under the final rule these payments are now called "inertia service payments".

122 TransGrid, Submission on the draft determination, pp1-2.

The extent of the circumstances under which the TNSP must meet the obligation

ElectraNet and TasNetworks suggest that, under circumstances in which AEMO has provided notice of an inertia shortfall, there may be a limited number of parties with whom the TNSP can contract.[123]

ElectraNet considers it unrealistic to expect that TNSPs will be able to contract with a guarantee of performance as generators may simply decide against entering a contract with a guarantee of this nature.[124]

Further, a lack of competition from third-party providers may create a significant risk that the costs passed through to customers will not be efficient. ElectraNet suggests that arrangements are needed to safeguard outcomes for electricity consumers by providing essential protections for the TNSP in a procurement role in the event that there is a lack of competitive provision of such services within its network.

PIAC and the South Australian Chamber of Mines and Energy (SACOME) both raise as an issue the importance of considering consumers' actual willingness to pay for higher levels of reliability in determining and procuring the minimum levels of inertia.[125] The costs of procurement by TNSPs should reflect consumer preferences regarding cost versus reliability trade-offs.

The ability of the TNSP to recover the costs of meeting the obligation

TransGrid, ElectraNet and TasNetworks raise the possibility of significant cashflow issues arising under the draft rule.[126] TransGrid considers that, where costs are recovered via network support pass-through arrangements, there can be a significant cashflow impact because the TNSP must pay the provider for the service but does not recover the costs until up to two years later.[127]

ElectraNet considers that cashflow impacts could be substantial in the first instance because there is no specific network support allowance in place for the new services under an existing revenue determination and the specifics of the necessary commercial details are uncertain.[128]

Both ElectraNet and TransGrid suggest that the rules need to include a mechanism for faster cost recovery, particularly where a service need is identified for the first time.

123 See submissions on the draft determination from: ElectraNet, p. 5; TasNetworks, p. 3.

124 ElectraNet, Submission on the draft determination, p. 9.

125 See submissions on the draft determination from: PIAC, p. 1; SACOME, p. 2.

126 See submissions on the draft determination from: TransGrid, pp. 4-5; ElectraNet, p.10; TasNetworks, p. 3.

127 TransGrid, Submission on the draft determination, pp. 4-5.

128 ElectraNet, Submission on the draft determination, p. 10.

4.4 The final rule

This section sets out further detail on the Commission's final rule to:

- place an obligation on TNSPs to make continuously available the minimum required levels of inertia determined by AEMO;
- require TNSPs and Registered Participants providing inertia network services to provide inertia on instruction by AEMO.

4.4.1 Making sure the inertia is continuously available

Under the final rule, the obligation to provide inertia network services is placed on the TNSP for the relevant inertia sub-network, or, if there is more than one TNSP for the sub-network, the TNSP that has the transmission planning responsibility in each electrical sub-network.[129] In the case of Victoria, the obligation will be placed on AEMO through its role as the jurisdictional planning body.

Placing the obligation on the TNSP with transmission planning responsibility establishes a clear path of responsibility.

An absolute obligation on TNSPs to guarantee the availability of the required levels of inertia at all times is not practical. It may also result in excessive costs depending on the extent to which the TNSP needs to contract with a large number of inertia providers in order to confidently meet the obligation at all times.

Therefore, the TNSP must make a range and level of inertia network services available such that it is likely that inertia network services that provide required levels of inertia when enabled are continuously available, taking into account planned outages and the risk of unplanned outages.[130]

The Commission also agrees with the views expressed by stakeholders in response to the draft determination that, in some circumstances, there may be a limited number of parties with whom to contract for the provision of services, or that generators may not wish to enter into contracts with the Inertia Service Provider. Therefore, clause 5.20B.4(c)(1) of the final rule requires the Inertia Service Provider to use reasonable endeavours to make the inertia network services available by the date specified by AEMO (rather than being an absolute obligation to make the services available by the specified date).[131]

The obligation will only apply in relation to sub-networks where an inertia shortfall has been identified by AEMO and a notice published and given to the relevant Inertia Services Provider. This will maintain system security where it is needed while not imposing undue market or compliance costs on other areas. As future shortfalls are

129 Final Rule clause 5.20B.4(a).

130 Final Rule clause 5.20B.4(c); clause 4.3.4(j).

131 Final Rule clause 5.20B.4(c).

identified, the relevant TNSP will have time to prepare and identify activities to meet the obligation.

Meeting the obligation

Under the final rule, the TNSP will be required to seek and identify the least-cost option or combination of options to meet the obligation to provide inertia network services, for the time in which the shortfall is projected to exist. The required levels of inertia could be made available by the TNSP through either:

- directly investing in synchronous condensors;
- entering into inertia services agreements with Registered Participants to provide inertia network services by means of a synchronous generating unit or synchronous condensor; or
- any other types of inertia network services that can be provided by a TNSP investing in its network or by Registered Participant under an inertia services agreement.

An inertia services agreement is a contractual arrangement between the TNSP and a third party under which a person agrees to provide one or more inertia network services or to undertake an activity approved by AEMO that can reduce the secure operating level of inertia by contributing to the operation of an inertia sub-network in a secure operating state. The entry into an inertia services agreement may be a more cost-effective means of providing inertia network services than the construction of new assets by the TNSP. Alternatively, it may be a part of a combination of options necessary in order to meet the shortfall within an initial 12 months, while longer term options are considered by the TNSP to meet the ongoing shortfall. An inertia services agreement could involve the TNSP contracting with a synchronous generator to be able to request them to be online at certain times, or to run in synchronous condensor mode.

In order for the TNSP to meet the required levels of inertia, through a contracting approach, it may need to contract with multiple potential third party providers to make sure that the required level can be met at any given time.

Where AEMO identifies an inertia shortfall in a given sub-network, the obligation on the TNSP is to make inertia continuously available for the full secure operating level of inertia, and not just for the amount of the shortfall. This is because any contracts that the TNSP has with synchronous generators to come online to provide inertia are likely to cause other synchronous generators, which are also providing inertia, to be pushed out of the dispatch merit order, potentially resulting in only a small, or no, overall increase in inertia. To avoid this, the TNSP will still be obliged to make the full secure operating level of inertia continuously available in the sub-network, even in circumstances where AEMO has identified only a small shortfall in inertia.

The TNSP's proposal to make the required levels of inertia available must be developed and set out as part of its Transmission Annual Planning Report (TAPR). The required levels of inertia will need to be sourced from within the sub-network to make

sure that the inertia is available to be provided to the system should separation and islanding of the sub-network occur.

Service classification and cost recovery

The obligation to make inertia network services available is a regulatory obligation or requirement imposed on the relevant TNSP in connection with the provision of prescribed transmission services.

The TNSP will be entitled to seek a revenue allowance that includes forecast operating expenditure or capital expenditure for its efficient costs of meeting the requirement. This may include an amount forecast to be spent as inertia services payments for inertia network services to be provided by third parties to the TNSP. The AER will assess the efficiency of that expenditure as part of the regulatory determination process for a regulatory control period.

The commencement of the obligation on TNSPs will occur during a regulatory control period.

For any increase in the costs of providing prescribed transmission services that are incurred during the regulatory control period that is underway when the rule commences in order to meet the inertia requirement, the TNSP may be able to use the network support pass through under clause 6A.7.2 of the Rules (for inertia service payments) or the cost pass-through provisions under clause 6A.7.3 of the Rules or a combination of the two. Pass-through applications under clause 6A.7.3 are subject to a materiality threshold equal to one per cent of maximum allowed revenue for the regulatory year.[132]

In order to make clear that the determination of an inertia shortfall during the course of a regulatory control period constitutes a pass through event under chapter 6A of the NER, the final rule adds a new category of pass-through event - an 'inertia shortfall event'. An inertia shortfall event occurs where a TNSP is required to provide, or cease providing, inertia network services and meeting this requirement materially increases or decreases the TNSP's costs of providing prescribed transmission services.

Under the draft rule, it was assumed that a material increase in costs arising from a requirement to meet an inertia shortfall during a regulatory control period would fall within the definition of a regulatory change event cost pass-through. The addition in the final rule of a new category of pass through event should provide greater certainty to the Inertia Service Provider that the costs of meeting the obligation can be efficiently recovered during the regulatory control period in which the costs are incurred.

Under the final rule, payments made to third parties under inertia services agreements (inertia services payments) are a type of network support payment and differences in the forecast amount of network support payments for a regulatory year and the actual network support payments in that regulatory year can be passed through to

132 Clause 6A.7.3 of the NER.

transmission network users under the network support pass through in clause 6A.7.2 of the rules.[133]

Where AEMO reviews and updates the required levels of inertia for a given sub-network during a regulatory control period, the relevant TNSP will either enter into new inertia services agreements, or update the conditions of existing agreements. The TNSP may also compare this against the cost of physically constructing the required assets in order to meet the obligation.

In the case of inertia services agreements, any adjustment to the required levels of inertia, will likely require the TNSP to apply to the AER for cost recovery under the existing network support pass-through provisions in the NER, if the TNSP is meeting any shortfall through contractual arrangements.[134] Network support pass-through is not subject to a materiality test and allows for increases and decreases in the amount of payments forecast in revenue determinations to be adjusted annually on an "overs and unders" basis, but after the period in which the costs are incurred. In making a determination on the TNSP's application for cost pass-through, the AER takes into consideration the efficiency of the TNSP's activities in meeting the obligation.

If the TNSP determines that the construction of network assets would be the most efficient way to meet the obligation to provide inertia network services in the next regulatory control period then this should form part of the TNSP's capital expenditure allowance for the period. In this case, the value of the network assets would be rolled into the TNSP's regulatory asset base at the beginning of the following regulatory control period.

Timing and application of the RIT-T

As set out in section 3.4, AEMO will determine separate required levels of inertia for each defined inertia sub-network to operate as an island should it be separated from the rest of the NEM. AEMO will assess the levels of inertia that are typically being provided in each sub-network and determine whether or not a shortfall exists, or is likely to exist, with respect to the minimum required levels of inertia.

In the event that a shortfall is declared for a given sub-network, the TNSP will be required to meet the obligation to make the minimum required levels of inertia available. The TNSP must meet the obligation by the date specified by AEMO in the notice of assessment given to the TNSP (which must be no earlier than 12 months after the notice of assessment is published unless an earlier date is agreed with the TNSP).

The TNSP will also be required to meet any adjustments made by AEMO to the required levels of inertia for as long as a shortfall in inertia remains. The TNSP will be required to make the inertia available to meet the adjustment by the date specified by AEMO in the notice of assessment given to the TNSP (which must be no earlier than 12

133 Final Rule amendment to chapter definition of “network support payment”, clause 5.20B.4(j).

134 Clause 6A.7.2 of the NER.

months after the notice of assessment is published unless an earlier date is agreed with the TNSP).

If AEMO determines that a downward adjustment needs to be made to the required level of inertia, or that there will no longer be a shortfall in inertia within a sub-network, then AEMO must specify in a notice to be given to the TNSP the date from which the inertia obligation no longer applies to the TNSP. This date cannot be earlier than 12 months after the publication of the notice unless an earlier date is agreed with the TNSP. This should provide certainty to the TNSP and third-party providers when evaluating the benefits of investing in the construction of physical assets compared to expenditure under inertia services agreements.

As part of the transitional amendments in the final rule, the Commission proposes that TNSPs will not be required to meet any obligation to make sure that the inertia network services are continuously available until 1 July 2019.[135]

Under the draft rule, the requirement to make inertia network services available by 1 July 2019, combined with the requirement to apply the RIT-T to network investments to meet the requirement, was likely to restrict the options available to TNSPs in meeting the obligation initially. It was expected that TNSPs would need to contract with existing generators, or owners of existing synchronous condensors, to make sure that the obligation could be met.

However, the Commission agrees with views expressed by stakeholders in response to the draft determination that limiting the options available to TNSPs to third-party contracting could preclude potentially efficient investment options. Under some circumstances, there may be a lack of competitive provision of the required services, and that contracts should not be entered into at any cost.

Therefore, under the final rule TNSPs are not required to apply the RIT-T to proposed expenditure on "inertia service payments" or to network investment undertaken by the TNSP where:

- an inertia shortfall is declared in the inertia sub-network;
- prior to the declaration the TNSP is not under an obligation to provide inertia network services; and
- the time for making the inertia network services available is less than 18 months after the notice is given by AEMO.[136]

The objective of the RIT-T exemption for network investments is to provide the TNSP with a practical ability to meet the obligation in a reasonable time, and in an efficient manner, in the first instance that a shortfall is declared within the sub-network. The RIT-T exemption only applies if the shortfall needs to be met within 18 months of notification due to the time likely to be needed by the TNSP to undertake a full RIT-T

135 Final Rule clause 11.100.4(b).

136 Final Rule clause 5.16.3(a)(9)-(10).

assessment and install the necessary equipment. It will still be necessary for the TNSP to undertake a RIT-T for any subsequent ongoing adjustments to the required levels of inertia as the Commission expects that there will be a reasonable level of foresight in the projection of inertia shortfalls into the future, given that AEMO will be required to publish such projections in the NTNDP.

The Commission recognises the view held by some stakeholders that the TNSP may be more predisposed to building physical network assets than contracting with third parties for the provision of inertia and that this may result in a higher cost outcome or foreclose subsequent market sourcing options. However, the Commission considers that the potential costs associated with this risk are relatively low given that the TNSPs are only required to make the absolute minimum levels of inertia available. Further, limiting the TNSP's options to contracting with third-party providers in the first instance may lead to inefficient outcomes if there is limited competition for the provision of inertia network services and potentially more efficient network investments are precluded from meeting the obligation.

Nevertheless, the final rule will impose a requirement on TNSPs to undertake a process of screening of potential third-party providers of services to improve the efficiency of the contracting solution and to make sure that the TNSP considers all options available to meeting the obligation beyond network investments. The TNSP will be required to prepare and publish information to enable potential providers of inertia network services to develop non-network options. This information will include a description of the requirement for inertia network services, the technical characteristics that a non-network option would be required to deliver, a summary of potential options to make the inertia network services available, and information to assist non-network providers wishing to present proposals to the TNSP.[137]

The exemption to conducting a RIT-T for network investments will increase the competitive pressure on third-party providers of services to maximise the probability of a more efficient outcome through contracting for the provision of inertia network services.

If the TNSP proposes network investment to meet the requirement to provide inertia network services then it must provide information in its TAPR setting out the date when the proposed relevant network investment became or will become operational, the purpose and total cost of the proposed network investment, and the indicative total cost of any non-network options considered.[138]

Location

When investing for the provision of inertia, the TNSP will necessarily need to assess the location of the new synchronous devices in order to determine the impacts on system strength. These synchronous devices will also have an impact on the control of system frequency and may either partially or fully address the required levels of inertia

137 Final Rule clause 5.20B.4(g).

138 Final Rule clause 5.20B.4(i).

needed to maintain system security. Meeting the required levels of inertia and minimum required levels of system strength in a coordinated manner should be an inherent part of the TNSP's planning process.

Further, allocating the responsibility to the TNSP for the provision of inertia and system strength would be more likely to avoid the possibility of higher costs that would be incurred through the duplication of network assets. For example, the TNSP would be in a better position to identify that the construction of a single synchronous condensor would be a more cost effective approach to the simultaneous management of both frequency and system strength. There is a greater likelihood that separate assets would be constructed to address frequency and system strength individually if separate entities were given responsibility or separate mechanisms were used.

4.4.2 Providing inertia to the system

This section sets out further detail on the provision of inertia to the system based on the sources of inertia made available by the TNSP.

The obligation to provide inertia to the system when instructed by AEMO

Under the final rule:

- AEMO may enable inertia network services up to:[139]
  - the minimum threshold level of inertia where a contingency event that would result in the islanding of an inertia sub-network has been classified as a credible contingency event or defined as a protected event; and
  - the secure operating level of inertia where the inertia sub-network is islanded.
- AEMO may enable or cease inertia network services by giving instructions to a TNSP who is providing inertia network services or to a Registered Participant who has contracted with the TNSP to provide inertia network services; and
- The Inertia Service Provider and Registered Participants that provide an inertia network service must comply with instructions from AEMO to enable or cease the inertia network services.

The Commission considers that a role for AEMO to enable inertia is consistent with AEMO's role in managing the secure operation of the power system. Any generators that receive dispatch instructions will be required to meet the dispatch target provided by AEMO.[140]

139 Final Rule clause 4.4.4(a) or (b). An inertia network service is enabled when AEMO has selected the relevant inertia network service and it is providing inertia to an inertia sub-network.

140 Clause 3.8.23 of the NER.

AEMO will be required to give instructions to enable inertia network services in an inertia sub-network to provide up to the minimum threshold level of inertia in circumstances where an event that would result in the islanding of the sub-network has been classified as a credible contingency event or defined as a protected event.

AEMO will be required to give instructions to enable inertia network services in an inertia sub-network to provide up to the secure operating level of inertia[141] in circumstances where an inertia sub-network is islanded.

AEMO will not be obliged to provide the full secure operating level of inertia to the system if it does not consider that level of inertia to be necessary to maintain the islanded sub-network in a secure operating state. AEMO is best placed to be able to determine the optimal amount of inertia to be provided based on changing system conditions, including maximum contingency size and the tolerance of the system to RoCoF. For example, the amount of inertia required to maintain the power system in a secure operating state at any particular point in time is likely to be principally determined by the generating unit with the largest contingency size that is online at the time. AEMO will also be able to take into account any additional inertia being incidentally provided at the time by other providers of inertia that are not contracted with the TNSP.

The TNSP will be required to provide AEMO with a schedule of the inertia network services which it has made available to meet the obligation.[142] The schedule will rank the inertia network services and will act as a guide to the most efficient means of providing the required levels of inertia to the system from the various sources.

Given AEMO's oversight of the power system role, it can coordinate most effectively the provision of inertia from different sources. AEMO will instruct the Inertia Service Provider or Registered Participants to provide inertia to the system in accordance with the schedule of inertia network services provided by the TNSP. AEMO will be required to use reasonable endeavours to select services in the order of priority specified in the schedule.[143]

Conditions of contracting with generators

The operation of inertia services agreements with generators for the provision of inertia will be similar to existing provisions under clause 5.4AA of the NER in respect of network support payments. If a TNSP contracts with a generator under an inertia services agreement for the provision of inertia, the TNSP must register the relevant generating unit with AEMO as an inertia generating unit that may periodically be used to provide inertia network services.[144]

---

141 Or the secure operating level of inertia adjusted for activities approved by AEMO under clause 5.20B.5 of the final rule.

142 Final Rule clause 5.20B.6(a).

143 Final Rule clause 4.4.4(c).

144 Final Rule clause 5.20B.6(b).

When AEMO elects to enable the generator to provide inertia, it will notify the TNSP of its intention. At these times, AEMO will be required to constrain on the generator providing inertia and the generator will not be eligible to set the spot price in relation to its minimum loading level.[145] Any generation capacity that the generator offers over and above its minimum loading level will be dispatched and settled as normal through the NEM dispatch process.

AEMO will be required to review and approve the technical conditions of any inertia services agreements to be entered into between the TNSP and third parties. Any technical limitations associated with TNSP contracts for inertia must be consistent with AEMO's ability to maintain the power system in a secure operating state.

The majority of existing sources of inertia in the NEM are thermal generators that were built ten or more years ago. In many cases, changes to technical performance standards were not applied to these generating units at the time the standards were introduced. Contracts with these generators for the provision of inertia should establish that certain performance standards can be met, in particular the capability to ride through instances of high RoCoF.

Under the final rule, the TNSP will be required to provide AEMO with specified details of inertia services agreements. This information will include as a minimum:[146]

- details of the contracted generator so it can be registered with AEMO, including the nature of the service, the purpose for which the service is being provided, and the location of the service;
- details of the availability of the service, including its minimum loading level, the RoCoF withstand capability of the contracted generator, periods of notice and response times, and any other restrictions;
- levels of inertia provided by the contracted generator.

An Inertia Service Provider will be required, without delay, to notify AEMO of any event which has changed or is likely to change the availability of any inertia network service or inertia support activity made available by the Inertia Service Provider to AEMO as soon as the Inertia Service Provider becomes aware of the event.[147]

While technical specifications and performance standards for inertia network services will be required to be approved by AEMO, AEMO will not have a role in assessing or approving the commercial terms of inertia services agreements.

Providing for AEMO to determine the timing and magnitude of the provision of inertia may create some challenges for the TNSP when negotiating contract terms with third parties. The conditions and payment structures for the provision of inertia will likely be influenced by the frequency with which inertia network services are enabled by

145 Final Rule clause 3.9.7(c).

146 Final Rule clause 5.20B.6(c).

147 Final Rule clause 4.9.9C.

AEMO, which the TNSP may find difficult to forecast. However, AEMO will be expected to base its decisions with respect to the enablement of inertia network services on the schedule of inertia network services provided by the TNSP. The TNSP will be able to use the schedule as a basis for forecasting the expected costs of inertia services agreements that it enters into.

5 Other activities to meet the obligation

This chapter sets out further detail on the aspect of the final rule which allows a TNSP to reduce the level of inertia it is required to provide by investing or contracting with third-party providers to undertake activities other than the provision of inertia. In all cases, AEMO would need to be satisfied that the activities will contribute to the operation of the inertia sub-network in a satisfactory or secure operating state. These activities may include alternative frequency control services, including fast frequency response services.

Under the final rule:

- The types of services that can be provided by Inertia Service Providers to meet an inertia shortfall are specified. These services must be for the provision of inertia and are called "inertia network services".
- The inertia network services that qualify to provide inertia up to the minimum threshold level of inertia and the secure operating level of inertia are:[148]
  - services made available by the Inertia Service Provider investing in synchronous condensors; and
  - services made available to the Inertia Service Provider by a Registered Participant and provided by means of a synchronous generating unit or synchronous condensor.
- Other types of activities ("inertia support activities") may be used by the Inertia Service Provider to reduce the secure operating level of inertia or the minimum threshold level of inertia, with approval from AEMO.[149] Inertia support activities may include, but are not limited to, installing or contracting for the provision of frequency control services, installing emergency protection schemes or contracting with generators in relation to the operation of their generating units in specified conditions.

The Commission has considered stakeholder submissions on the draft rule and has made the following change, which is reflected in the final rule:

- The final rule extends the use of inertia support activities to reduce the minimum threshold level of inertia in addition to the secure operating level of inertia. The Commission considers that, under the proposal in the draft rule, limiting the use of inertia support activities to reducing only the secure operating level of inertia may preclude the development of potentially lower cost options. The final rule will maintain the requirement for the Inertia Service provider to seek approval from AEMO in order to use any inertia support activities to reduce their obligation to provide inertia.

148 Final Rule clause 5.20B.4(d)-(e).

149 Final Rule clause 5.20B.5(a).

5.1 Meeting the obligation through other activities

The draft rule proposed that the TNSP would be able to contract with third-party providers of FFR services as a means of reducing the level of inertia it was required to provide by an agreed amount.

This section explores the potential options available to the TNSP, including:

- opportunities for the provision of FFR services and special protection schemes; and
- other opportunities to contract with generators to reduce contingency size or not run at certain times.

5.1.1 Fast frequency response and special protection schemes

One of the matters required to be considered by AEMO under the draft rule, when determining the required levels of inertia for an inertia sub-network, is the availability and capability of existing frequency control services in the sub-network. The greater the amount, and the faster the speed, of frequency response services, the less inertia will be needed to maintain the frequency within the bounds of the FOS and revert the frequency to the normal operating bands following a contingency.

An increase in the size or speed of frequency control services should reduce the amount of inertia needed to maintain the secure operation of the power system. However, under the draft rule, the extent to which increased levels of frequency response services could be used as an alternative to inertia was limited. Frequency control services would not be able to substitute for the minimum threshold level of inertia, which is the minimum amount of inertia needed to operate the inertia sub-network in a satisfactory operating state when islanded.

Fast frequency response

Inertia and FFR are distinct services which perform different roles in the management of system frequency. Inertia acts to slow the rate of frequency change caused by a contingency. This is different to FFR, which actively injects power or reduces consumption to arrest the frequency change and revert the frequency back towards normal operating levels. Technologies that are capable of acting as a direct substitute for inertia by instantaneously and continuously maintaining local frequency are not technically possible at present. However, research suggests that these technologies are likely to become available in the future.

Greater amounts of FFR, or faster acting FFR services, will reduce the amount of inertia required to maintain system frequency within the bounds of the FOS. Consequently, co-optimisation of the services would likely lead to lower overall cost arrangements. The use of FFR to reduce the required level of inertia will be influenced by a number of factors:

- *Response to frequency change*: The level of inertia provided is an inherent physical property of a synchronous generating unit or synchronous condensor and acts to dampen changes in system frequency following a sudden shift in generation or load. This is different to frequency response services which involve a power injection following a change in frequency in order that the system frequency can be stabilised back to normal operating levels.

  As such, all frequency response services involve a time delay following the change in generation or load, with some response services being faster than others. Even FFR technologies involve a time delay between the initial change in frequency and the frequency response. This delay is comprised of four separate components which sum to equal the total time to respond:

  1. the period of time taken to measure the change in frequency and determine an appropriate response;

  2. the time taken to communicate to the device providing the response;

  3. the time taken to activate the response; and

  4. the time taken to ramp up from the point of activation to the maximum response output.

  The local detection of a change in frequency can be done very quickly, in the order of two cycles (40 milliseconds).[150] However, such a short period of time risks false identification and longer periods are likely to be required to provide a more accurate measurement and/or confirmation of the size and nature of the frequency change before an appropriate response can be determined. Once the frequency change has been measured, and an appropriate response determined, there are a range of technologies capable of providing a frequency response. Activation and ramping times are technology specific.

  The time delay of FFR technologies therefore implies that there is a level of inertia that must be provided to the power system at any point in time to resist frequency changes at the time of the contingency event as well as over the first few hundred milliseconds following a contingency event. Beyond this initial time period, FFR technologies have the potential to be used in combination with inertia to stabilise system frequency.

- *Fault ride-through capability*: Faults in the transmission system can quite often be the cause of contingency events. Under these circumstances, inverter-connected generation can be limited in its ability to provide active power to the network. This limitation is greater the closer the proximity to the fault. Inverter connected technologies cannot provide FFR services until such time as the fault is cleared.

150 AECOM, *Feasibility of fast frequency response obligations of new generators - Report to the AEMC*, 8 June 2017, p. 13.

Following the clearance of a fault, the active recovery time of the inverter-connected technology is influenced by the strength of the system, with slower recovery times occurring in weak systems. The provision of FFR services by wind generators is an example of a technology that is affected by system strength. The ability to provide power injections following disturbances is usually dependent on voltage stability and a weak system may suppress the ability for wind generators to provide a frequency response.

The period of time required to clear faults is likely to have an impact on the minimum response time capability of FFR services, which may limit the extent to which FFR can be relied upon as a substitute for inertia.

- *Specification of FFR services*: There are a variety of different technologies that have the potential to provide a fast frequency response contingency service to manage sudden changes in system frequency. Each of these technologies may provide these services with distinct operational characteristics, including whether the service is capable of rapidly injecting as well as withdrawing active power, whether the service is capable of sustaining the delivery of active power over a period of time, and the specific profile of the power injection in response to the frequency change.

- *Maturity of FFR technologies*: Fast frequency response services are not a mature technology, and are at an early stage of development or deployment. There are only limited examples of fast frequency response technologies being used to provide a contingency service in major power systems in the world. Consequently, the ability to use FFR technologies is to be limited initially, but is also likely to increase over time as experience is gained through active use in power systems. The Commission therefore considers that a long-term solution to managing frequency in a low inertia system should anticipate the use of FFR technologies.

Special protection schemes

A special protection scheme is a form of FFR that could be used to provide enhanced frequency control. These schemes utilise designated sensors and communication equipment to trigger immediate load or generation shedding as soon as a specific event has occurred, such as the trip of an interconnector. As a special protection scheme is triggered by the specific event, rather than a fall in frequency, it may act much faster than conventional load shedding schemes. This allows for a faster response to the event, potentially preventing a change in frequency rather than arresting a change once it has already begun.

5.1.2 Contracting with generators to reduce the required levels of inertia

The level of inertia provided to the system determines the instantaneous RoCoF that will result from the occurrence of a contingency event of a given size. The speed with which the frequency changes determines the amount of time that is available to arrest

the decline or increase in frequency before the frequency moves outside the fixed bounds of the FOS.

Contracting with large generators to reduce potential contingency size by not generating at certain times would reduce the level of inertia required to maintain secure operation of the system.

A further constraint is the withstand capability of generators to high rates of change of frequency. The capability of generators within a sub-network to withstand high RoCoF will influence the level of inertia required to maintain system security.

Generators that trip as a consequence of high RoCoF may exacerbate the disturbance to the system and lead to an even higher RoCoF by both contributing to the overall size of the contingency as well as reducing the level of inertia in the system.

Contracting with specific generators with low RoCoF withstand capability to not generate at certain times would also reduce the level of inertia required to maintain secure operation of the system.

5.2 South Australian Government's view

The South Australian Government proposes that the rules should be amended to enable AEMO to determine and procure the necessary range of ancillary services to manage high RoCoF.[151] The South Australian Government proposes that the focus should not be solely on inertia and that a broader range of ancillary services should be considered to address the issue.

5.3 The draft rule

The Commission made a draft rule in response to the South Australian Government's rule change request.

- The draft rule specified the types of services that can be provided by Inertia Service Providers to meet an inertia shortfall. These services must be for the provision of inertia and are called "inertia network services".
- The inertia network services that qualify to provide inertia up to the minimum threshold level of inertia are:
  - services made available by the Inertia Service Provider investing in synchronous condensors; and
  - services made available to the Inertia Service Provider by a Registered Participant and provided by means of a synchronous generating unit or synchronous condensor.

151 South Australian Minister for Mineral Resources and Energy, *Managing the rate of change of power system frequency rule change request – attachment A*, 12 July 2016, p. 2.

- The inertia network services that qualify to provide inertia beyond the minimum threshold level of inertia and up to the secure operating level of inertia are those services that can be used for the minimum threshold level of inertia and other types of inertia network services provided by a Registered Participant.

5.3.1 Stakeholder views on the draft rule

In submissions on the draft rule, several stakeholders highlight the importance of being able to adopt activities other than the use of synchronous inertia in order to manage system frequency.[152] AEMO and the South Australian Council of Social Service (SACOSS) both note the benefits of the use of potentially lower cost frequency control options but also emphasise the need for AEMO to undertake adequate testing of the proposed alternative services prior to approval.[153] AEMO suggests the establishment of a program of trials of new technology to develop sufficient experience for TNSPs to justify investment, and to develop practical demonstrations as a basis for AEMO to confirm their effectiveness.[154]

A number of stakeholders also question the requirement in the draft rule that the alternative frequency control services may only be used as a substitute for the secure operating level of inertia and not for the lower minimum threshold level of inertia.[155] AEMO suggests that the rules should allow for other services to effect a reduction in the minimum threshold level of inertia, and for AEMO and the Inertia Service Provider to consider the capabilities of each proposed service.[156] CEC suggests that explicitly omitting this opportunity will limit the potential for lowest cost solutions to be used in the future.[157]

5.4 The final rule

Under the final rule, a TNSP may seek AEMO approval to reduce its obligation to make available the required levels of inertia, either through investments or entering into contracts with third-party providers of services other than the provision of inertia.[158] AEMO may approve this where it is satisfied that the other services will contribute to the operation of an inertia sub-network in a satisfactory operating state or

152 See submissions on the draft determination from: SACOSS, p. 1; S&C Electric, p. 2; CEC, p. 5; Spark Infrastructure, p. 2; AEMO, p. 16; TasNetworks, p. 4; South Australian Department of Premier and Cabinet, p. 5.

153 See submissions on the draft determination from: AEMO, p. 16; SACOSS, p. 1.

154 AEMO, Submission on the draft determination, p. 16.

155 See submissions on the draft determination from: S&C Electric, p. 2; CEC, p. 5; AEMO, p. 16; TasNetworks, p. 4; South Australian Department of Premier and Cabinet, p. 5.

156 AEMO, Submission on the draft determination, p. 16.

157 CEC, Submission on the draft determination, p. 5.

158 Final Rule clause 5.20B.5(a).

a secure operating state.[159] Additional activities, referred to as "inertia support activities", may include, but are not limited to:

- installing or contracting for the provision of frequency control services, including fast frequency response services;
- installing special protection schemes;
- contracting with generators to reduce contingency size at certain times; and
- contracting with generators with low RoCoF withstand capability to not run at certain times.

Any inertia support activities undertaken will be permitted to reduce the secure operating level of inertia and the minimum threshold level of inertia with approval from AEMO. Under the draft rule, any additional activities undertaken by the TNSP were only permitted to reduce the obligation to make available the secure operating level of inertia and not the lower minimum threshold level of inertia. However, the Commission agrees with the views expressed by stakeholders that inertia support activities would still require approval from AEMO in order to reduce the minimum threshold level of inertia and that limiting these activities to reducing only the secure operating level of inertia may preclude the development of potentially lower cost options. Therefore, the Commission has determined in the final rule to extend the use of inertia support activities to allow for a reduction in the minimum threshold level of inertia.

AEMO will be required to assess whether, and to what extent, the additional activity could be used to reduce the secure operating level of inertia or minimum threshold level of inertia. This will be undertaken on a case-by-case basis in order to account for the varying characteristics of different technologies.

As part of the approval process, TNSPs will be required to work closely with AEMO and potential service providers to assess the implications for network and power system operations. As with the delivery of inertia, a range of factors will need to be assessed by the TNSP in coordination with AEMO, including potential impacts on system strength at different locations, risk of intra-regional separation and islanding, and consideration of services provided by generators with low RoCoF withstand capability. The availability and provision of additional activities will need to be factored into the formulation of constraints for power system operation.

The TNSP must provide information in its TAPR about any inertia support activities undertaken to reduce the minimum threshold level of inertia or the secure operating level of inertia.[160]

159 Final Rule clause 5.20B.5(a)(3).

160 Final Rule clause 5.20B.4(h)(2).

Similar to inertia services agreements for inertia, under the final rule a TNSP is not required to apply the RIT-T to proposed expenditure under contracts with third-party providers of additional activities.[161]

The TNSP's assessment of additional activities may be a complex task, as it might have to compare offers of very different service characteristics. Even within similar services, there are likely to be a range of potential options. As discussed in section 5.1, there are various characteristics of FFR that would need to be taken into account in comparing projects, including the capability to provide both raise and lower services, the design of the control systems as either open-loop or closed-loop, allowance for energy recovery periods following the provision of FFR, and the ability to ride-through faults and maintain active power levels.

161 Final Rule clause 5.16.3(a)(9).

6 Implementation and transitional arrangements

This chapter outlines the transitional arrangements introduced in the final rule, including:

- the dates by which AEMO must develop and publish an inertia requirements methodology and inertia requirements in the first instance, and the relevant TNSP's obligation to make available inertia network services to meet those requirements; and
- the treatment of any NSCAS gaps declared prior to the commencement of the final rule on 1 July 2018.

6.1 Initial determination of inertia requirements and TNSP provision of inertia services

The implementation of the rule includes:

- On the date the transitional rules commence, AEMO will be taken to have determined inertia sub-networks with boundaries the same as the boundaries of each NEM region at that date.
- AEMO must publish the inertia requirements methodology by 30 June 2018, setting out the process AEMO will use to determine the inertia requirements for each inertia sub-network. In producing the first methodology, AEMO is not required to comply with the NTNDP consultation process.
- AEMO must make a determination of the inertia requirements for each inertia sub-network by 30 June 2018 applying the initial inertia requirements methodology.
- If AEMO determines that there is an inertia shortfall in an inertia sub-network in its initial assessment carried out by 30 June 2018, AEMO must notify the relevant TNSP and publish a notice as soon as practicable after making that assessment. AEMO's notice must specify the date by which the TNSP must make the necessary inertia services available. This date cannot be before 1 July 2019 unless an earlier date is agreed with the relevant TNSP.
- In addition to providing any inertia services by the date specified by AEMO, the TNSP must provide information in its TAPR (due to be published by 30 June 2018) in relation to the activities it proposes to undertake to satisfy its obligation to make inertia services available and in relation to inertia support activities it proposes to undertake. If the TNSP receives a notice from AEMO after 30 April 2018, then it is not required to do so but the information must be included in its next TAPR.

AEMO to develop inertia requirements methodology and determine inertia requirements

The transitional arrangements in the final rule set out how AEMO must develop the initial inertia requirements methodology and determine the inertia requirements.

The final rule includes an on-going obligation on AEMO to follow the NTNDP consultation process when updating the inertia requirements methodology. However, the publication of the final rule is not concurrent with AEMO's NTNDP process. Therefore, the transitional arrangements in the final rule require AEMO by 30 June 2018 to publish a methodology setting out the process AEMO will use to determine the inertia requirements for each sub-network. In producing this methodology, AEMO is not required to comply with the NTNDP consultation process. However, AEMO must comply with the NTNDP consultation process for any subsequent proposal to change this methodology.

After publishing the first inertia requirements methodology, AEMO must also make a determination of the inertia requirements for each inertia sub-network by 30 June 2018, including declaring an inertia shortfall if required.

TNSP provision of inertia services

If AEMO determines that there is an inertia shortfall in a region, AEMO must publish and give to the TNSP for the inertia sub-network a notice of that assessment. The assessment must include AEMO's specification of the date by which the TNSP must make the inertia services available. This cannot be before 1 July 2019 unless an earlier date is agreed with the relevant TNSP.

If there is an inertia shortfall, the TNSP must provide any inertia services by the date specified by AEMO. In addition, the TNSP must provide information in its TAPR (due to be published by 30 June 2018) regarding the activities it proposes to undertake to satisfy its obligation to make inertia services available and in relation to inertia support activities it proposes to undertake. If the TNSP has insufficient time to include this information in its TAPR, then it is not required to do so but the information must be included in its next TAPR.

6.2 Transitional arrangements for NSCAS

As discussed in chapter 3, from 1 July 2019 a system security issue that could be addressed as an inertia shortfall cannot be addressed through the NSCAS framework. However, the Commission considers that transitional arrangements are necessary in order to accommodate the possible declaration of a NSCAS gap prior to 1 July 2018, when the new inertia requirements framework commences.

NSCAS gaps are usually declared for 5 year planning horizons and actions can be taken by TNSPs or AEMO to address these gaps. However, if an inertia related NSCAS gap is declared between 19 September 2017 and 1 July 2018, the final rule prevents:

- AEMO from acquiring NSCAS for any period after 1 July 2019;[162]
- a TNSP from responding to the NSCAS gap for any period after 1 July 2019.[163]

If, in this period, AEMO declares an inertia related NSCAS gap and provides a TNSP 12 months or more notice to meet the gap, the relevant TNSP must treat the NSCAS gap as if it were a notice of an inertia shortfall under the new framework.[164] The Commission considers that if the TNSP is provided with at least 12 months to meet the gap, being the same minimum level of notice a TNSP would receive under the new framework, this would be sufficient time for the TNSP to be obliged to address the gap and be able to do so pursuant to the new inertia requirements framework.

However, if AEMO provides less than 12 months' notice, the TNSP may elect to treat the gap:[165]

- under the existing NSCAS framework; or
- as if it were a notice of an inertia shortfall under the new framework.

If the TNSP elects to the treat the NSCAS gap under the existing NSCAS framework, the NSCAS framework will continue to apply to that gap. This includes allowing AEMO to act as procurer of last resort for the balance of the planning horizon of the gap. AEMO has the ability to act as procurer of last resort if the relevant TNSP advises AEMO, in response to the gap, that it will be taking no, or insufficient, action to address the gap, as reassessed by AEMO after receiving such advice.

In order for the TNSP to be able to treat the NSCAS gap under the new framework, the NSCAS gap must be represented as a shortfall in the level of inertia typically provided in a region (having regard to typical patterns of dispatched generation in central dispatch) compared to the minimum level of inertia required to operate the region in a secure operating state when it is islanded.[166]

If the TNSP elects to treat the declaration of the NSCAS gap as if it were a notice of an inertia shortfall under the new framework then any associated services procured would be subject to the provision of the new framework, including the ability for the TNSP to:

- not undertake a RIT-T, if it receives less than 18 months notice of the inertia shortfall;[167] and

---

162 Final rule clause 11.100.5(b).

163 Final rule clause 11.100.5(c).

164 Final Rule clause 11.100.6(b).

165 Final Rule clause 11.100.6(a).

166 Final Rule clause 11.100.6(a) and (b), definition of inertia related NSCAS gap.

167 Final Rule clause 5.16.3(a). If the TNSP receives more than 18 months notice then it is not exempted from undertaking a RIT-T for network investments.

- apply to recover its associated costs as an inertia shortfall event under the NER cost pass-through provisions.[168]

The Commission considers that this transitional approach for NSCAS gaps declared between 19 September 2017 and 1 July 2018 facilitates a practical and efficient transition to the new more transparent and clearly defined framework, without limiting the TNSP's flexibility to continue with the existing NSCAS framework where necessary.

In addition, these transitional arrangements could expedite the management of low inertia issues by:

- specifying the requirement for inertia network services prior to 1 July 2018, which is when AEMO is required under the final rule to publish the initial inertia requirements methodology; and

- allowing the NSCAS gap that is equivalent to an inertia shortfall to be addressed under the new framework would not require a RIT-T to be undertaken for expenditure to meet the inertia shortfall, where permitted under the new framework.

168 Clause 6A.7.3 of the NER.

Abbreviations

AEMC or Commission	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ESOO	Electricity Statement of Opportunities
FCAS	frequency control ancillary services
FFR	fast frequency response
FOS	Frequency Operating Standards
FPSS	Future Power System Security
MCE	Ministerial Council on Energy
NEM	National Electricity Market
NEO	national electricity objective
NER	National Electricity Rules
NSCAS	network support and control ancillary services
NTNDP	National Transmission Network Development Plan
PIAC	Public Interest Advocacy Centre
RIT-T	Regulatory Investment Test for Transmission
RoCoF	rate of change of frequency
SACOME	South Australian Chamber of Mines and Energy
SACOSS	South Australian Council of Social Service
SRAS	System Restart Ancillary Services
TAPR	Transmission Annual Planning Report
TNSP	Transmission Network Service Provider
UFLS	under-frequency load shedding

A Frequency control in the National Electricity Market

This appendix provides background on the current NEM frameworks for the management of power system frequency and the impacts of contingency events.

A.1 The management of power system frequency

The interconnected national electricity system operates within the constraints of a number of defined physical parameters. One such parameter is system frequency. Conventional electricity generation, like hydro, coal and gas, operate with large spinning turbines that are synchronised to the frequency of the grid. Changes to the balance of supply and demand for electricity can act to speed up or slow down the frequency of the system. Conventional generators support the stability of the power system by working together to maintain a constant operating frequency across the interconnected network.

In each synchronous generating unit, the large rotating mass of the turbine and alternator has a physical inertia which must be overcome in order to increase or decrease the rate at which the generator is spinning. In this manner, large conventional generators that are synchronised to the system act to dampen changes in system frequency. In the electricity system, the greater the number of generators synchronised to the system, the higher will be the system inertia, and the greater will be the ability of the system to resist changes in frequency due to sudden changes in supply and demand.

Whether the system frequency is rising or falling depends on the balance between generation and load. Whenever total generation is higher than total electricity consumption the system frequency will be rising and vice versa.

Managing frequency becomes more challenging when it is changing rapidly because there is less time in which to arrest the decline or rise before it strays beyond acceptable bounds.

The rate of change of frequency is proportional to the size of the sudden change in supply or demand as a result of the contingency event and inversely proportional to the level of system inertia at the time that the contingency occurs.[169] The greater the size of the contingency event, or the lower the system inertia, the faster the frequency will change.

169 Contingency events may be classified as either credible or non-credible. A credible contingency is an event which AEMO considers to be reasonably possible. Generally, such events would involve the loss of one generating unit or network element. A non-credible contingency is any other contingency, a sequence of credible contingencies within a five-minute period, or a further separation event in an island.

Managing changes in power system frequency

To keep the power system in a secure operating state, the frequency must be controlled within a defined range. This range, specified in the Frequency Operating Standards (FOS), sets out the range of allowable frequencies for the electricity system under different conditions, including normal operation, following contingency events, and during emergency situations.[170] Under the FOS, AEMO is required to maintain the system frequency within the operational frequency tolerance band of 49.0 to 51.0 Hz for a reasonably possible ("credible") contingency event.[171] Generator, network and end-user equipment must be capable of operating within the range of frequencies defined by the FOS.

AEMO maintains the secure operation of the system by continuously monitoring the system frequency as it dispatches generation to meet consumer demand. Calculations on the level of generation to be dispatched are undertaken every dispatch interval to meet expected energy consumption over the next five minutes. There is a possibility in each five-minute dispatch interval that the level of actual energy consumption is different to what was anticipated. A substantial difference has the potential to result in a large shift in system frequency.

AEMO may restrict the operation of the power system to reduce the potential size of sudden changes in generation or load. AEMO continually monitors the system to determine the likely impact of the occurrence of the largest credible contingency and may limit flows on the network, or power station output, to reduce the potential size of the contingency, or the likely impact, should it occur.

In addition to constraining the system, variations in frequency are managed in the NEM through the procurement of Frequency Control Ancillary Services (FCAS). These services are provided by generators to control system frequency in response to supply or demand disturbances. In particular, "contingency FCAS" is used to control frequency in response to major variations caused by contingency events such as the loss of a generating unit, a significant transmission line, or a large industrial load. Contingency FCAS acts to arrest steep rates of change of frequency and then stabilises and recovers the system frequency over time to bring it back within the normal operating frequency bands.

There are six contingency FCAS markets: up to six-second, 60-second and five-minute markets for both raise and lower services. The six-second service is therefore currently the quickest acting. In the event of a frequency deviation away from 50 Hz, for the

170 The Reliability Panel sets the level of the Frequency Operating Standards in consultation with AEMO. A review of the Frequency Operating Standards is undertaken by the Reliability Panel based on terms of reference received from the AEMC. The AEMC has provided the Reliability Panel with Terms of Reference to review the Frequency Operating Standard that applies in the national electricity market. The terms of reference for this review were published on 30 March 2017 and can be found on the AEMC website - http://www.aemc.gov.au/Markets-Reviews-Advice/Review-of-the-Frequency-Operating-Standard#

171 Clause 4.3 of the NER.

system to remain within the current requirements of the FOS requires a relatively low rate of change of frequency (RoCoF) compared with those now possible in the NEM, notably in an islanded South Australia.

If the level of dispatched generation is significantly below the level of energy consumption, the shedding of load may be required to keep the frequency within the limits of the FOS. Under the NER arrangements, AEMO is obliged to return the power system to a satisfactory operating state following any contingency event, including all non-credible contingency events.[172] This may include restoring the power system following a range of different events, including the loss of interconnection between two regions or the simultaneous trip of multiple generating units within a region.

In any instance that the level of dispatched generation is different to total energy consumption, the rate that the frequency changes will be determined by the size of this difference and the level of system inertia. The lower the system inertia, the greater will be the rate of frequency deviation in response to a given change in supply or demand, and the greater will be the requirement for FCAS to revert the system frequency to normal operating levels.

AEMO procures FCAS to maintain system frequency within the limits of the FOS by ensuring that total generation matches total demand in real time. FCAS is used to meet the FOS under normal system operating conditions and in response to credible contingency events. Under multiple contingency events and non-credible 'separation' events, the under-frequency load shedding (UFLS) scheme is used to prevent the system frequency from breaching the extreme frequency excursion tolerance limits, which define the maximum boundaries of the FOS.[173] Outside of these limits, there are no obligations on generators or loads to remain connected to the system. The UFLS scheme is used as a last resort to minimise the impact of major disturbances in the system to prevent the occurrence of wide ranging blackouts.

A.2 The impact of contingency events on power system frequency

The ability to maintain control of power system frequency following a contingency event, such as the loss of a large generator, load or transmission line can be considered through the following three-part framework:

172 This obligation is established in various clauses of the NER and the Frequency Operating Standards. This includes clause 4.3.2, which places an obligation on AEMO to achieve the AEMO power system security responsibilities in accordance with the power system security principles. NER clause 4.2.6(c) then sets out these principles, which includes a requirement that adequate load shedding facilities initiated automatically by frequency conditions outside the normal operating frequency excursion band should be available and in service to restore the power system to a satisfactory operating state following significant multiple contingency events. The FOS also requires AEMO to maintain the frequency of the power system within the extreme frequency excursion tolerance limits, for any multiple contingency event.

173 A multiple contingency event is defined in the FOS as either a contingency event other than a credible contingency event, a sequence of credible contingency events within a period of five minutes, or a further separation event in an island.

1. The initial RoCoF, influenced by the size of the contingency and the level of system inertia.

2. The capacity to restore the stability of the system through the use of frequency response services.

3. The ability of generators and loads to withstand or "ride-through" changes in frequency.

The initial rate of change of frequency

The rate at which system frequency changes determines the amount of time that is available to arrest any decline or increase in frequency before it moves outside of the permitted operating bounds.

Prior to the occurrence of a contingency event, there are two actions that could be taken to minimise the resulting initial frequency change:

- constrain generator output or interconnector flow to minimise the impact of the contingency; and/or

- increase the level of inertia in the system to resist the initial frequency change.

For credible contingencies, AEMO has the ability to introduce constraints, in order to maintain system security, that alter the operation of the power system. Constraints to control the RoCoF would limit the maximum contingency size, relative to the amount of inertia online. However, the effect of a binding constraint is likely to be an increase in the wholesale electricity price. For example, a constraint on an interconnector may limit the ability of power to flow from a lower priced region to a higher priced region.

An alternative to constraining the system to limit the impact of the contingency would be to increase the level of inertia in the power system. A higher level of inertia would permit the occurrence of larger contingencies for a given level of initial RoCoF.

There is currently no mechanism for AEMO or any other party to obtain and pay for additional inertia. In the past, inertia has been plentiful and so such a mechanism has not previously been required.

Capability to restore the supply-demand balance

Limiting the initial rate of change of frequency will only act to increase the amount of time before frequency moves outside of acceptable bands. Inertia does not act to arrest the frequency change or revert frequency back to normal operating levels.

Currently, AEMO is able to procure FCAS, to maintain frequency within defined limits set out in the FOS. In particular, "contingency FCAS" is used to control frequency in response to major variations caused by contingency events such as the loss of a generating unit or a significant transmission line. Contingency FCAS acts to arrest steep rates of change of frequency and then stabilises and recovers the system

frequency over time to bring it back to within the normal operating frequency bands. The current fastest contingency FCAS operates over a timeframe of up to six seconds.

To permit a greater potential level of RoCoF for credible contingency events would require the development of a faster-acting contingency FCAS, which has come to be termed a "fast frequency response (FFR) service". FFR services are faster than the existing six-second service and would provide greater flexibility in the level of RoCoF that could be permitted. The Commission consequently considers that managing frequency in a low inertia system should aim to facilitate the use of fast-frequency technologies and to be able to effectively co-optimise the provision of these services with the provision of inertia.

While a number of technologies exhibit very rapid response times, the physical realities of accurately measuring frequency changes may limit the response capabilities of FFR technologies.

The time delay of FFR technologies implies that there is a minimum level of inertia that must be online at any point in time to resist frequency changes caused by contingency events. The inertia slows the frequency change to provide time for frequency response services to be activated. Beyond this initial time period, fast frequency response technologies have the potential to be used in combination with inertia above a minimum threshold level to stabilise system frequency.

Tolerance of the system

In designing a framework for inertia and FFR services, and consequently a RoCoF limit, it will be important to understand the tolerance of all parts of the system to that level of RoCoF. A RoCoF limit of 2 Hz/s would not be effective if the maximum RoCoF that could be tolerated by individual generators and loads was 1 Hz/s.

In practice, generators and loads will have a range of withstand capabilities. While it will likely be important to understand these in general, that will particularly be the case for equipment providing inertia and FFR services. For example, a generator contracted to provide inertia would need to be able to withstand RoCoF to at least the targeted RoCoF limit.

The performance standards relating to the ability of generators to withstand rates of change of system frequency are set out in the NER.[174] These standards have been imposed as a condition of generator connection agreements since 2007.

The current standards are automatically met if a generating unit can withstand a RoCoF of ±4 Hz/s for quarter of a second. Generators may negotiate a lower standard, but the minimum standard is ±1 Hz/s for one second. There is no obligation on generators to remain connected to the system through an event where the RoCoF exceeds those levels, even if the frequency remains within the bounds of the FOS.

174 Schedule 5.2.5.3 of the NER.

B Summary of other issues raised in submissions

This appendix sets out the issues raised in the second round of consultation on this rule change request and the AEMC's response to each issue. If an issue raised in a submission has been discussed in the main body of this document, it has not been included in this table. Please refer to the draft rule determination for a detailed discussion of the issues raised in the first round of consultation and the AEMC's response to those issues.[175]

Stakeholder	Issue	AEMC response
ElectraNet	ElectraNet considers that if TNSPs are to be allocated responsibility for tendering: they should be able to access protection against uncompetitive market responses, for example access to similar provisions to cl 3.11.5 as noted above; AEMO should clearly define a price-volume threshold for the amount of service to be acquired, based on defined criteria; AEMO should formally confirm that proposed provision of services/capabilities meet the need specified by AEMO; and the procurement role should pass back to AEMO if the threshold is exceeded in order for it to contract, or if necessary, resort to exercise its powers of intervention. (p. 6).	The Commission has made changes to the draft rules such that TNSPs will not be required to undertake a RIT-T for network investments if the obligation to meet an inertia shortfall or fault level shortfall falls within 18 months of the date the shortfall is initially declared. This will mean that contracting with generators will not be the only option available to the TNSP to meet the obligation in the short term.
ENA	Specifically, the framework should enable efficient outcomes when TNSPs procure system security services in what may be a limited market for such services, by providing adequate protections and governance under the Rules. (p. 5).	
ElectraNet	The draft Rule implies a contracted generator may offer capacity above its minimum output and, if dispatched, potentially set price. This is likely to create significant difficulty in pricing of contracts as it will de-risk that generator's operation in the market if the unit is called on under an inertia contract which presumably will compensate it for the decision to commit but offer it the opportunity	Contract payments made to generators would, in part, cover the cost to generators of being on call to provide inertia or system strength when instructed to do so. It is possible that market conditions may be favourable for the generator when called upon. Equally, the generator may face low or even negative price outcomes at other times.

175 AEMC, *Managing the rate of change of power system frequency - draft determination*, 27 June 2017.

Stakeholder	Issue	AEMC response
	to earn additional revenue. (p. 6).	
ElectraNet	Operation of the contracts will also interact with the operation of spot markets for energy and ancillary services in that commitment of contracted generators often will need to be done in pre-dispatch timeframe. A basic tenet of the NEM design to date is that AEMO does not instruct unit commitment, only dispatch. Any decisions about unit commitment for inertia or system strength will unavoidably interact with rebidding activity by market participants in the pre-dispatch timeframe which is where NEM participants achieve price discovery and the opportunity to amend or adjust unit commitment. (p. 6).	The Commission considers that any risks of adverse interactions between contracting and rebidding activity would likely be limited given that the required levels of inertia and system strength are only the minimum levels needed to maintain the system in a secure operating state.
ElectraNet	Accordingly, to avoid creating unlimited and unmanageable obligations, ElectraNet considers that the obligation in draft cl 5.20B.4 should be amended to require TNSPs to use reasonable endeavours in delivering the service, in conjunction with a specific requirement for AEMO acceptance that the response proposed by TNSPs is seen by AEMO as a full and sufficient response to the service obligation it has determined. (p. 9).	The Commission has made changes to the draft rules such that TNSPs will be required to use 'reasonable endeavours' when making the services available by the specified date.
ENA	The Draft Rules impose upon both NSPs and AEMO a fundamentally important new set of new system security related functions and obligations, to address significant system security needs in the NEM. Yet there is no provision made for, nor any discussion of the possibility of appropriate liability immunities, protections, or limitations for NSPs in connection with the performance of these functions. (p. 7).	
ElectraNet	TNSPs costs for contracts (for amounts AEMO has determined) should be fully recompensed, and there should be no opportunity for these costs to be revisited and reviewed by the AER. (p. 7).	The TNSP is required to identify and procure the least cost option or combination of options that will satisfy its obligation in the time required. The addition in the final rule of a new category of

Stakeholder	Issue	AEMC response
ENA	The AEMC should confirm that contract service payments for both system strength and inertia should fully qualify for cost recovery as network support pass through; and Address through appropriate mechanisms, the material cash flow risks of unfunded network support payments for up to two years at a time. Options for consideration include the provision to seek pass through of forecast costs (for e.g. linked to one of the existing cost pass through provisions under the Rules) or another appropriate revenue and pricing adjustment. (p. 8).	pass-through event should provide greater certainty to the TNSP that the efficient costs of meeting the obligation can be recovered.
ElectraNet	ElectraNet considers that contracts relating to system strength should be treated similarly for cost recovery purposes, which should be addressed in the drafting. (p. 9).	The final rule applies the same cost recovery provisions to inertia and system strength.
ENA	At this stage, members have reservations as to how these arrangements may negatively impact cash flows. There are no specific network support allowances in place at present for the new services or regulatory allowances. TNSPs should be entitled to full and timely pass through of those costs to be efficiently incurred in meeting the new service obligations, consistent with the revenue and pricing principles under the National Electricity Law. (p. 8).	The addition in the final rule of a new category of pass-through event should provide greater certainty to the TNSP that the efficient costs of meeting the obligation can be recovered.
TransGrid	While TransGrid is committed to providing services efficiently but there is limited incentive for contracting, especially if materiality is high and/or there is an un-forecast step change in service requirements. Inertia requirements will be externally driven and the service need could be unpredictable and the costs may not be included in a revenue allowance. Costs recovered via pass-through arrangements have a cash flow impact - a provider is paid for a service but the contract cost is recovered up to two years later. Contracting approaches also bring compliance risks which cannot be contracted out. (p. 5).	

Stakeholder	Issue	AEMC response
ENA	In relation to addressing investment certainty, we are concerned as to how AEMO's ability to amend or remove a regional inertia requirement (with 12 months' notice) may impact upon investment certainty requirements. At face, this could lead to the potential for contract premium uplifts for a particular inertia service from a small number of potential service providers (p. 8).	The Commission considers that, in the interests of maintaining a secure power system, AEMO must be able to revise the required levels of inertia or system strength after becoming aware of a material change to the power system, where the timing, occurrence or impact of the change was unforeseen.
TasNetworks	TasNetworks does not believe it appropriate to consider solutions related to the management of fault level separately from inertia. (p. 13).	A principle reason for placing the obligation on TNSPs is the ability to coordinate the provision of both inertia and system strength.
AEMO	AEMO supports the AEMC's proposal that, in at least the short term, NSPs are best placed to manage the minimum inertia required for their networks as this will allow immediate inertia issues to be resolved. In the longer term, it may be more efficient to allocate this responsibility centrally to AEMO, ideally through an integrated market mechanism (p. 11).	The obligation placed on TNSPs applies to the minimum required levels of inertia and system strength. The Commission agrees that a market mechanism would be preferable to provide the additional inertia and frequency control services above the minimum levels. Potential market mechanisms are being progressed through the *Inertia ancillary service market* rule change request from AGL and as part of the *Frequency control frameworks review*.
ENA	Given the lead times involved (including the implications for RIT-T processes), the AEMC should consider adopting a commencement date for all the new system security services of 1 July 2019. This may also allow for any developments from the potential establishment of an inertia ancillary services market as proposed by AGL to be established concurrently. (p. 9).	The final rule aligns the commencement date of the obligation on TNSPs for both system strength and inertia to 1 July 2019.
TransGrid	These draft rules have been subject to a very short consultation for such important system security issues. While there is a need to ensure system security over the coming summer periods, it is important these rule changes properly account for other ongoing reforms and avoid entrenching inefficient or ineffective processes (p. 3).	The rule change request has followed the statutory timelines set out under the National Electricity Law. Two extensions to the timeline were made under section 107 during the course of the Commission's assessment of the rule change request.

Stakeholder	Issue	AEMC response
Australian Energy Council	It seems complicated, inefficient and simply inappropriate that two mechanisms, a regulated mechanism and a market-based mechanism, be introduced to provide the same services to the NEM, which are based on a continuum. On this basis, the Energy Council contends that it is premature to make the draft more preferable rule as proposed. Instead, it should be deferred, and considered in conjunction with the proposed Inertia Ancillary Service Market rule change. (p. 2).	The Commission does not agree that the two mechanisms are providing the same services. A high level of confidence needs to be established that the minimum required levels of inertia can be made available when required. This minimum level of inertia is better suited to TNSP procurement with regulatory oversight. A market based mechanism is better suited to additional variable levels of inertia which have the potential to provide market benefits.
EnergyAustralia	Given the interrelationship between the minimum level of inertia and additional inertia for market benefits, we are concerned that they are being considered under separate processes. This split process may result in a sub-optimal balance between the proposed centrally-planned and procured approach to minimum levels and the market mechanism to be reviewed later. We would support this decision being deferred and considered in conjunction with the Inertia Ancillary Services Market (ERC0208) Rule change proposal. (p. 2).	
EnergyAustralia	Consideration should be given to ensuring that the benefits of installations such as synchronous condensors can be captured, without market distortion from allowing monopoly asset owners to be involved in a competitive element of the market. Such distortion could well flow into the proposed market mechanism for obtaining additional inertia. For this reason, we would reiterate our position that the two mechanisms should be considered together. (p. 2).	The obligation on TNSPs is to make available the minimum levels of inertia necessary to maintain a secure operating system. The participation of TNSPs in a market mechanism for inertia will be a key consideration in the Commission's assessment of the Inertia ancillary service market rule change request.
PIAC	PIAC recommends that the rules should ensure that the minimum level of inertia identified for each sub-region by AEMO, and the cost of procurement by TNSPs, reflects consumer preferences regarding cost-¬reliability trade-¬offs. (p. 1).	The minimum level of system services are required to make sure that the system can remain in a secure operating state. However, the Commission agrees that generators should not be contracted with for the provision of these services at any cost.
Australian Energy	The Energy Council argues that the factors which affect the	The Commission has set out the range of factors that AEMO will need

Stakeholder	Issue	AEMC response
Council	determination of the minimum threshold level of inertia are sufficiently variable that the minimum threshold level is actually a dynamic value, rather than one which should be determined annually or less frequently. (p. 2).	to take into account when determining the minimum level of system services. While the level may need to be adjusted over time, it will not be as variable as additional levels of inertia which could provide market benefit. These additional levels of inertia may vary on a five-minute basis.
EnergyAustralia	There is still not a settled understanding of the specific RoCoF limits that the power system is capable of withstanding (p. 1).	The Commission agrees that the RoCoF withstand capability of many older generating units is the NEM is largely unknown. This will be an important consideration in the design of a market mechanism for inertia.
EnergyAustralia	In order to ensure that measures to maintain system security are imposed at least cost, any mechanism to obtain inertia should require the minimum amount needed to ensure that emergency frequency control schemes can operate as intended during a non-credible contingency (p. 1).	The Commission has proposed a market mechanism for inertia as part of its assessment of AGL's rule change request to establish an Inertia ancillary service market. A key consideration of determining the level of inertia needed will be the limit on RoCoF which will, in part, be informed by the speed of emergency frequency control schemes.
Hydro Tasmania	Hydro Tasmania believes that it is important to ensure that the methodology for determining the inertia requirement and shortfalls appropriately recognises that the underlying need for inertia in each region should be calculated on a forward looking basis (p. 1).	The final rule includes an obligation on AEMO to provide, at a minimum, five-year projections of inertia and system strength shortfalls in the NTNDP.
Hydro Tasmania	Hydro Tasmania believes that AEMO's calculation methodology to determine inertia should be transparent and provide an opportunity for market participants to be consulted where appropriate. (p. 2).	The final rule requires AEMO to develop an inertia requirements methodology through the NTNDP consultation process.
Hydro Tasmania	Given that unexpected changes can happen in the market, there may be value in enabling AEMO to recalculate and adjust the inertia requirement more frequently if required. This would enable the inertia requirement to be aligned with, and be responsive to market changes (p. 2).	The final rule provides AEMO with the ability to adjust the required levels of inertia or system strength if there is a material change in system conditions such as the retirement of a large generator.
Clean Energy	While the NTNDP is a reasonable platform for publishing the	AEMO has a responsibility under the NER to maintain system

Stakeholder	Issue	AEMC response
Council	anticipated inertia requirements, this assessment would benefit from greater transparency provisions such that an independent view can be formed on the likelihood of forecasted inertia requirements being realised (p. 3).	security. The Commission considers that a consultation process undertaken with industry participants through the NTNDP process should be sufficient to inform AEMO to facilitate the development of the required methodology.
Clean Energy Council	The National Electricity Rules must be clear that only a Registered Participant's generating units with clearly stated and known ROCOF performance standards may register as an inertia service provider. Testing must be a requirement register. (p. 3).	Under the final rule, in sub-networks of the NEM where an inertia shortfall has been identified by AEMO, there is an obligation on the TNSP that is the Inertia Services Provider to provide specified details of the inertia network services it is making available to AEMO and seek AEMO's approval for the technical specifications and performance standards for those services and for the information necessary for AEMO to enable or cease the provision of those services. AEMO must approve this information or advise the Inertia Service Provider of its concerns and the changes it requires to this information.
Origin Energy	The AEMC should consider how excess inertia capacity that has been installed by TNSPs, is treated if the minimum level of inertia is reduced below previously identified levels. Under this scenario TNSPs will continue to receive a regulated payment under the RAB, however the asset is now surplus to requirements. Origin would argue that an AEMO led process that looks to procure contracts over a multi-year period would better deal with fluctuations in inertia requirements and not lock in a payment system over many decades for stranded assets (p. 2).	The Commission recognises the view held by some stakeholders that the TNSP may be more predisposed to building physical network assets than contracting with third parties for the provision of inertia and that this may result in a higher cost outcome or foreclose subsequent market sourcing options. However, the Commission considers that the potential costs associated with this risk are relatively low given that the TNSPs are only required to make the absolute minimum levels of inertia available. Further, limiting the TNSP's options to contracting with third-party providers in the first instance may lead to inefficient outcomes if there is limited competition for the provision of inertia network services and potentially more efficient network investments are precluded from meeting the obligation. Nevertheless, the final rule will impose a requirement on TNSPs to undertake a process of screening of potential third-party providers of services to improve the efficiency of the contracting solution and to make sure that the TNSP considers all options available to meeting

Stakeholder	Issue	AEMC response
		the obligation beyond network investments. If the TNSP proposes network investment to meet the requirement to provide inertia network services then it must provide information in its TAPR setting out the date when the proposed relevant network investment became or will become operational, the purpose and total cost of the proposed network investment, and the indicative total cost of any non-network options considered.
ENGIE	Because the amount of inertia needed varies to such an extend depending on what ROCOF and contingency size are being catered for, it would seem to be very difficult to establish a true minimum level of inertia without being very conservative, in which case, there is less value in establishing a minimum value. (p. 5).	The minimum level of inertia is only required to manage the operation of the islanded sub-network in a secure operating state. Under islanded conditions, the sub-network would be operated in a highly constrained state. The level of inertia required to fully alleviate constraints on the network could be significantly higher than this minimum level.
ENGIE	Rather than attempt to identify a minimum level of inertia, ENGIE suggests that AEMO seek to procure sufficient inertia service to cater for the largest credible contingency in each region, at an agreed maximum ROCOF (p. 5).	The largest contingency in a region is not always constant. The Commission considers that the inertia required to manage a given RoCoF for the occurrence of the largest contingency in a region is variable and is better suited to being procured through a market mechanism.
SA Government	All types of other services to reduce contingency size should be taken into account. (p. 5).	Other types of activities ("inertia support activities") may be used by the Inertia Service Provider to reduce the secure operating level of inertia or the minimum threshold level of inertia, with approval from AEMO. Inertia support activities may include, but are not limited to, installing or contracting for the provision of frequency control services, installing emergency protection schemes or contracting with generators in relation to the operation of their generating units in specified conditions.
SA Government	The Division is still of the view that the guidelines for a system standard for RoCoF should be established by the Reliabiltiy Panel when reviewing the frequency operating standard (submission on	A system standard for RoCoF is being considered under the AEMC's *Frequency operating standards review*.

Stakeholder	Issue	AEMC response
	draft determination, p. 5). Considering the maximum allowable RoCoF alongside the traditional parameters of frequency bands and timeframes to restore frequency following events will be a prudent measure to provide certainty to the market. (p. 6).	
TasNetworks	In relation to the wording of Chapter 5.20B.4(d), TasNetworks recommends that the Rule not be so prescriptive as to only mention synchronous condensers and in doing so, preclude the delivery of inertia network services from other technologies (p. 18).	Other types of activities ("inertia support activities") may be used by the Inertia Service Provider to reduce the secure operating level of inertia or the minimum threshold level of inertia, with approval from AEMO. Inertia support activities may include, but are not limited to, installing or contracting for the provision of frequency control services, installing emergency protection schemes or contracting with generators in relation to the operation of their generating units in specified conditions.
AEMO	AEMO recommends that the AEMC consider potential NEM-wide inertia requirements in a subsequent rule change proposal that will investigate the procurement of inertia and other services to deliver market benefits. (p. 16).	Agreed. The Commission considers it important that future market frameworks for inertia take into account potential NEM-wide requirements. The Commission intends to give this further consideration under the *Inertia ancillary service market* rule change request and the *Frequency control frameworks review*.
ElectraNet	Neither AEMO nor TNSPs will know if there is a need for it to call for the commitment of a generator under contract until pre-dispatch has been reviewed based on commitment intentions of market participants. If after reviewing the pre-dispatch it is determined there is a need for additional unit commitment this would be included in a subsequent pre-dispatch with the unit operating at minimum stable load which generally will result in a reduction in forecast market price. This reduction may then prompt another generator to reduce its commitment on (valid) commercial grounds, leading to a further round of rebidding. Although rebidding to settle unit commitment is a normal part of the NEM, AEMO or a TNSP will be active participants in this process under amended Rules, in conflict with the underlying principle of neutrality. An important question for operation of the energy market is therefore whether AEMO or TNSPs are best	The obligation on TNSPs to make available the required services and the obligation on AEMO to determine when these services are required will only apply to the minimum levels of inertia and system strength that are necessary to maintain the system in a secure operating state. Additional inertia which could provide market benefits would be more suited to the adoption of a market mechanism.

Stakeholder	Issue	AEMC response
	equipped to make the decision about unit commitment. There may be no alternative to making this decision where additional unit commitment is needed to ensure security, but it is a recent development and not foreseen in development of the associated market Rules. (p. 7).	
ElectraNet	ElectraNet considers it is that for TNSPs to specify the order in which AEMO should dispatch inertia service providers as inappropriate as it requires TNSPs to make advance (blind) decisions about the order of commitment. The decision about priority of use is an economic choice that can only be made economically with knowledge of the circumstances of the day and should be made by AEMO. An arrangement of this form implies TNSPs are to have a stake in the commercial outcomes of the energy and ancillary service markets alongside active market participants. ElectraNet submits TNSPs should not be expected to play this role, which is a fundamental departure from the key design principles of the wholesale market. (p. 7).	The Commission does not consider that AEMO should be making economic decisions around the relative merits of dispatching generators based on contracts that were negotiated by TNSPs. The final rule includes an ability for the TNSPs to inform AEMO of a schedule of services so that AEMO can aim to minimise the costs to consumers, and the cash flow concerns of the TNSPs. However, AEMO's primary responsibility is to maintain system security.
South Australian Chamber of Mines and Energy	The ability for the TNSP to pass through costs for capital investment or service agreements should be weighed up against the cost to consumers for these services. Particularly as these arrangements have a two-year lag time until they are applied to network charges. Uncertainty for the TNSP and consumers as to the cost of these services and their flow through will impact investment confidence in the State. AEMC must assess the financing arrangements to ensure that the most efficient procurement occurs in a timely manner, while providing certainty and affordability to consumers. (p. 2).	The minimum level of system services are required to make sure that the system can remain in a secure operating state. However, the Commission agrees that generators should not be contracted with for the provision of these services at any cost.
ElectraNet	The draft Rule for managing RoCoF provides for AEMO to notify of a shortfall to be addressed in no less than 12 months in the future. ElectraNet appreciates that it will be important for a timely response but notes that in the event AEMO specifies the minimum 12 month response time this will bias the response to third party contracts	The Commission has made changes to the draft rules such that TNSPs will not be required to undertake a RIT-T for network investments if the obligation to meet an inertia shortfall or fault level shortfall falls within 18 months of the date the shortfall is initially declared. This will mean that contracting with generators will not be

Stakeholder	Issue	AEMC response
	away from TNSP capital investment even when this option may be the most efficient outcome. This will occur as third-party contract costs are to be recoverable as "inertia support payments" that will not be subject to the RIT-T, but capex expenditure by TNSPs must be subject to a RIT-T under the draft Rule. (p. 11).	the only option available to the TNSP to meet the obligation in the short term.
Hydro Tasmania	Hydro Tasmania suggests that Tasmania should be considered an inertia sub-network, and suggests that for the purposes of inertia management, it is always operating as an island. (p. 2).	The NEM mainland and Tasmania operate as two separate synchronous systems. The two systems are separated by the Basslink DC interconnector which allows for energy transfer but does not require the two systems to operate synchronously. In order for Tasmania to operate as an island, inertia must be sourced locally. This would imply that separate required levels of inertia would be needed for Tasmania.
TasNetworks	The Tasmanian region will need to be defined as an inertia sub-network for obvious reasons. In the context of the proposed Rule changes, Tasmania is also continuously 'islanded' for the purposes of determining inertia requirements. (p. 18).	
Clean Energy Council	Sub-networks must be assessed and planned for transparently and through the NTNDP and ESOO as appropriate. (p. 3).	In determining and adjusting the boundaries of inertia sub-networks, AEMO must comply with the Rules consultation procedures.
South Australian Council of Social Service	SACOSS believes that additional constraints need to be built into the use of FFR as a substitute for inertia. AEMO should be required to undertake testing and economic evaluations of any alternative frequency control activities. (p. 1).	Under the final rule, any inertia support activities undertaken by the TNSP to reduce the required levels of inertia will require AEMO approval.
AEMO	It may also be necessary to impose requirements for new generating units to have the ability to offer services such as active power control and FFR to ensure that such services are available in the future. AEMO has previously provided similar advice on the merits of mandatory active power controls (although not FFR at this stage) for all new generators to Essential Services Commission of South Australia (p. 16).	The Commission is considering this proposal as part of its *Frequency control frameworks review*.
Australian Energy Council	TNSPs are not the most appropriate entity to provide inertia services because they may act as both procurer and supplier of the services, creating a conflict of interest and entrenching economic	This role sits suitably with TNSPs for the following reasons:

Stakeholder	Issue	AEMC response
	inefficiencies (p. 1).	• The existing economic regulatory framework will provide incentives for TNSPs to determine the least-cost approach to meeting the obligation with oversight by the Australian Energy Regulator. • TNSPs are best placed to provide the required levels of inertia within each sub-network and to coordinate the location of inertia with other network support services, including obligations related to minimum system strength.
Australian Energy Council	The Australian Energy Council still believes that TNSPs are less likely to consider third party and non-network solutions due to their staff skills and organisational culture, and to this end, their provision of minimum inertia services is likely to be less efficient than they otherwise could be. (p. 2).	
SA Government	Negotiation for contracts by the TNSP for inertia or FFR will be challenged by having incomplete information on the frequency (and possibly the quantity) with which the services would be enabled by AEMO. AEMO is in a better position to provide this vital information with a higher degree of accuracy that would result in a robust and fast process. (p. 6).	
Origin Energy	AEMO is best placed to procure the minimum levels of inertia given its responsibility for maintaining and improving system security (NER 4.1.1.1(b)) and its experience in both tendering and evaluating competing offers through the SRAS procurement process (submission on draft determination, p. 1). An AEMO managed process would allow for greater transparency where TNSPs and other market participants can compete equally to secure inertia contracts with the most cost effective provider being awarded the contract. (p. 1).	
Meridian Energy Australia	We share the concerns expressed by some that the approach adopted by TNSPs must be carefully monitored to ensure any natural bias towards network solutions does not distort this procurement (p. 1).	Under the final rule, TNSPs are required to identify and procure the least cost option or combination of options that will satisfy its obligation in the time required. For all ongoing adjustments in the level of services over time, the TNSP will be required to undertake a RIT-T for any proposed network investments.
Hydro Tasmania	Hydro Tasmania, however, believes that care needs to be taken to ensure that investments made now do not subsequently lock out future investments that may provide a more cost effective solution	

Stakeholder	Issue	AEMC response
	for customers (p. 1).	
Origin Energy	If AEMO managed the process, a more dynamic and efficient response to changing levels of inertia (up or down) as contracts can be awarded to successful applicants over shorter timeframes than can be achieved by TNSPs building synchronous condensers. This avoids consumers paying additional charges through the TNSPs regulated asset base (RAB) on stranded assets that are excess to requirements. (p. 1).	The Commission considers this risk to be low given that synchronous condensors would only be built to provide the minimum required levels of inertia to maintain system security. Further, the Commission considers it equally possible that, without the option of building a synchronous condensor, TNSPs may be forced into relatively expensive contracts with generators where there may be limited competition for the provision of services.
SA Government	Placing obligations on TNSPs in the Rules would likely lead to investments that are locked in for long periods of time for providing services that may vary considerably with changing system conditions. (p. 6).	
ENGIE	ENGIE believes that responsibility for maintaining inertia fits more appropriately with the roles and responsibilities of AEMO as defined in the National Electricity Law (NEL). ENGIE refers to the NEL clause 49 - AEMO's statutory functions and in particular, and notes clause 49(1)(e) in which AEMO is assigned the function to "maintain power system security". In contrast, the NEL defines TNSPs as having responsibility to "... own, control or operate a transmission or distribution system that form part of the interconnected national electricity system". (p. 2).	The Commission considers that the final rule is consistent with these functions as specified in the NEL. Under the final rule, the TNSP is responsible for making the required services available and AEMO is responsible for instructing the provision of these services at the times it considers necessary in order to maintain a secure operating system.
ENGIE	ENGIE believes that by assigning responsibilities for system inertia procurement to TNSPs, the AEMC would be moving outside of the policy and regulatory framework established by the NEL and NER. If such a step is to be taken, then the fundamental principle of power system security management being assigned to one entity (AEMO) will be undermined. (p. 2).	
ENGIE	Another possible justification that might be applied for regulating the procurement of system inertia services could be that a competitive	The Commission does not consider that the minimum required levels of inertia needed to maintain a secure operating system should be

Stakeholder	Issue	AEMC response
	regime had been trialled, but there was evidence of market failure, necessitating the imposition of a regulated solution. Given that there has been no effort to implement a competitive solution however, this justification cannot be applied at this time. (p. 3).	open to procurement through a market mechanism where there is the possibility of a market failure and the services are not available when needed. Contracts are needed to ensure the availability of such services.
ENGIE	In any case, it is clear that AEMO are far better placed than the TNSP's to decide how much inertia service is needed both in real time, and into the future. It follows that giving AEMO the responsibility for procurement and dispatch of inertia services will lead to more effective management of inertia, as well as more efficient outcomes. (p. 5).	The final rule places an obligation on AEMO to determine the level of services required and also to instruct the provision of these services in real time. However, the Commission considers that procurement of the services should rest with TNSPs with regulatory oversight by the AER.
ENGIE	The tender process conducted by AEMO could be open to participation be existing synchronous generators and to TNSPs. Presumably, TNSPs could offer the provision of inertia by installing synchronous condensers. Unless other participants were able to offer sufficient levels of inertia at a total cost below that offered by the TNSP, then AEMO would then offer the contracts to the TNSP. This in effect would provide a safety net, to ensure that the overall cost of inertia was economic. (p. 5).	

C Legal requirements under the NEL

This appendix sets out the relevant legal requirements under the NEL for the AEMC to make this final rule determination.

C.1 Final rule determination

In accordance with s. 102 of the NEL, the Commission has made this final rule determination in relation to the rule proposed by the South Australian Minister for Mineral Resources and Energy.

In accordance with section 103 of the NEL, the Commission has determined to make a more preferable final rule. A copy of the more preferable final rule is attached to and published with this final rule determination. Its key features are described in section 2.1.

The Commission's reasons for making the final rule are set out in section 2.4.

C.2 Power to make the rule

The Commission is satisfied that the more preferable final rule falls within the subject matter about which the Commission may make rules. The more preferable final rule falls within s. 34 of the NEL as it relates to the operation of the NEM (section 34(1)(a)(i)), the operation of the national electricity system for the purposes of the safety, security and reliability of that system (section 34(1)(a)(ii)), and the activities of persons (including Registered Participants) participating in the NEM or involved in the operation of the national electricity system (section 34(1)(a)(iii)).

C.3 Commission's considerations

In assessing the rule change request, the Commission considered:

- its powers under the NEL to make the rule;
- the rule change request;
- submissions received during first and second rounds of consultation;
- submissions received with respect to consultation on the System security market frameworks review; and
- the Commission's analysis as to the ways in which the proposed rule will or is likely to, contribute to the achievement of the NEO and how the more preferable final rule will, or is likely to, better contribute to the achievement of the NEO.

There is no relevant Ministerial Council on Energy (MCE) statement of policy principles for this rule change request.[176]

The Commission may only make a rule that has effect with respect to an adoptive jurisdiction if satisfied that the proposed rule is compatible with the proper performance of Australian Energy Market Operator (AEMO)'s declared network functions.[177] The more preferable final rule is compatible with the performance of those functions as it leaves those functions unchanged.

C.4 Civil penalties

C.4.1 Amended provisions

The Commission's final rule amends clauses of the existing NER (as set out in Table C.1 below) that are currently classified as civil penalty provisions under Schedule 1 of the National Electricity (South Australia) Regulations. The Commission considers that these clauses should continue to be classified as civil penalty provisions and therefore will not recommend any change to their classification to the COAG Energy Council.

Table C.1 Amended clauses that the Commission recommends should continue to attract a civil penalty

New clause reference	Who the obligation is imposed upon	Recommendation
4.10.2(c)	Any person operating equipment interfacing with a transmission network. Change relates to persons operating equipment interfacing with the transmission network that is involved in the provision of inertia network services	Retain
4.11.1(b)	The provider of inertia network services	Retain

C.4.2 New provisions

The Commission cannot create new civil penalty provisions. However, it may recommend to the COAG Energy Council that new or existing provisions of the NER

176 Under s. 33 of the NEL the AEMC must have regard to any relevant MCE statement of policy principles in making a rule. The MCE is referenced in the AEMC's governing legislation and is a legally enduring body comprising the Federal, State and Territory Ministers responsible for Energy. On 1 July 2011 the MCE was amalgamated with the Ministerial Council on Mineral and Petroleum Resources. The amalgamated council is now called the COAG Energy Council.

177 Section 91(8) of the NEL.

be classified as civil penalty provisions. Subject to consultation with the AER, the Commission will recommend to the COAG Energy Council that the provisions set out below in Table C.2 be classified as civil penalty provisions are set out below in Table C.2. The Commission considers that the new provisions should be classified as civil penalty provisions for the reasons set out in the table.

Table C.2 New clauses that the Commission recommends should attract a civil penalty

New clause reference	Who the obligation is imposed upon	Recommendation
3.9.7(c)	Generator in respect of inertia network services provided by inertia generating unit	This clause should be classified as a civil penalty provision because the obligation to comply with dispatch instructions is key to the provision of inertia network services when they are required in an inertia sub-network
4.3.4(j)	Transmission Network Service Provider that is a Inertia Service Provider	This clause should be classified as a civil penalty provision because the obligation to provide inertia network services when they are required is key to AEMO being able to manage the power system with required levels of inertia
4.3.4(k)	Transmission Network Service Provider that is a Inertia Service Provider	This clause should be classified as a civil penalty provision because the obligation to provide information on inertia network services to AEMO will allow AEMO to enable inertia services in order to manage the power system with required levels of inertia
4.4.4(g)	Registered Participant providing an inertia network service	This clause should be classified as a civil penalty provision because the obligation to provide inertia network services when they are required is key to AEMO being able to manage the power system with required levels of inertia
4.4.4(h)	Registered Participant providing an inertia network service	This clause should be classified as a civil penalty provision because the obligation to make sure that appropriate personnel and

New clause reference	Who the obligation is imposed upon	Recommendation
		facilities are available to receive and respond to AEMO instructions to enable inertia services is key to AEMO being able to manage the power system with required levels of inertia
4.9.9C	Transmission Network Service Provider that is Inertia Service Provider	This clause should be classified as a civil penalty provision because the provision of information on changes to the availability of inertia services is key to AEMO being able to manage the power system with required levels of inertia.
5.20B.5(f)	Transmission Network Service Provider that is Inertia Service Provider	This clause should be classified as a civil penalty provision because prior approval by AEMO of changes to activities that may reduce inertia requirements is key to AEMO being able to manage the power system with required levels of inertia
5.20B.6(f)	Transmission Network Service Provider that is Inertia Service Provider	This clause should be classified as a civil penalty provision because prior approval by AEMO of the specifications and performance standards relating to inertia network services is key to AEMO being able to manage the power system with required levels of inertia

C.5 Conduct provisions

The more preferable final rule does not propose any changes to conduct provisions.

C.6 Northern Territory legislative considerations

From 1 July 2016, the NER, as amended from time to time, apply in the Northern Territory, subject to derogations set out in Regulations made under Northern Territory legislation adopting the NEL.[178] Under those Regulations, only certain parts of the

178 National Electricity (Northern Territory) (National Uniform Legislation) (Modifications) Regulations.

NER have been adopted in the Northern Territory.[179] As the proposed rule relates to parts of the NER that currently do not apply in the Northern Territory, the Commission has not assessed the proposed rule against additional elements required by Northern Territory legislation.[180]

179 For the version of the NER that applies in the Northern Territory, refer to : http://www.aemc.gov.au/Energy-Rules/National-electricity-rules/National-Electricity-Rules-(Northern-Territory).

180 National Electricity (Northern Territory) (National Uniform Legislation) Act 2015.