# Network Support and Control Ancillary Services (NSCAS) Description and Quantity Procedure

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| **Prepared by:** | AEMO System Security Planning |
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# Current version release details

| Version | Effective date | Summary of changes |
|---|---|---|
| ~~2.2~~[3.0] | ~~17 December 2021~~[1 December 2024] | [Amended to include inertia network services and system strength services following the *National Electricity Amendment (Improving security frameworks for the energy transition) Rule 2024*, include measures to better account for uncertainty and make minor drafting updates.] ~~Amendment to the planning assumption that one transmission line per region may be switched out of service.~~ |

Note: There is a full version history at the end of this document.

# 1. Introduction

## 1.1. Purpose and scope

~~These~~ This document contains~~are~~ the *NSCAS description* and the *NSCAS quantity procedure* (**Procedures**) made under clause 5.20.2 of the National Electricity Rules (**NER**).

These Procedures have effect only for the purposes set out in the NER. The NER and the National Electricity Law prevail over these Procedures to the extent of any inconsistency.

The purpose of these Procedures ~~is document~~ is to describe each type of *network support and control ancillary service* (*NSCAS*), and to detail a procedure for determining the location and quantity of each type of *NSCAS* required.

Under the NER, *Transmission Network Service Providers* (TNSPs) may procure or provide the services necessary to meet the *NSCAS needs* determined under these Procedures. In limited circumstances, AEMO has a last resort planning power to meet certain types of *NSCAS gaps* that will not be met by a TNSP[1].

## 1.2. Definitions and interpretation

### 1.2.1. Glossary

Terms defined in the *National Electricity Law* and the NER[2] have the same meanings in these Procedures unless otherwise specified in this clause. Terms defined in the NER are intended to be identified in these Procedures by italicising them, but failure to italicise a defined term does not affect its meaning.

The words, phrases and abbreviations in the table below have the meanings set out opposite them when used in these Procedures.

| Term | Definition |
|---|---|
| ~~*credible contingency event*~~ | ~~An event described in clause 4.2.3(b), certain examples of which are set out in schedule 5.1~~ |
| ESOO | Electricity *statement of opportunities*, prepared and published under NER 3.13.3A |
| Inertia RSAS | RSAS that provide an *inertia network service* |
| ISP | *Integrated System Plan*, prepared and published under NER 5.22 |
| MBAS | Market Benefit Ancillary Service, described in section 2.3.1 |
| ~~*NEM*~~ | ~~*National Electricity Market*~~ |
| NEMDE | National Electricity Market Dispatch Engine |
| NER | National Electricity Rules. NER followed by a number refers to that numbered rule or clause of the NER |
| ~~*NMAS*~~ | ~~*Non-market ancillary service*~~ |

[1] The last resort planning power is exercised under NER 3.11.3 and 3.11.5.

[2] Most NER terms used in these Procedures are defined in the NER glossary (Chapter 10), but some are separately defined in NER 3.11.5, 5.20.1 and S5.1.14.

| Term | Definition |
|---|---|
| ~~*NSCAS*~~ | ~~*Network support and control ancillary service*.~~ |
| ~~*NSCAS Report*~~ | ~~The document referred to in clause 5.20.3 of the NER and published annually by AEMO under that name~~ |
| ~~*NSCAS tender guidelines*~~ | ~~The document referred to in clause 3.11.5 (b) of the NER and published by AEMO under that name~~ |
| ~~*protected event*~~ | ~~Has the meaning given in clause 4.2.3(f).~~ |
| Other RSAS | RSAS other than Inertia RSAS or System Strength RSAS |
| RSAS | Reliability and Security Ancillary Service, described in section 2.2.1 |
| System Strength RSAS | RSAS that provide a *system strength service* |
| TNSP | *Transmission Network Service Provider* |
| USE | *Unserved energy* |

### 1.2.2. Interpretation

These Procedures are subject to the principles of interpretation set out in Schedule 2 of the *National Electricity Law*.

## 1.3. Related documents

| Title | Location |
|---|---|
| Network Support and Control Ancillary Services Tender Guidelines | ~~https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/ancillary_services/nscas-tender-guidelines-2017.pdf?la=en&hash=9226CE5C03AE55639EACDFD312909335~~https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/ancillary-services/network-support-and-control-ancillary-services-procedures-and-guidelines |

# 2. NSCAS Description

~~The *NSCAS description* first notes the parties to which the description applies and the types of *NSCAS*, before providing a description, purpose and examples for each of the types.~~

## 2.1. NSCAS needs ~~application~~ and types

*NSCAS*[3] are *non-market ancillary services* (*NMAS*) with the capability ~~procured~~ to control *active power* ~~active~~ and *reactive power* flow into or out of an electricity *transmission network*, to address any of the following requirements (*NSCAS needs*):

- Maintain *power system security* and reliability of *supply* of the *transmission network* in accordance with the *power system security standards* and the *reliability standard*[4].

[3] ~~The NSCAS definition is in the Chapter 10 Glossary of NER Version 150.~~

[4] ~~NER Version 150, Clause 3.11.6 (a)(1).~~

- Maintain or increase the *power transfer capability* of the *transmission network* so as to maximise the present value of net economic benefit. ~~to all those who produce, consume or transport electricity in the market~~[5].
- Meet the *inertia requirements*, but only where, as a result of AEMO revisions, those requirements exceed one or more of the *binding inertia requirements* applicable to a relevant TNSP (in its capacity as an *Inertia Service Provider*) for the following three years.
- Meet the *system strength requirements* for *minimum three phase fault levels*, but only where, as a result of AEMO revisions, a *minimum three phase fault level* exceeds the minimum specified in the *system strength standard specification*[6] currently applicable to a relevant TNSP (in its capacity as a *System Strength Service Provider*) for the following three years.

### ~~2.1.1. Application of the NSCAS description~~

~~This *NSCAS description* applies to:~~

- ~~AEMO;~~
- ~~*Transmission Network Service Providers* (*TNSPs*); and~~
- ~~Respondents to any call for offers for *NSCAS* in accordance with the NSCAS Tender Guidelines.~~

### ~~2.1.2.~~ Types of NSCAS

AEMO has described ~~defined~~ the types of *NSCAS* according to the needs that would be primarily addressed by them – that is:

- A need to maintain ~~, maintaining~~ *power system security* and reliability of *supply* to the *transmission network* (including through the provision of inertia system strength).
- A need to increase~~, and increasing~~ net market benefits.

Each type and sub-type of NSCAS is described in detail in section 2.2.

~~As such, AEMO has divided *NSCAS* into the following types:~~

- ~~Reliability and Security Ancillary Service (RSAS) including:~~
  - ~~Inertia RSAS.~~
  - ~~System Strength RSAS.~~
  - ~~Other RSAS.; and~~
- ~~Market Benefit Ancillary Service (MBAS).~~

~~[5] NER Version 150, Clause 3.11.6 (a)(2).~~

[6] NER S5.1.14

## 2.2. Reliability and Security Ancillary Service (RSAS)

### 2.2.1. Description

There are three sub-types of RSAS, as follows:

- **Inertia RSAS** – an *inertia network service* necessary to meet any of the *inertia requirements*, if they have been revised to a level that exceeds the currently applicable *binding inertia requirements*[7].
- **System Strength RSAS** – a *system strength service* necessary to meet a *minimum three phase fault level*, if it has been revised to a level that exceeds the *minimum three phase fault level* in the currently applicable *system strength standard specification* for any *system strength node*[8].
- **Other RSAS** – any other *NMAS* required to maintain *power system security* and reliability of *supply* of the *transmission network* in accordance with the *power system security standards* and the *reliability standard*.

~~RSAS is a *NMAS* procured in order to assist AEMO to maintain power system security of the *transmission network* in accordance with the *power system security standards* or maintain reliability of supply of the *transmission network* in accordance with the *reliability standard*. This service may not include any services that are excluded from *NSCAS* under the NER.~~ RSAS can be provided by entities including but not limited to *Generators*~~generators~~, *Integrated System Providers*, TNSPs~~,~~ and *Market Customers*~~market customers~~.

### 2.2.2. Purpose of Reliability and Security Ancillary Service

~~The purpose of procuring RSAS is to maintain the *power system* within acceptable technical parameters or to increase access to *supply* such that the *NEM* can maintain *power system security* and reliability of *supply* of the *transmission network* in accordance with the *power system security standards* and the *reliability standard*.~~

RSAS can provide~~s~~ AEMO with the tools it needs to operate the *NEM* consistent with its *power system security responsibilities*, including: ~~and reliability obligations. These obligations are described as follows:~~

- **System security:**
  - To maintain the system in a *secure operating state*[9] during normal operation, consistent with the *power system security standards*.

[7] Section 2.4 details the limitations applicable to AEMO's declaration of *NSCAS gaps* for Inertia RSAS.

[8] Section 2.4 details the limitations applicable to AEMO's declaration of *NSCAS gaps* for System Strength RSAS.

[9] The *power system* is in a *secure operating state* if it will return to a *satisfactory operating state* following a *credible contingency event* or a *protected event* (for example trip of a *transmission line* or *production ~~generating~~ unit*). A *satisfactory operating state* is a state in which all *transmission network* elements operate within acceptable technical limits (for example voltage, frequency and current are all within safe accepted limits). See NER ~~clauses~~ 4.2.2 and 4.2.4 ~~of the NER~~ for more information.

– To return the system to a *secure operating state* within 30 minutes following a *credible contingency event* or *protected event*, consistent with the *power system security standards*.

- **Reliability:**

1. To ensure each *NEM region* has sufficient local *generation* and *transmission* capacity such that demand can be supplied consistent with the *reliability standard*[10].

AEMO seeks to meet these responsibilities~~meets these obligations~~ by dispatching *generation* in line with market *bids*, invoking and revoking *constraint* equations, and adjusting *network* equipment such as voltage setpoints and *reactive plant* status.

However, ~~*network*~~ conditions can arise such that after AEMO has used all available operational tools the *network* is still not secure, or there is still insufficient *supply* to meet demand in a *NEM region*.

In this situation, AEMO must intervene in the *dispatch* of the *NEM* through some combination of directing or instructing *Market Participants*, activating emergency reserves, and *load sheddingshedding load*.

Procurement of RSAS will increase the security and reliability of the *NEM* while also reducing the number of instances that AEMO needs to intervene in the *dispatch* of the *NEM*.

### ~~2.2.2.~~2.2.3. Examples of Reliability and Security Ancillary Service

RSAS can be provided through a variety of methods to enable AEMO to operate the *NEM* within the *power system security standards* and the *reliability standard*.

Examples of Inertia RSAS to meet the *inertia requirements* could include, but are not limited to:

- *NMAS* contracts with *Market Participants* such as *Generators* or *Integrated Resource Providers* to provide an *inertia network service*.

Examples of System Strength RSAS to meet the *minimum three phase fault level* could include, but are not limited to:

- *NMAS* contracts with *Market Participants* such as *Generators* or *Integrated Resource Providers* to provide a *system strength service*.

Examples of Other RSAS to maintain power system security could include, but are not limited to:

- *NMAS* contracts with *Mmarket Pparticipants* such as *Generatorsgenerators* or *Integrated Resource Providers* ~~energy storage providers~~ for voltage control beyond what is required by their registered *performance standards* (for example contracting a gas unit to come online when needed to provide voltage control, ~~or~~ a hydro unit to operate in *synchronous condenser* mode, or a wind farm to import or export additional quantities of *reactive power*).

[10] The reliability standard is determined by the Reliability Panel and defined in the NER. In NER version 150 the reliability standard is defined in NER 3.9.3C and allows for up to 0.002 % unserved energy in a *NEM* region per year. This may change in future NER versions.

- Upgrading network elements to expand their secure operating envelope (for example, increasing the maximum voltage rating of a bushing in a substation).

Examples of Other RSAS to avoid unserved energy (USE), and thereby meet the *reliability standard*, could include, but are not limited to:

- Increasing *network* thermal limits, voltage limits, transient limits or oscillatory limits to increase *power transfer*. This could involve solutions such as runback schemes, *NMAS* voltage support contracts, dynamic *reactive plant* or others.
- Increasing *power transfer capability* by reducing the largest effective contingency size with controllable distributed energy resources, batteries, or pre-contingent *load* reduction.

## 2.3. Market Benefit Ancillary Service (MBAS)

### 2.3.1. Description

MBAS is a *NMAS* procured to increase the *power transfer capability* of the *transmission network*, to maximise the present value of net economic benefit ~~to all those who produce, consume or transport electricity in the market~~. MBAS can be provided by entities including but not limited to *Generators*, *Integrated Resource Providers*, TNSPs and *Market Customers*~~generators, *TNSPs*, and market customers~~.

### 2.3.2. Purpose of Market Benefit Ancillary Service

~~The purpose of procuring MBAS is to maximise the present value of net economic benefit to all those who produce, consume or transport electricity in the electricity market.~~

~~One way that~~ MBAS can lower the cost of *dispatch* ~~be delivered is~~ by increasing *power transfer* limits in order to reduce the impact of *constraint* equations on *NEM* dispatch. AEMO uses *constraint* equations to model *power system* limits in the National Electricity Market dispatch engine (NEMDE), with each *constraint* equation providing a mathematical representation of a physical limit of the *transmission network*.

These and a large range of other *constraints* apply in NEMDE to ensure that physical limits are not exceeded. NEMDE will optimise the solution across all *constraints* and costs to fulfil the optimisation objective, and in doing so, determine the lowest-cost solution possible within *constraints*. This may mean that the resultant *dispatch* includes higher cost *generation*. MBAS may be procured to maintain or increase the *power transfer* limit of *constraints* by addressing the underlying *power system* limitations, if the cost of the procured MBAS is less than the benefit of the lowered cost of *generation dispatch*.

Examples of *power system* limits addressed through MBAS include but are not limited to:

- Transmission thermal limitations.
- Voltage upper and lower limitations.
- Voltage stability.
- Transient stability.
- Oscillatory stability.

- System strength limitations[11].

### 2.3.3. Examples of Market Benefit Ancillary Service

MBAS can be provided through a variety of methods to maintain or increase the *power transfer capability* of the *transmission network*. Examples include but are not limited to:

- *Static var compensators*, *synchronous condensers*, and braking resistors.
- *Reactive plant* (capacitor banks, reactors).
- Operation of *connected plant* ~~Generators running generating plant~~ with power system stabilisers designed to increase *power transfer capability*.
- Fast runback schemes of *generating units*.
- Line uprating.
- Virtual *transmission lines*.
- Phase shifting *transformers*.
- Series compensation.
- Control of customer *load* in response to certain signals.
- Installation of or utilisation of existing, small-scale *generation*.

## 2.4. NSCAS gaps and last resort planning powers

AEMO may declare an *NSCAS gap* when it forecasts that a need for NSCAS will arise within a given time horizon following the publication of the relevant *NSCAS Report*.

Under the NER, the forecast horizon applicable to Other RSAS and MBAS is five years. For Inertia RSAS and System Strength RSAS, a three-year horizon applies. This means AEMO may only declare *NSCAS gaps* for Inertia RSAS or System Strength RSAS if:

- AEMO has revised the relevant requirements to reflect updated forecasts of *power system* development; and
- the revision results in a forecast requirement for *inertia network services* or *system strength services* exceeding the level of those services that a TNSP is required to procure under the NER within the next three years.

AEMO cannot declare *NSCAS gaps* for Inertia RSAS or System Strength RSAS:

- where a shortfall is expected to arise after the next three years (these forecasts are published in the *Inertia Report* or *System Strength Report* as applicable); or
- where a shortfall is caused by a decline in the forecast availability of *inertia network services* or *system strength services*, rather than an increase in the requirements for those services.

[11] ~~MBAS procured to address system strength limitations excludes any service that is also capable of being made available as a *system strength service* to address a *fault level shortfall* through the arrangements in NER 5.20C, as excluded under NER 11.101.5.~~

Where a TNSP does not meet a declared *NSCAS gap* for RSAS in full, AEMO has last resort planning powers to procure services to meet that gap under NER 3.11.3 and 3.11.5. AEMO has no last resort planning powers for MBAS.

# 3. NSCAS Quantity Procedure

## 3.1. NSCAS quantity procedure context

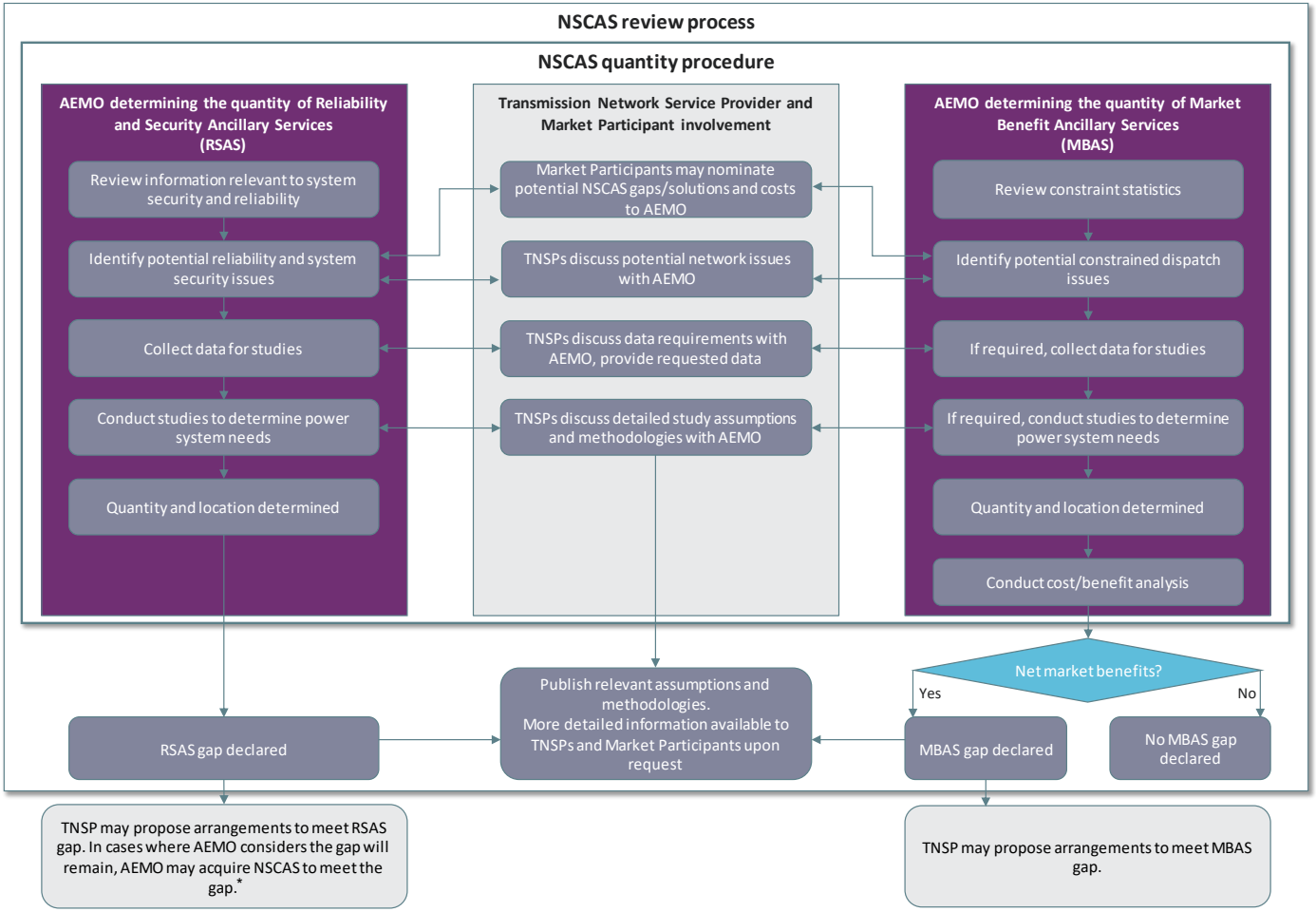
This *NSCAS quantity procedure* records the process to identify the location and quantity of each type of *NSCAS* required.

Figure 1 illustrates the steps taken in the *NSCAS quantity procedure*, and where the procedure fits in relation to the overall *NSCAS* review and (if applicable) tender process.

*NSCAS needs* identified via the *NSCAS quantity procedure* are procured by the relevant TNSP or, as a last resort in the case of RSAS, ~~possibly~~ by AEMO using the *NSCAS Tender Guidelines*. ~~in the case of RSAS.~~

The remainder of this section ~~procedure~~ explains how the quantity and location of required *NSCAS* is determined – first for RSAS (including each sub-type), then for MBAS – before providing an appendix noting the inputs and assumptions for the NSCAS review.

**Figure 1 The structure of the NSCAS quantity procedure in the greater NSCAS review process**




Note: *TNSP – Transmission Network Service Provider*
*Subject to limitations outlined in Section 2.4.

## 3.2. Determining the quantity of RSAS

### 3.2.1. Identify transmission system security and reliability issues

AEMO will identify issues in relation to *power system security* and reliability where RSAS is likely to be an effective solution.

Issues will be identified from review of information that may include but is not limited to:

- Planning reports such as *Transmission Annual Planning Reports*, *Integrated System Plans* (ISP), and previous *NSCAS* assessments or other existing analysis having identified *power system security* or reliability challenges expected to arise in future due to forecast *network* changes.
- Forecasting reports such as the electricity *statement of opportunities* (ESOO).
- Operational experience and incidents such as:
  - Operations staff recommendations about possible future *power system security* and reliability challenges based on operational knowledge and experience.
  - Historical periods where the system was not in a *secure operating state*.
  - Historical periods where *power system security* could be maintained or restored[12] only with extreme intervention measures.
  - Historical periods where *power system security* could be maintained or restored only by issuing directions.
  - Historical periods where there was USE[13].
  - Historical periods where ~~avoiding~~ USE was only avoided ~~achieved~~ with extreme intervention measures.
  - Historical periods where ~~avoiding~~ USE was only avoided ~~achieved~~ by issuing directions.
- Issues recommended for investigation by *Market Participants*[14].

Additional issues may also be identified through *power system* simulation studies using assumptions highlighted in Appendix A~~Appendix A~~.

AEMO will also consider whether an issue is currently under investigation by the TNSP and whether the TNSP has or is in the process of identifying a solution to an issue when determining the scope of its investigations.

[12] Following a *credible contingency event* or *protected event* AEMO must use reasonable endeavours to restore the *power system* ~~network~~ to a *secure operating state* as soon as practicable, and in any event within 30 minutes.

[13] USE can only be addressed by RSAS if the reliability standard is projected to not be met in the year the USE is projected to occur.

[14] Each ~~Annual NSCAS Review Report~~ *NSCAS Report*~~, starting from the 2020 NSCAS review,~~ will include details of the timeframes and logistics for submitting recommendations of issues and solutions to be considered in the next annual review of *NSCAS needs*~~Annual NSCAS Review~~.

### 3.2.2. Collect required data for assessment of RSAS needs

AEMO will seek to obtain information to assess RSAS needs (if it is not already available to AEMO), such as:

- *Interconnector active power* transfer limits.
- Continuous and short-term ratings of transmission assets.
- A list of future committed *transmission network* and *generation* developments.
- A list of anticipated and actionable *transmission network* developments.
- A list of anticipated, and ISP forecast, *generation* and storage developments.
- Most recent relevant *connection point* forecasts.
- Historical *power system* snapshots under various conditions.
- Details of existing *NMAS* agreements.
- Minimum acceptable *reactive power* margins.
- Network voltage limits.
- Data for modelling the performance of relevant *production units*, ~~generator systems, batteries,~~ dynamic plant, control schemes.
- Protection settings for fault-clearing times of key *transmission network* components.
- Any other information AEMO considers necessary to assess RSAS needs.

### 3.2.3. Conduct market modelling to determine Inertia RSAS and System Strength RSAS needs

Where necessary, AEMO will conduct market modelling to create projections of future levels of available system strength and inertia. *Constraints* to 'force on' *production units* for system strength or inertia reasons will be removed from any market modelling runs to model economic *dispatch*, except where contracts or network investments exist to meet this need.

Inertia RSAS and System Strength RSAS needs must be assessed over a planning horizon of three years. Market modelling will be undertaken using the inputs and assumptions recorded in Appendix A to determine the location and quantity of Inertia RSAS and System Strength RSAS needs.

Inertia RSAS and System Strength RSAS may need to be location-specific to have the desired effect. Appropriate margins will be added when assessing quantities to account for uncertainties in the market modelling assumptions. Descriptions of how margins were determined will be recorded in the *NSCAS Report*.

### 3.2.4. Conduct power system simulation studies to determine the Other RSAS need

Where necessary, study cases will be developed to model the relevant power system operating conditions under which the identified system security or reliability issues arise. Studies will quantify the extent of the Other RSAS issues and identify solutions to resolve them. Studies may also consider solutions to issues proposed by TNSPs or *Market Participants*, who will be

consulted accordingly. These solutions are called *NSCAS needs* under the NER. In this context they are more specifically Other RSAS needs.

Other RSAS needs are to be assessed over a planning horizon of at least five years. *Power system* analysis will be undertaken using the inputs and assumptions recorded in Appendix A to determine the location and quantity of Other RSAS needs. In this context "location" and "quantity" can be interpreted broadly as meaning a functional quantitative description of the Other RSAS need.

In some instances, the quantification will be simple to describe, for example megavolt amperes reactive (MVAr) of *reactive power* absorption at a specific location. Others will be more complex, for example the design and coordination of power system stabilisers to increase transient stability limits does not have a simple unit of measure. In such instances, the description of the location and quantity of the Other RSAS need will proceed in so far as is practical.

In so far as is practical, AEMO will describe any *NSCAS need* in a manner that is neutral as to whether it can be delivered by a *network option* or a *non-network option*.

The type of analysis to be conducted will depend on the specific issue being assessed. In general, the analysis is expected to include simulations of system normal conditions or 'system typical'[15] conditions and *credible contingency events* or *protected events* to assess the ability to maintain *power system security* or to restore ~~the network to~~ a *secure operating state* within 30 minutes. This may include thermal and voltage limit studies, dynamic stability studies, voltage reactive margin studies, and more if required.

Other RSAS may need to be location-specific to have the desired effect. Appropriate margins will be added when assessing *NSCAS* quantities to account for uncertainties in the *power system* simulation studies. Descriptions of how margins were determined will be recorded in the *NSCAS Report*.

### 3.2.5. Inertia RSAS gap declaration

To declare an *NSCAS gap* for Inertia RSAS caused by AEMO revising the *inertia requirements*, AEMO will assess inertia projections over a planning horizon of three years, and compare the inertia projection results against the new *inertia requirements*[16]. AEMO will set a reasonable metric for the percentage of time that the new *inertia requirements* must be met before a gap is declared. AEMO will consider all relevant factors when determining whether a gap exists, including but not limited to:

- market modelling results;
- market trends and insights; and
- relevant government policy announcements.

[15] See Appendix A for further information on 'system typical' considerations.

[16] The methodology for determining the inertia requirements can be found in the Inertia Requirements Methodology.

In general, AEMO will use a metric requiring inertia projections to exceed new *inertia requirements* for a percentage of time equivalent to three standard deviations above the mean (approximately the 99.87th percentile).

In some cases, the nature of an *NSCAS* study, the tested system conditions, or the resolution of modelling data may not align with a normal distribution, or may otherwise be inadequately represented by a three-standard-deviation approach. In these cases, AEMO may use an alternative statistical approach as part of the study, on a case by case basis. The alternative approach used, and AEMO's reasons for using it, will be detailed in the *NSCAS Report*.

Inertia RSAS needs will be recorded in the *NSCAS Report* as *NSCAS needs* (Inertia RSAS specifically). This will serve as the declaration of an *NSCAS gap* for Inertia RSAS.

### 3.2.6. System strength RSAS gap declaration

To declare an *NSCAS gap* for System Strength RSAS, caused by AEMO revising the *system strength requirements*, AEMO will assess fault level projections over a planning horizon of three years, and compare the fault level projection results against the *system strength requirements*[17]. AEMO will set a reasonable metric for the percentage of time that the new *system strength requirements* must be met before a gap is declared. AEMO will consider all relevant factors when determining whether a gap exists, including but not limited to:

- market modelling results;
- market trends and insights; and
- relevant government policy announcements.

In general, AEMO will use a metric requiring projections to exceed the new *system strength requirements* for a percentage of time equivalent to three standard deviations above the mean (approximately the 99.87th percentile).

In some cases, the nature of an *NSCAS* study, the tested system conditions, or the resolution of modelling data may not align with a normal distribution, or may otherwise be inadequately represented by a three-standard-deviation approach. In these cases, AEMO may use an alternative statistical approach as part of the study, on a case by case basis. The alternative approach used, and AEMO's reasons for using it, will be detailed in the *NSCAS Report*.

System Strength RSAS needs will be recorded in the *NSCAS Report* as *NSCAS needs* (System Strength RSAS specifically). This will serve as the declaration of an *NSCAS gap* for System Strength RSAS.

### ~~3.2.3.~~3.2.7. Other RSAS gap declaration

Other RSAS needs ~~Solutions~~ for confirmed system security issues and confirmed system reliability issues will be recorded in the *NSCAS Report* as *NSCAS needs* (Other RSAS ~~needs~~ specifically). This will serve as the declaration of an *NSCAS gap* for Other RSAS~~(an RSAS gap specifically)~~.

[17] The methodology for determining the system strength requirements can be found in the System Strength Requirements Methodology.

~~AEMO may then request the relevant TNSP to put arrangements in place to meet the Other RSAS gap, or to provide reasons why the *NSCAS gap* will not be met. If the TNSP does not do so, AEMO can procure RSAS itself through the NSCAS tender process.~~

## 3.3. Determining the quantity of MBAS

### 3.3.1. Identify constrained dispatch issues

AEMO will review binding *constraint* statistics to determine if solutions to alleviate the constraints are likely to provide sufficient economic benefits. The binding constraints review may include but is not limited to:

- *Constraint* equations that have historically bound causing market impacts.
- *Constraint* equations that have bound causing market impacts in studies for the ESOO~~Electricity Statement of Opportunities~~, the ISP~~*Integrated System Plan*~~, or other forward-looking investigations.
- Constraints recommended for consideration by *Market Participants*[18].

Where deemed appropriate by AEMO, any high priority *constraints* identified in this initial screening will be further investigated.

AEMO will also consider whether an issue is currently under investigation by the TNSP and whether the TNSP has or is in the process of identifying a solution to an issue when determining the scope of its investigations.

### 3.3.2. Collect data required for assessment of MBAS solutions

AEMO will obtain any additional information required to assess MBAS solutions, if it has not already been obtained as per section 3.2.2~~3.2.2~~.

### 3.3.3. Conduct power system simulation studies to determine the MBAS solution

Where deemed necessary, study cases will be developed to model the relevant power system operating condition where the constraint is binding to determine the appropriate NSCAS solution and revised transfer limit. Studies may also consider solutions proposed by TNSPs or *Market Participants*, who will be consulted accordingly. Power system analysis undertaken will use the inputs and assumptions recorded in Appendix A~~Appendix A~~ to determine the location and quantity of the NSCAS required.

In so far as is practical, AEMO will describe any solution in a manner that is neutral as to whether it can be delivered by a *network option* or a *non-network option*.

The type of analysis to be conducted will depend on the specific issue being assessed. In general, the analysis is expected to include simulations of system normal conditions and *credible contingency events* or *protected events* to assess the ability to maintain system security or to restore the network to a secure operating state within 30 minutes. This may

[18] Each Annual *NSCAS* Report, starting from the 2020 *NSCAS* review, will include details of the timeframes and logistics for submitting recommendations of constraints and solutions to be considered in the next Annual *NSCAS* Review.

include thermal and voltage limit studies, dynamic stability studies, voltage reactive margin studies, and more if required.

MBAS may need to be location-specific to have the desired effect and appropriate margins will be added when assessing *NSCAS* quantities to account for uncertainties in the power system simulation studies. Description of how margins were determined will be recorded in the *NSCAS Report*.

### 3.3.4. Conduct cost benefit assessment for enhancing network transfer capability

AEMO, where necessary, will carry out a cost benefit assessment to identify and declare an MBAS gap to address identified high priority constraints.

Any cost benefit assessment will be tailored as appropriate to the issue and solutions under consideration. The level of detail of assessments will be commensurate to the estimated capital cost of the solutions. Solutions with an estimated capital cost less than the *regulatory investment test for transmission* (RIT-T) cost threshold[19] will be assessed to a level of detail akin to a network capability incentive parameter action plan (NCIPAP) assessment. Solutions with an estimated capital cost greater than the RIT-T threshold may be assessed in greater detail accordingly.

Any AEMO cost benefit assessment will consider factors that may include but are not limited to:

1. Solution costs, considering:
    a. Capital cost of the proposed solutions identified. AEMO will estimate the capital cost of solutions based on its internal cost database, or any other available relevant information, including information provided by TNSPs and *Market Participants*. In so far as is practical, AEMO will consider both *network options* and *non-network options*.
    b. Operating and maintenance costs of the proposed solutions identified.
    c. Weighted average cost of capital (WACC).
    d. Economic life of assets.
2. Market benefits, considering:
    a. Quantifying the reduction in the binding of the constraint. This may take the form of determining the reduction in binding hours, and the increase in the transfer limit to calculate a MWh value of higher cost generation avoided.
    b. The relative cost difference between the higher cost generation dispatched when the constraint is binding, and the lower cost generation dispatched when the constraint is not binding.

[19] $6 million at the time of publication of this document. This value may be revised by the AER over time. Refer to https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/cost-thresholds-review-for-the-regulatory-investment-tests-2018.

AEMO may consider and record additional market benefit classes[20] if they are deemed to be important to the market benefit test decision, and if it is practical to do so.

~~From this analysis AEMO may identify and declare an MBAS gap. AEMO may then request the relevant *TNSP* to put arrangements in place to meet the MBAS gap, or to provide reasons why the *NSCAS gap* will not be met. Arrangements to meet the MBAS gap will be subject to rules requirements applying to *TNSP* expenditure.~~

### ~~3.3.2.~~3.3.5. MBAS gap declaration

Alleviation of constraints that have been found by AEMO to yield net market benefits will be recorded in the *NSCAS Report* as *NSCAS needs* (MBAS needs specifically). This will serve as the declaration of an *NSCAS gap* for MBAS~~(an MBAS gap specifically)~~.

~~AEMO may then request the relevant TNSP to advise when it will put arrangements in place to meet the MBAS gap, or provide reasons why the *NSCAS gap* will not be met.~~

[20] For example AER, Cost benefit analysis guidelines - Guidelines to make the Integrated System Plan actionable, p20, August 2020, at https://www.aer.gov.au/system/files/AER%20-%20Cost%20benefit%20analysis%20guidelines%20-%2025%20August%202020.pdf and the Application guidelines regulatory investment test, December 2018 https://www.aer.gov.au/system/files/AER%20-%20Final%20RIT-T%20application%20guidelines%20-%2014%20December%202018_0.pdf

# Appendix A. Inputs and Assumptions for NSCAS assessment

This appendix provides the broad modelling assumptions AEMO will apply when determining the *NSCAS* requirements. Some of the assumptions are applicable to the assessments of ~~both~~ all *NSCAS* types and others are only applicable to one type.

AEMO will consult with TNSPs during the *NSCAS* review, including discussing detailed study assumptions and methodologies to ensure that the most appropriate inputs and methods are used.

To the extent it is practical to do so, AEMO ~~will~~ may share and discuss preliminary results of identified RSAS and MBAS issues with *Market Participants*.

A description of the specific methodology followed, and the assumptions applied in the calculation of any declared *NSCAS gap*, will be provided to the local TNSP at the time of publication of the *NSCAS Report* or as soon as practicable thereafter. This may also include relevant study files and models to the extent necessary and consistent with AEMO's confidentiality obligations.

AEMO, where necessary, will publish descriptions of any relevant assumptions and methodologies used in the NSCAS review. AEMO will publish this information at the time of publication of the *NSCAS Report* (for example as an appendix) or as soon as practicable thereafter.

The *NSCAS Report* will include contact information whereby *Market Participants* may request more detailed information regarding study assumptions and methodologies, beyond what is published in the *NSCAS Report*.

## A.1 Inputs and assumptions associated with generation and storage

- AEMO will include newly committed *generation* and storage within the area of study as per the latest information available on AEMO's generation information page[21] at the start of the NSCAS review.
- As appropriate, AEMO will consider anticipated *generation* projects, and ISP forecast *generation* and storage in the area of study, to either test the *NSCAS* study results, or form an alternate system condition for *NSCAS* analysis.
- AEMO will use the outcomes of AEMO's ISP~~*Integrated System Plan*~~, ESOO~~Electricity Statement of Opportunities~~ or other available information to inform assumptions about future *plant* ~~generator~~ operation for use in the NSCAS studies, including situations where ~~generator~~ performance may be expected to differ from existing *performance standards*.
- *Generation* and storage ~~Generator technologies~~ and economic drivers are evolving and NSCAS studies will use the inputs and assumptions applied in the ISP ~~*Integrated System*~~

[21] AEMO, NEM Generation Information, at https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.

*Plan* and ESOOElectricity Statement of Opportunities (including the latest CSIRO GenCost Report[22] or any replacements) to inform analysis on potential *NSCAS needs*. An example of this would be the adaption of coal generators to switching off during low price and/or any other relevant conditions.

- *Generators* and *Integrated Resource Providers* intending to close a *production* generating *unit* must notify AEMO at least 42 months (3.5 years) ahead of the closure date[23]. Announced retirements will be considered in the *NSCAS* review. AEMO may use the outcomes of the ISP*Integrated System Plan* and ESOOElectricity Statement of Opportunities to inform studies of the potential future need for *NSCAS* for the risk of a *production* generating *unit* closing in the 3.5 – 5 year period that has not yet been announced. This analysis is anticipated to use *expected closure years*[24] and risks of early or delayed retirement identified in the ISP*Integrated System Plan*, unless other relevant and appropriate information becomes available.

## A.2 Inputs and assumptions associated with interconnector transfers

- *Interconnector* transfers will be assumed at transfer levels appropriate to the given study bounded by the maximum transfer limits.
- If committed projects (network or non-network) will lead to an increase in *interconnector* transfer limits, then the revised *interconnector* limits will be assumed in the modelling.

## A.3 Inputs and assumptions associated with loads and demand

- Plausible demand levels will be sourced from the best available demand forecasts at the time of assessment. *NSCAS* studies will be conducted at various demand levels appropriate to the issue being assessed.
- *Loads* will be modelled in a manner consistent with the type of study to be performed for determining the *NSCAS need*.

## A.4 Other inputs and assumptions

- Committed *transmission network* augmentations will be modelled in order to determine *NSCAS needs*.
- Anticipated or actionable *transmission network* augmentations could be used for alternate system conditions where AEMO considers this could form the more onerous study conditions.

[22] AEMO and CSIRO. GenCost 2019-20: Preliminary results for stakeholder review, published December 2019, at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/Inputs-Assumptions-Methodologies/2019/CSIRO-GenCost2019-20_DraftforReview.pdf.

[23] National Electricity Rules, version 150, clause 2.10.1

[24] AEMO, NEM Generation Information, at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.

- AEMO will consider any cost information provided by TNSPs and *Market Participants*.
- AEMO will consider *non-market ancillary services* that will be active during the study period.
- The impact of relevant control schemes will be incorporated in the assessment of the *NSCAS needs*.
- AEMO will consider 'system typical' *network* configurations that may apply where AEMO has identified credible or typical pre-contingent operational conditions without all *network elements* in service, and which present reasonably foreseeable additional challenges in maintaining *power system security* or reliability.
- Examples of 'system typical' network configurations may include:
  - *Network elements* which are out of service or not operating to their applicable performance requirements, and are not scheduled to return to service or normal operation until some time within or beyond the study horizon.
  - *Network elements* which have had frequent or extended *outages*, such that an *outage* could plausibly occur during the study horizon.
  - A critical piece of equipment that has previously been out of service and has posed a risk to power system security or reliability, or has necessitated the issue of directions.
- AEMO will discuss proposed 'system typical' study assumptions with the local TNSP and consider their feedback on evolving network considerations as the experts on their local *network* conditions.
- AEMO contingency studies will either start from a system normal configuration with all *transmission network* elements in service[25], or from a 'system typical' network configuration. Individual generating units may be out of service as per expected market behaviour. From this starting point AEMO will assess whether the system can be maintained in a secure operating state. On a case by case basis AEMO may assess if the system can be returned to a secure operating state within 30 minutes of a *credible contingency event* or *protected event*.
- AEMO contingency studies will assume the worst-case plausible network conditions for the issues being assessed. For example, if a high voltage issue is most severe at minimum demand occurring at midday during a spring weekend, AEMO will study those network conditions. Where necessary, AEMO will apply thermal ratings that align with the time of day, time of year, and weather, that align with the network conditions being assessed.
- When assessing the ability of the system to return to a secure operating state within 30 minutes of a *credible contingency event* or *protected event*, AEMO may assume the initial event occurs during worst case plausible network conditions for the issues being assessed. AEMO may factor in the probability of the event occurring during these conditions when determining if there is an *NSCAS need*.
- AEMO will conduct the NSCAS review by applying the planning assumption that no transmission line per region may be switched out of service before a *credible contingency event* or *protected event* in order to meet system security and reliability obligations such as

[25] Excluding elements that are out of service as part of the system normal configuration, for example to maintain system security.

addressing high voltage levels. Exceptions to this approach may include plausible network conditions which permit the assumption that one or more lines may be switched in a region (or sub-region), informed by the experience of the relevant AEMO and TNSP system operators.

# Version release history

| Version | Effective date | Summary of changes |
|---|---|---|
| 2.2 | 17 December 2021 | Amendment to the planning assumption that one transmission line per region may be switched out of service. |
| 2.1 | 1 October 2020 | Amendments to approach for definition of NSCAS types.<br>Amendments to approach for assessments of system security.<br>Amendments to process for selection of constraints.<br>Introduced high level modelling principles, replaced detailed processes.<br>Combined the NSCAS description procedure and NSCAS quantity procedure into a single procedure. |
| 1.0 | 5 April 2011 | First Issue |