NETWORK SUPPORT AND CONTROL ANCILLARY SERVICES (NSCAS) DESCRIPTION AND QUANTITY PROCEDURE

PREPARED BY:	AEMO System Planning
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VERSION RELEASE HISTORY

Version	Effective Date	Summary of Changes
1.0	5 April 2011	First Issue
2.0 Draft	Draft for consultation released 4 August 2020	• Amendments to approach for definition of NSCAS types. • Amendments to approach for assessments of system security. • Amendments to process for selection of constraints. • Introduced high level modelling principles, replaced detailed processes. • Combined the NSCAS description procedure and NSCAS quantity procedure into a single procedure.

CONTENTS

1. INTRODUCTION

1.1. Purpose and scope

These are the *NSCAS description* and the *NSCAS quantity procedure* 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 this 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.

1.2. Definitions and interpretation

1.2.1. Glossary

Terms defined in the *National Electricity Law* and the NER 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
MBAS	Market Benefits Ancillary Service
NEM	*National Electricity Market*
NER	National Electricity Rules
NMAS	*Non-market ancillary service*
NSCAS	*Network support and control ancillary service*
NSCAS tender guidelines	The document referred to in clause 3.11.5 (b) of the NER and published by AEMO under that name
RSAS	Reliability and Security Ancillary Service
TNSP	*Transmission Network Service Provider*

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

Reference	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

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 application and types

NSCAS[1] are non-market ancillary services procured to control active and reactive power flow into or out of an electricity *transmission network*, to address the following *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*[2].
- Maintain or increase 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[3].

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 defined the types of *NSCAS* according to the needs that would be primarily addressed – that is, maintaining system security and reliability, and increasing net market benefits.

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

- Reliability and Security Ancillary Service (RSAS); and
- Market Benefit Ancillary Service (MBAS).

2.2. Reliability and Security Ancillary Service (RSAS)

2.2.1. Description

RSAS is a non-market ancillary service 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*, TNSPs, and *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*.

[1] The NSCAS definition is in the Chapter 10 Glossary of NER Version 144.
[2] NER Version 144, Clause 3.11.6 (a)(1).
[3] NER Version 144, Clause 3.11.6 (a)(2).

RSAS provides AEMO with the tools it needs to operate the *NEM* consistent with its system security and reliability obligations. These obligations are described as follows:

- **System security**
  1. To maintain the system in a secure operating state[4] during normal operation, consistent with the *power system security standards*.
  2. To return the system to a secure operating state within 30 minutes following a credible contingency or protected event, consistent with the *power system security standards*.
- **Reliability:**
  3. To ensure each *NEM* region has sufficient local generation and transmission capacity such that demand can be supplied consistent with the *reliability standard*[5].

AEMO 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 shedding 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.

2.2.3. 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 RSAS to maintain power system security could include, but are not limited to:

- Non Market Ancillary Service (NMAS) contracts with market participants such as *generators* or 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).
- Upgrading *network* elements to expand their secure operating envelope (for example, increasing the maximum voltage rating of a bushing in a substation).

Examples of RSAS to avoid unserved energy, 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.

[4] The power system is in a secure operating state if it will return to a satisfactory operating state following a credible contingency or a protected event (for example trip of a transmission line or 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 clauses 4.2.2 and 4.2.4 of the *NER* for more information.

[5] The reliability standard is determined by the Reliability Panel and defined in the NER. In NER version 144 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.

- 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 non-market ancillary service 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*, 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 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[6].

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).
- 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.

[6] 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.

- Phase shifting transformers.
- Series compensation.
- Control of customer load in response to certain signals.
- Installation of, or utilisation of existing, small-scale generation.

3. NSCAS QUANTITY PROCEDURE

3.1. NSCAS quantity procedure context

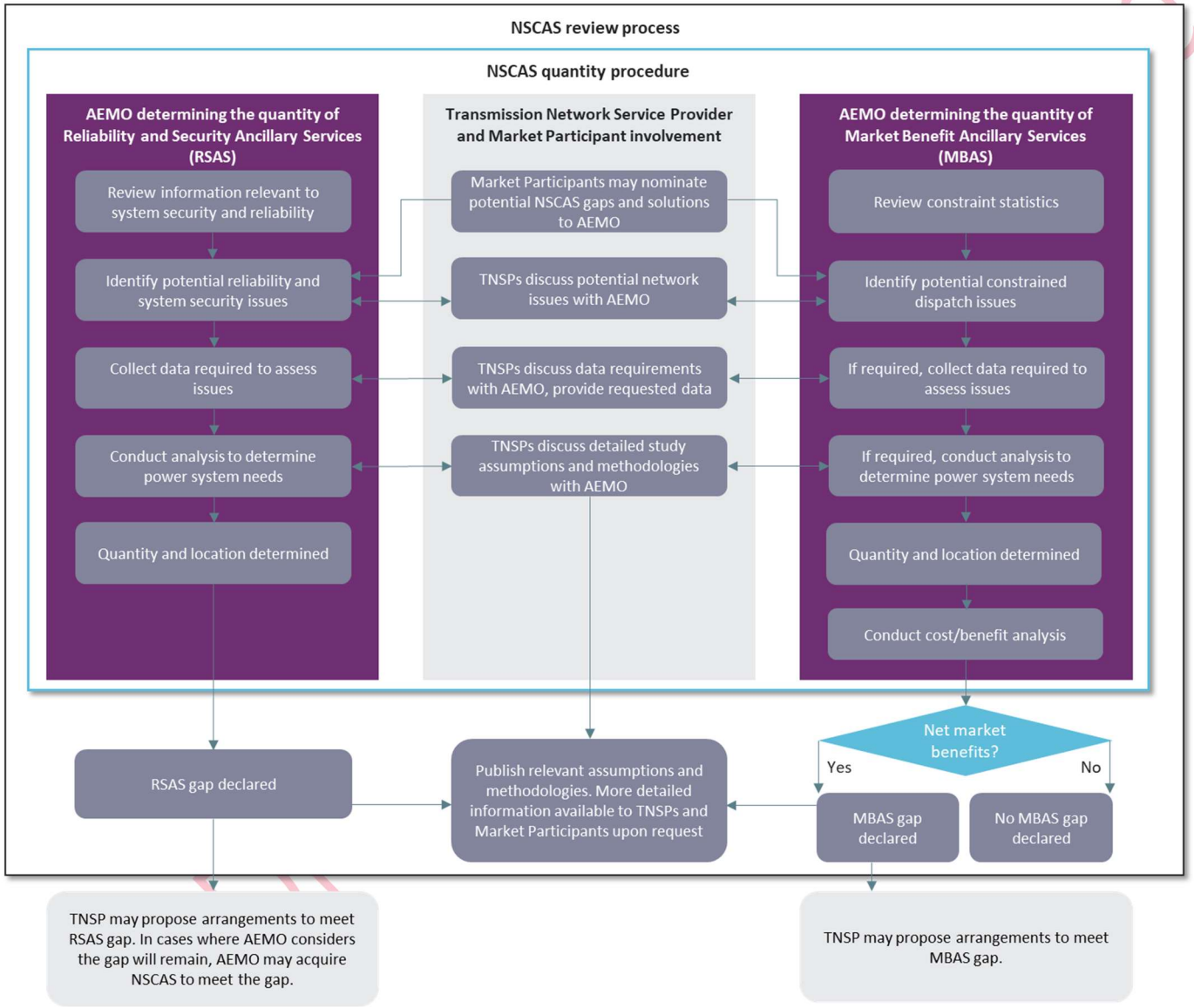
This *NSCAS quantity procedure* records the process to identify the location and quantity of each type of *NSCAS* required.

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

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

The remainder of this procedure explains how the quantity and location of required *NSCAS* is determined – first for RSAS, 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

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*, and previous *NSCAS* assessments or other existing analysis having identified system security or reliability challenges expected to arise in future due to forecast *network* changes.
- Forecasting reports such as the *Electricity Statement of Opportunities*.
- Operational experience and incidents such as:
  - Operations staff recommendations about possible future 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 system security could be maintained or restored[7] only with extreme intervention measures.
  - Historical periods where system security could be maintained or restored only by issuing directions.
  - Historical periods where there was unserved energy (USE)[8].
  - Historical periods where avoiding USE was only achieved with extreme intervention measures.
  - Historical periods where avoiding USE was only achieved by issuing directions.
- Issues recommended for investigation by market participants[9].
- Additional issues may also be identified through power system simulation studies using assumptions highlighted in 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.

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.
- Most recent relevant connection point forecasts.
- Historical power system snapshots under various conditions.
- Details of existing *non-market ancillary services* agreements.
- Minimum acceptable reactive power margins.

[7] Following a credible contingency or protected event AEMO must restore the *network* to a secure operating state within 30 minutes.
[8] 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.
[9] Each Annual NSCAS Review Report will include details of the timeframes and logistics for submitting recommendations of issues to be considered in the next Annual NSCAS Review.

- *Network* voltage limits.
- Data for modelling the performance of relevant 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 power system simulation studies to determine the 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 RSAS issues and identify solutions to resolve them. These solutions are called *NSCAS needs* under the NER. In this context they are more specifically RSAS needs.

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 RSAS needs. In this context "location" and "quantity" can be interpreted broadly as meaning a functional quantitative description of the RSAS need.

In some instances, the quantification will be simple to describe, for example 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 RSAS need will proceed in so far as is practical.

The type of analysis to be conducted will depend on the specific issue being assessed. In general, the analysis is expected to include pre-and post-contingency simulations of credible contingency events or protected events followed by assessment of the ability to maintain 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.

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.

3.2.4. RSAS gap declaration

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

AEMO may then request the relevant TNSP to put arrangements in place to meet the 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 *Electricity Statement of Opportunities*, the *Integrated System Plan*, or other forward-looking investigations.

- Constraints recommended for consideration by market participants[10].

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 needs

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

3.3.3. Conduct power system simulation studies to determine the MBAS need

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. Power system analysis undertaken will use the inputs and assumptions recorded in Appendix A to determine the location and quantity of the *NSCAS* required.

The type of analysis to be conducted will depend on the specific issue being assessed. In general, the analysis is expected to include pre-and post-contingency simulations of credible contingency events or protected events followed by assessment of the ability to maintain 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.

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.

3.3.4. Conduct cost benefit assessment for enhancing network transfer capability

AEMO, where necessary, will carry out a cost benefit assessment to determine if investment is warranted 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. 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.
    b. Operating and maintenance costs of the proposed solutions identified.
    c. Weighted average cost of capital (WACC).
    d. Economic life of assets.

[10] Each Annual NSCAS Review Report will include details of the timeframes and logistics for submitting recommendations of constraints to be considered in the next Annual *NSCAS* Review.

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.

This approach identifies the market benefits of enabling efficient generation dispatch. It does not consider any other benefit including:

- Capital deferral.
- Reductions in ancillary service costs.
- Competition benefits.
- Reduction in impact of high-impact-low-probability events.
- Additional optional value gained or forgone from implementing the investment.

AEMO may consider these additional market benefits 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.

3.3.5. 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* (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.

APPENDIX A. INPUTS AND ASSUMPTIONS FOR NSCAS NEED 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 *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.

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*.

Inputs and assumptions associated with generation

- AEMO will include newly committed generation within the area of study as per the latest information available on AEMO's generation information page[11] at the start of the *NSCAS* review.
- AEMO will use the outcomes of AEMO's *Integrated System Plan*, *Electricity Statement of Opportunities* or other available information to inform assumptions about future generator operation for use in the *NSCAS* studies, including situations where generator performance may be expected to differ from existing performance standards.
- Generator technologies and economic drivers are evolving and *NSCAS* studies will use the inputs and assumptions applied in the *Integrated System Plan* and *Electricity Statement of Opportunities* (including the latest CSIRO GenCost Report[12] 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 intending to close a generating unit must notify AEMO at least 42 months (3.5 years) ahead of the *closure date*[13]. Announced retirements will be considered in the *NSCAS* review. AEMO may use the outcomes of the *Integrated System Plan* and *Electricity Statement of Opportunities* to inform studies of the potential future need for *NSCAS* for the risk of a 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*[14] and risks of early or delayed retirement identified in the *Integrated System Plan*, unless other relevant and appropriate information becomes available.

[11] 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

[12] 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

[13] National Electricity Rules, version 145, clause 2.10.1

[14] 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

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.

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*.

Other inputs and assumptions

- Committed *transmission network* augmentations will be modelled in order to determine *NSCAS needs*. Projects that are well advanced but not yet committed, which may come within the *NSCAS* review periods, may be included in an *NSCAS* assessment as a sensitivity.
- 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 contingency studies will start from a system normal configuration with all transmission network elements in service[15]. 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 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 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 one transmission line per region may be switched out of service in order to meet system security and reliability obligations such as addressing high voltage levels. Exceptions to this approach will include plausible network conditions which permit the assumption that more than one line may be switched in a region (or sub-region), or conversely plausible network conditions for which assuming pre-contingent switching of any transmission lines is not feasible. These exceptions would be subject to an appropriate assessment by AEMO of the risk associated with such an assumption, informed by the experience of the relevant AEMO and TNSP system operators.

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