POWER SYSTEM SECURITY GUIDELINES

PREPARED BY: Operational Support
PROCEDURE TYPE: System Operating Procedure
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FINAL APPROVER: Damien Sanford
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DATE: 22 March 2019
In vulnerable line list, QLD region:
- Added Strathmore - Clare South 7208 and Collinsville North - Tee King Creek - Clare South 7128 132 kV Lines.
- Removed Bouldercombe – Rockhampton No.7108 and Bouldercombe – Egans Hill No.7221 132 kV lines

In vulnerable line list, TAS region:
- Added Sheffield - Wesley Vale and Sheffield - Devonport 110 kV lines

In vulnerable line list, VIC region:
- Updated LTTW End Date of Eildon PS – Mt Beauty No.1 and No.2 220 kV Lines.

Change to regulation FCAS requirement (section 19.3)

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In vulnerable line list: Queensland region: removed Chinchilla - Columboola No.7349 and No.7350 132 kV lines.
- Victoria region: added Hazelwood PS – Rowville No.1 and No.2 220 kV lines
- Minor edits.

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In vulnerable transmission line list
- Updated the category of Tungatinah - New Norfolk tee Meadowbank No. 1 and No. 2 110 kV Lines
- Added Dumaresq - Bulli Creek No. 8L and No. 8M 330 kV lines

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In vulnerable transmission line list Queensland region:
- updated LTTW End Date of Collinsville North – Proserpine No.7125 and No.7126 132 kV lines
- updated LTTW End Date of Tarong – Chinchilla No.7168 and No.7183 132 kV lines
- Added Goonyella - North Goonyella Tee - Stoney Creek No.7122 and Goonyella - Newlands No.7155 132 kV Line
- Added Tungatinah - New Norfolk tee Meadowbank No. 1 and No. 2 110 kV

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| 93      | 22/3/2019  | Y Xu J Deere| S Rajapakse | T van der Walt   | L Thomsson     | D Sanford| In vulnerable line list, QLD region:  
- Added Strathmore - Clare South 7208 and Collinsville North - Tee King Creek - Clare South 7128 132 kV Lines.  
- Removed Bouldercombe – Rockhampton No.7108 and Bouldercombe – Egans Hill No.7221 132 kV lines. |

| 92      | 31/12/2018 | A Le        | Y Xu     | L Tedesco        | E Whyte        | T van der Walt | In vulnerable line list  
- Queensland region: removed Chinchilla - Columboola No.7349 and No.7350 132 kV lines.  
- Victoria region: added Hazelwood PS – Rowville No.1 and No.2 220 kV lines  
- Minor edits. |

| 91      | 04/09/2018 | A Le        | Y Xu     | S Rajapakse      | L Thomson      | T van der Walt | In vulnerable transmission line list  
- Updated the category of Tungatinah - New Norfolk tee Meadowbank No. 1 and No. 2 110 kV Lines  
- Added Dumaresq - Bulli Creek No. 8L and No. 8M 330 kV lines |

| 90      | 01/03/2018 | A Le K Wong | Y Xu     | T van der Walt   | L Thomson      | D Sanford       | In vulnerable transmission line list Queensland region:  
- updated LTTW End Date of Collinsville North – Proserpine No.7125 and No.7126 132 kV lines  
- updated LTTW End Date of Tarong – Chinchilla No.7168 and No.7183 132 kV lines  
- Added Goonyella - North Goonyella Tee - Stoney Creek No.7122 and Goonyella - Newlands No.7155 132 kV Line  
- Added Tungatinah - New Norfolk tee Meadowbank No. 1 and No. 2 110 kV  
Tasmania region:  
- Added Tungatinah - New Norfolk tee Meadowbank No. 1 and No. 2 110 kV |
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<td>Replaced the part of NER Clause 4.8.3 with a reference in the section AEMO’s advice on power system emergency conditions.</td>
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<td>Updated status and End Date Probable / End Date Proven for multiple lines (Table 5) to reflect new reclassification criteria. Updated Section 16.2 Planned Outage of One Protection of a Duplicated Scheme. Updated links in important notice, footnote 1 and Section 14.2.</td>
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<td>Section 23 An initial notification no longer through AEMO Emergency Communications System (Whispir). Update section 16.3, Unplanned Outage of One Protection of a Duplicated Scheme Updated the name and status of 7125 &amp; 7126 in QLD vulnerable list.</td>
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<td>QLD Vulnerable list: Updated reference to No.7117 and No.7118 132 kV lines. Added No.7117 and No.7413 132 kV lines. Reviewed the procedure.</td>
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<td>Updated Lightning Reclassification Criteria. Reviewed the document Basslink LOL info included Added new 132 kV lines to vulnerable list – 7306 &amp; 7121; 7108 &amp; 7221. Updated status and End Date Probable / End Date Proven for multiple lines.</td>
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<td>K Wong</td>
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<td>Updated actions needed under Geomagnetic Disturbance conditions Added Chinchilla – Columboola No.7349 and No. 7350 132 kV lines to vulnerable list. Minor editorial change in Table 5.</td>
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<td>Number of subelectrical networks in QLD reduce from 3 to 2 Updated the status of 7168 &amp; 7183.</td>
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<td>from Probable to Proven Updated section 19.3.1 on resetting time error for region separation and restoration. Update history pages deleted to keep the recent updates only.</td>
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<td>Update the status of the DDTS–GNTS No.1 and No.3 220 kV lines from ‘Probable’ to ‘Proven’ Added 857 &amp; 858 Ross–Chalumbin 275 kV line to vulnerable list. Added 9W3 and 9W7 132 kV lines to vulnerable list – NSW.</td>
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<td>P Ryan</td>
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<td>Included the definition for Exceptional Events in the table 4. Added three phase faults to the process diagram (figure 3). Editorial change in section 19.4</td>
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<td>Y Xu, M San</td>
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<td>Revised the Lightning Assessment Definitions Added Coffs Harbour to Raleigh 9W3 &amp; Coffs Harbour to Boambee South 9W8 132 Kv lines to vulnerable lines table</td>
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Important Notice

Purpose
This document has been prepared by AEMO as required by clause 4.10.1 of the National Electricity Rules (Rules), and has effect only for the purposes set out in the Rules. The Rules and the National Electricity Law (Law) prevail over this document to the extent of any inconsistency.

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Interpretation

a) In this document, a term defined in the National Electricity Rules (NER) has the same meaning as given to that term in the NER. Those terms are intended to be identified by italicising them, but failure to italicise a NER-defined term does not affect its meaning.

b) In this document, capitalised words or phrases or acronyms have the meaning set out opposite those words, phrases, or acronyms in Table 1, or as defined in SO_OP_2000 Glossary.

c) Unless the context otherwise requires, this document will be interpreted in accordance with Schedule 2 of the National Electricity Law.

Table 1  Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>ECS</td>
<td>Emergency Control Scheme</td>
</tr>
<tr>
<td>EMMS</td>
<td>Electricity Market Management System</td>
</tr>
<tr>
<td>GIC</td>
<td>Geomagnetic Induced Current</td>
</tr>
<tr>
<td>GMD</td>
<td>Geomagnetic Disturbance</td>
</tr>
<tr>
<td>Guidelines</td>
<td>These Power System Security Guidelines</td>
</tr>
<tr>
<td>MNSP</td>
<td>Market Network Service Provider</td>
</tr>
<tr>
<td>MT Timeframe</td>
<td>Medium term PASA timeframe</td>
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<tr>
<td>PTP</td>
<td>Permission to proceed</td>
</tr>
<tr>
<td>PTR</td>
<td>Permission to restore</td>
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<tr>
<td>ST Timeframe</td>
<td>Short term PASA timeframe</td>
</tr>
<tr>
<td>VDS</td>
<td>VAr Dispatch Scheduler</td>
</tr>
</tbody>
</table>
1 Introduction
   a) These Power System Security Guidelines are made in accordance with NER clause 4.10.1(b), and form part of the power system operating procedures.
   b) If there is any inconsistency between these Guidelines and the NER, the NER will prevail to the extent of that inconsistency.

2 Purpose
These Guidelines describe:
   a) how AEMO seeks to operate the power system within the limits of the technical envelope;
   b) how AEMO seeks to meet its power system security responsibilities generally; and
   c) the information and actions required from registered participants to assist in maintaining or restoring power system security.

3 Application
These Guidelines apply to AEMO and all registered participants.

4 Related Policies and Procedures
Table 2 Related policies and procedures

<table>
<thead>
<tr>
<th>Policies and Procedure</th>
<th>Title</th>
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<tbody>
<tr>
<td>SO_OP_2000</td>
<td>Glossary</td>
</tr>
<tr>
<td>SO_OP_3705</td>
<td>Dispatch</td>
</tr>
</tbody>
</table>

5 AEMO Policy on the Management of Secure and Satisfactory Limits

Network constraints, developed from TNSP limit advice will be used by AEMO in the NEM dispatch process to ensure that plant remains within rating and power transfers remain within stability limits so that the power system is in a secure operating state.

AEMO will adhere to the signed off TNSP stability limit advice at all times but based on advice from the TNSP can operate to a more conservative stability limit. Operating to a less conservative limit requires AEMO to perform a due diligence on the advice received from the TNSP and is subject to a sign off by AEMO and the TNSP prior to the revised limit being utilised.

In all cases where AEMO makes a determination that it is necessary to adjust the power system such that the power system remains in or is returned to a secure operating state, AEMO will aim to minimise the impact on market outcomes.

AEMO may seek from the TNSP revised plant thermal ratings, or an agreed plan / network solution prior to invoking a network constraint.

AEMO may apply constraints to reflect the technical envelope at any time. Without limitation, examples of constraint action and considerations are likely to include:

- Constraints on interconnector flows to levels whereby there are sufficient FCAS to cater for the loss of an interconnection.
• Constraints on interconnector flows to levels which ensure that for the loss of that interconnector or part of that interconnector all other plant or equipment under AEMO’s control or co-ordination is operated within the appropriate operational or emergency limits.

• Constraints on interconnector or intra-regional flows to levels which ensure voltage conditions throughout the power system remain within the limits of operation as determined by AEMO and Network Service Providers.

• Constraints on interconnector or intra-regional flows to levels which ensure voltage conditions throughout the power system remain within limits for a satisfactory operating state under any credible contingency event scenario.

• Constraints on scheduled plant to maintain transmission line flows within secure limits.

• Constraints on scheduled plant to maintain interconnector or intra-regional flows within secure limits. This may take the general form: Risk <= Satisfactory limit – Secure limit.

• Constraints on a regulated interconnector controlled by a high voltage direct current system (HVDC) when the HVDC system is unable to control the interconnector flow to the level determined by the dispatch algorithm. In this case AEMO may set a fixed level of flow for the relevant interconnector at a physically realisable level.

Should AEMO not be able to manage secure and satisfactory limits through the use of network constraints, the following options will be used.

The options described are in a suggested priority order. They are available at all times but the circumstances at the time will dictate which particular option(s) will be utilised in managing the limit.

5.1 Revision to Plant Thermal Ratings
The TNSP provides to AEMO a revised plant thermal rating if available and AEMO inputs these revised plant rating into the operational systems.

5.2 Revision to Power System Limits
TNSP provides AEMO with revised power system limits together with any associated conditions. AEMO will perform a ‘due diligence’ of the revised limit to ensure that the advice is reasonable and that the power system remains in a satisfactory operation state following the credible contingency event indicated in the limit advice. The due diligence process is a check only and is not to recalculate the power system limit.

If the TNSP and AEMO agree on the revised limit and the associated conditions as being valid, both parties sign off on the revised limit. AEMO applies the revised limit.

5.3 Implement Agreed Plan
Implement plan agreed between AEMO and relevant registered participants (e.g. Contingency plan, Network Support Agreement (NSA)).

5.4 Reconfigure Network
Consider network re-arrangements, including where possible; switching of network elements, providing additional reactive support, reconfiguration or return to service of plant. Switching reconfiguration options may include sacrificial switching.

5.5 Reliability and Emergency Reserve Trader (RERT)
Under RERT, if there is sufficient notice, AEMO may dispatch or activate suitable reserve contracts to address a power system security event.
5.6 System Security Direction or Clause 4.8.9 Instruction

Identify any options for power system security directions or instructions under section 116 of the National Electricity Law and NER clause 4.8.9.

5.7 Reduction of FCAS Risk

If sufficient Raise FCAS are unavailable, use system security constraints to reduce the size of the largest generation at risk.

If sufficient Lower FCAS are unavailable, issue a direction under section 116 of National Electricity Law (which will be a direction where it applies to scheduled load, and otherwise will be a clause 4.8.9 instruction) for a reduction in the size of the largest load at risk.

5.8 Involuntary Load Shed

AEMO will instruct load shedding at the effective connection points.

6 Network Configuration Policy

All transmission elements available for service shall be on-load unless specific operational requirements or instructions covering a particular power system condition dictate otherwise.

6.1 Operation of Low Capacity Interconnections

Low capacity interconnections between regions arise when a power system event has resulted in outages of the transmission lines between interconnected regions.

This may leave an interconnector available with significantly reduced transfer capacity. A number of security issues may arise if a low capacity interconnection is used to reconnect two regions. AEMO has developed the following guidelines for management of low capacity interconnections. In order of preference below.

6.1.1 Option 1: Power Systems Remain Separated until High Capacity Interconnection becomes available

Option 1 is preferred as it generally provides the lowest level of risk to power system security.

Low capacity interconnections present many issues associated with maintaining power system security due to possible power swings through the low capacity transmission system after a major generation contingency event on either side of the interconnector. A contingency event associated with the low capacity connection is more than likely to result in a separation event. Management of power swings may actually require unnecessary load shedding in the area particularly where constraint action is ineffective.

6.1.2 Option 2: Move the Separation Point to Maximise Transmission Capacity to Supply Local Demand

After a separation, some areas may have insufficient transmission capacity to supply local demand. This can be rectified by reconnecting through a low capacity interconnection and then separating the systems at a different location. The objective is to move the separation point to provide more transmission capacity to a local area where needed.

This may leave some loads on a single contingency (radial) but the risk is rated against the possible damage to transmission equipment due to uncontrolled power swings through a reconnected low capacity system.
During switching to rearrange the separation point, the demand on either side of the interconnection should be stable during the reconnection to prevent uncontrolled power swings.

Under some situations supply may need to be disconnected before a separation point can be relocated.

6.1.3 Option 3: Re-establish a Low Capacity Interconnection then utilise Constraints and Contingency Plans to Manage Power System Security

This option is the highest risk to power system security as the low capacity connection will be highly unlikely to have sufficient capacity to carry additional loading due to the potential power swings from a contingency event on either side of the interconnector.

This option would only be applied in the following circumstances:

1) Pre-contingent load shedding has occurred or is forecast in the areas on either side of the interconnector and available network capacity is not sufficient to restore load.

2) Agreed contingency plans are available containing the following:
   ○ Manual or automatic actions to manage overloads due to contingent trip of generation on either side of the low capacity interconnection.
   ○ Manual or automatic actions to manage a contingency of one of the elements forming the low capacity interconnection.

If the above conditions cannot be achieved under the circumstances reconnection of a low capacity interconnection should not be attempted as AEMO would be unable to meet the requirements for power system security.

6.2 Transmission Line Outages opening a Bus Tie connection

When the outage of a transmission line results in the opening of a bus tie connection and the nature of the outage is such that the transmission line can be isolated and the circuit breakers forming the bus tie connection can be reclosed, then the Network Service Provider should consider returning that bus tie connection to service in order to increase the resilience of the power system.

7 Black System

7.1 Declare a black system

  a) Following a major power system emergency, loss of more than 60% of predicted regional load, affecting one or more power stations satisfies the conditions for declaring black system condition in that region.

  b) Following a major power system emergency, loss of supply to 60% predicted load (excluding pot line loads) in Qld North\(^1\) or Qld South, affecting one or more power stations satisfies the conditions for declaring black system condition for Qld North or Qld South as appropriate.

7.2 Exit a black system when

Restoration of the power system has reached to a level where all involuntary load shedding has ceased and clearance to restore the last load block has been given by AEMO.

\(^1\) QLD North electrical subnetwork consist of Central and Northern Queensland or all transmission networks north of South pine and Halye substations up to Port Dougles. Refer to Pg 20 of [SRAS Guidelines dated 05/09/2014](https://www.aemo.com.au).
The emergency situation is expected to continue to improve within the part of the power system declared as a black system.

8 Load Shedding and Restoration

8.1 Use of Priority Load Shedding Schedules

In accordance with NER clause 4.3.2(f), AEMO must request that the Jurisdictional System Security Coordinator for each participating jurisdiction provides AEMO with a schedule setting out the order in which loads in the participating jurisdiction, other than sensitive loads, may be shed by AEMO for the system security requirements given in NER clause 4.8.

8.2 Sensitive Loads

NER clause 4.3.2 (k) stipulates that it is AEMO’s responsibility to maintain security of supply toSensitive Loads advised by the Jurisdictional System Security Coordinators.

In accordance with NER clause 4.3.2(l), AEMO can interrupt supply to sensitive loads of the type covered in NER clause 4.3.2(f)(1)(i) if it is required for reasons of public safety or power system security.

Approval of the relevant Jurisdictional System Security Coordinator is required for the interruption of sensitive loads of the type covered in NER clause 4.3.2(f)(1)(ii) for reasons of public safety or power system security.

8.3 Load Shedding actions and responsibilities

In accordance with NER clause 4.3.2(h), AEMO maintains load shedding procedures for each participating jurisdiction under which loads will be shed and restored.

TNSPs are responsible for selecting and interrupting suitable loads from the Priority Load Shedding Schedules to match the amount of load to be shed as advised by AEMO.

AEMO control room staff will take the following action to progressively bring the power system to a reliable operating state:

• Review the amount of load shed and restore load in accordance with the Priority Load Shedding Schedules, as generation sources become available.
• Obtain sufficient FCAS in accordance with the Frequency Operating Standard.
• If required, issue directions to restore the power system to reliable operating state.

Whenever AEMO issues an instruction to shed load, the instruction must include specific reference to:

• The amount of load to be shed,
• Which location e.g. region or connection point(s)
• The time at which the instruction is to take effect

The rate of load shed (if applicable) or a specific target time to reach the outcome specified

Examples of such instructions

• Immediately shed 200 MW in the region XXX
• At 1230 hrs, commence load shedding a total of 200 MW in region XXX over a 15 min period
• Shed a total of 200 MW of load in region XXX within the next 30 minutes.
• At Substation XXX shed 100 MW at 20 MW per DI.

8.4 Supply Scarcity

Supply scarcity situations may be predicted in the PASA/Pre-dispatch time frame in which case AEMO will have issued Market Notices informing registered participants of the lack of reserve. AEMO may have entered into reserve contracts or issued directions. If reserve contracts have been established, the relevant contracted reserve will be dispatched by AEMO.

Refer to the Operations Procedure: Intervention and Direction SO.OP.3707

AEMO will be responsible for directing load shedding across interconnected regions in an equitable manner as specified in the power system security standards up to the power transfer limits of the network.

If insufficient generation, intra and inter regional network power transfer capability is available to allow all demand to be supplied (after taking into account demand side bids in the market), at one or more connection points, in one or more regions, then

• In conjunction with the dispatch of generation and demand side capacity through the dispatch processes of the market, AEMO may as necessary initiate reductions in demand, supplied from those connection points affected by the shortfall. As far as practicable, any reductions in each region must occur in proportion to the aggregate notional demand of the effective connection points in that region until the remaining demand can be met, such that the power system remains or returns (as appropriate) initially to a satisfactory operating state and ultimately to a secure operating state, as defined in the NER.

• An effective connection point is a connection point at which continued reduction is effective in reducing the supply shortfall, taking into account network constraints at all times.

• Any reductions in demand required under these arrangements must take into account sensitive loads and priority order advised to AEMO in accordance with the NER.

Notional Demand means the total demand being supplied plus:

• The amount of demand reduced through involuntary load shedding as requested by AEMO, and

• The amount of demand reduction due to mandatory restrictions imposed by the Jurisdiction, as estimated in the mandatory restriction schedule.

AEMO control room staff inform each TNSP of the amount of load to be shed in their region. In certain circumstances, reducing demand at some connection points of the power system may not be effective in reducing supply shortfall due to power transfer limits of the system. It may then be required to specify an area within a region where load shedding will be required.

For conditions where an area is identified such that load shedding would not be effective in reducing the supply shortfall then such areas should be excluded from the determination of the aggregate notional demand.

Example: The Victoria to New South Wales interconnection was operating at maximum capacity into New South Wales. The Queensland to New South Wales interconnection was operating below capacity in both directions. The central Queensland to Southern Queensland intra-regional interconnection was operating at full capacity in the southerly direction.

Following the loss of a large generating unit in the New South Wales region the power flow on the Victoria to New South Wales interconnection has resulted in a satisfactory but not secure operating state.

Due to insufficient generation or demand side options (in both New South Wales and Queensland) load shedding is required in the areas north of the Victoria to New South Wales interconnection. However load shedding in Central or North Queensland would not be effective.
because the Central Queensland to Southern Queensland intra-regional interconnection was operating at full capacity in the southerly direction.

When determining the proportional notional demands of New South Wales and Queensland for the purpose of equitable sharing of any load shedding only the Southern area demand of Queensland should be considered.

8.5 Load Restoration following a Load Shedding Event

Notwithstanding the requirements imposed on AEMO by NER clause 4.3.2(h) regarding the restoration of load in accordance with the priority load shedding schedules for each participating jurisdiction, the following guidelines will be used for load restoration following a significant load shedding event.

- AEMO will issue load restoration instructions to the relevant TNSP.
- The relevant TNSP will coordinate load restoration with the DNSPs in that jurisdiction.
- Load restoration will occur at a rate at which a secure operating state can be maintained.
- Load restoration may not necessarily be in accordance with the priority load shedding schedules if it is considered necessary for maintaining a secure operating state or for public safety. In particular this could be for the purposes of voltage control, frequency control or for the management of network limitations.

In order to facilitate load restoration at the maximum possible rate a flexible approach to the load restoration strategy will be maintained. To this end all possible alternative actions will be considered such as:

- Dispatch of scheduled plant.
- Directions to scheduled plant or market generating units.
- Clause 4.8.9 instructions.
- Reconnection of islanded sub-networks.
- Interconnection with adjoining regions.

It should be recognised that following significant load shedding unforeseen circumstances may arise during the restoration process. This may require switching to an alternate strategy or running two or more strategies in parallel.

The overall goal of the adopted strategy will be to restore as much load as quickly as possible. AEMO may also consider increasing the raise regulation and lower regulation Frequency Control Ancillary Services above the normal levels to cater for the uncertainty with which the load may be restored.

8.6 Load Restoration using the Demand Offset Facility

To facilitate the dispatch of available scheduled plant during the restoration of load, AEMO may use the Demand Offset Facility (DOF). The DOF increments the Total Demand for a region to apply at the end of the dispatch interval. The increments are determined by AEMO to reflect the amount of load restoration that is expected to take place during that dispatch interval.

9 System Security Protocol for Generating Unit Commissioning or Testing

The following applies to commissioning or any other testing associated with generating units.
9.1 Commissioning program
In accordance with NER clause 5.8.4, the registered participant will provide AEMO with the generator commissioning program at least 3 months prior to the commencement of the generator commissioning tests.

In accordance with NER clause 5.8.2, the registered participant must co-operate with AEMO and the relevant TNSP(s) to develop procedures to ensure that the commissioning of generating systems is carried out in a manner that:

- Does not adversely affect other registered participants
- Does not affect power system security or quality of supply of the power system
- Minimises the threat of damage to any other registered participant’s equipment

9.2 Submission of Offers
During commissioning or testing, generating units are required to follow dispatch targets as determined by AEMO. To ensure that dispatch and pre-dispatch outcomes reflect the technical envelope, and to allow AEMO to perform its power system security and reliability obligations, Generators should ensure all offers associated with commissioning or testing are submitted to pre-dispatch at least 24 hours in advance.

Any changes to the commissioning plan or test should be provided as revised offers with the final plan reflected in the offers at least 2 hours prior to the commencement of the actual commissioning or testing. AEMO will not provide permission to proceed for the commissioning or tests if the final offer is not submitted 2 hours in advance of the actual commissioning or testing. If the final commissioning or testing detailed in the final plan is delayed or altered, updated offers must be submitted with sufficient time given in pre-dispatch to allow power system security assessments to take place. AEMO will not provide permission to proceed for the rescheduled commissioning or testing if the updated offer is not submitted in sufficient time.

9.3 Load Rejection tests
For commissioning tests and in particular load rejection tests the following applies

- If the test will result in an unsatisfactory operating state then permission to proceed for the test will be withheld by AEMO.
- If the test results in the secure limit being exceeded but the secure limit is restored within 10 minutes (equivalent to 2 Dispatch Intervals), AEMO will grant permission to proceed for the test.
- Sufficient ramp rates and telemetered rate of change (ROC) for the generating unit to reach 0 MW within one DI is required. If the required ROC is not reflected in the offers for that generating unit, then permission to proceed for the load rejection test will not be granted by AEMO.

9.4 Rate of Change and Offer Requirements
In addition to the procedure detailed in section 9.2, the following is required to accommodate generating unit related tests where load is expected to be significantly reduced (e.g. load rejection tests, guard gate tests, governor valve testing, SRAS TTHL tests etc.). These steps need to be completed by midway through the dispatch interval (DI) immediately prior to the DI in which the test will take place.

- If the test is not reflected in the offers for that generating unit, then permission to proceed for the load rejection test will not be granted by AEMO. This includes sufficient offered and telemetered rate of change (ROC) for the generating unit to reach 0 MW within one DI. For
example if the load rejection test is 700 MW, the ROC down would have to be at least 140 MW/min to ensure receipt of a 0 MW target prior to the test. The AEMO EMMS will use the lesser of offered rate of change or telemetered rate of change unless the telemetered ROC is 0 MW/min. In this case the telemetered ROC will be ignored and the offered ROC used instead.

- If sufficient telemetered ROC down cannot be entered by the Generator, then they should set the ROC to 0 MW/min. For example if the ROC down required is 156 MW/min, but the maximum that can be entered by the Generator is 23 MW/min, then the ROC down should be set to 0 MW/min by the Generator. This is to ensure that EMS ignores the telemetered ROC and uses the offered ROC.

- If AEMO are still receiving non zero telemetered values for ROC down after the Generator has set the telemetered ROC down to 0 MW/min, then, as a last resort, AEMO may manually replace the values to zero in EMS.

- To restore the frequency to within the normal band as quickly as possible during a load rejection test, AEMO may enable additional raise regulation FCAS. The amount of additional raise regulation FCAS required will vary with system conditions, however, it should be sufficient such that the total raise regulation FCAS is in the range of 50-70% of the MW lost during the load rejection test.

10 Contingency Management

Contingency management refers to AEMO’s operational management of the power system so that the power system remains in a satisfactory operating state following the loss of a power system element. In most cases network constraints will be used to manage this process.

A contingency on the power system may result in any number of abnormal conditions, some of which are listed below;

- Reduced transmission capacity between generating systems and load centres
- Reduced interconnector transmission capacity
- Separation of parts of the network into islands
- Generation and Loads relying on single connections resulting in larger than normal credible contingencies

In cases where network constraints, plant re-rating or the use of network support and control ancillary services would not on their own, ensure that the power system remained in a satisfactory operating state following the occurrence of a contingency event it may be necessary to develop a contingency plan.

In considering necessary contingency plans, AEMO will aim to minimise the impact on the market outcomes, and also minimise the need for involuntary load shedding. In general, AEMO would seek to manage power system security (as previously mentioned in section 5 of this document) in order of preference:

- Reconfigure the transmission network
- Direction or clause 4.8.9 instruction
- Involuntary load shedding post contingency

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2 An offered rate of change greater than the registered rate of change will be rejected by the AEMO EMMS. To enable testing Generators should ensure a suitable rate of change has been registered.
- Involuntary load shedding pre-contingency (applicable only in cases of unplanned transmission outages).

Contingency plans will need to be agreed with parties involved in the execution of the plan. This will typically be AEMO, TNSPs and DNSPs. For example, if a contingency plan involves possible load shedding including sacrificial switching, then the relevant TNSPs and DNSPs will have to agree to the potential for load shedding as part of this plan. Affected Market Participants may also be required to be notified.

An attribute of a secure operating state is the ability to return to a satisfactory operating state following a credible contingency event (NER clause 4.2.4).

Generally, a credible contingency event can be regarded as the unplanned tripping of any single item of network or generation equipment. The majority of contingency events are considered as either credible or non-credible at all times. Some however, may be credible or non-credible depending on the surrounding circumstances at the time.

Only credible contingency events are considered when assessing whether the system is in a secure operating state.

10.1 Definition of a Credible Contingency Event

Under NER clause 4.2.3(a), a contingency event means ‘an event affecting the power system which AEMO expects would be likely to involve the failure or removal from operational service of one or more generating units and/or transmission elements’.

In relation to a contingency event:

1) AEMO will consider the failure or removal from operational service of a network element in the distribution system as part of the contingency event, if that has a material effect on security of the transmission network.

   Example (1)
   If the trip of a transmission element and a network element in the distribution system has no greater impact on security of the transmission network than the trip of the transmission element on its own, then AEMO will not consider the network element in the distribution system as part of the contingency event for the purpose of classifying the event as either a credible contingency event or non-credible contingency event.

2) AEMO will consider the disconnection of load as part of the contingency event if the disconnection of the load has a material effect on security of the transmission network.

   Example (2)
   If the disconnection of load at the same time as the trip of a transmission element has no greater impact on security of the transmission network than the trip of the transmission element on its own, then AEMO will not consider the disconnection of this load as part of the contingency event for the purpose of classifying the event as either a credible contingency event or non-credible contingency event.

The voluntary removal from service of transmission network equipment by a TNSP due to routine or unusual conditions is regarded as a planned or short notice outage; it is not regarded as a contingency event.

10.2 Definition of a Non-Credible Contingency Event

Non-credible contingency events are contingency events other than credible contingency events. Events which are considered to be non-credible contingency events include:

- The trip of any busbar in the transmission network
- The trip of more than one transmission element
• The trip of more than one network element in circumstances as described in AEMO interpretation of contingency event item (1) above
• The trip of transmission plant in a manner that is not normal (e.g. protection operated but did not isolate the plant as per design)
• The trip of multiple generating units
• The trip of more than one load block where the combined load lost exceeds that which would normally be considered a credible contingency event in that region
• A combination of transmission plant, scheduled generating units or load, where that combination is not normally considered likely.

10.3 Non-Credible Contingency Event Reporting
When a non-credible contingency event occurs, a Market Notice must be issued within two hours containing the following information:
• Time event occurred
• Region
• Elements that tripped (e.g. generating units, network elements, load)

11 Reclassifying Contingency Events
Reclassification of a non-credible contingency event to a credible contingency event may be necessary at times to adequately reflect current or expected conditions. Abnormal conditions may result in reclassification. The reclassification is based upon an assessed increase in the likelihood of a trip of equipment to occur, the occurrence of which is normally considered to be relatively low. If AEMO determines that the occurrence of the non-credible event is reasonably possible, based on established criteria, then AEMO must reclassify the event as credible.

The reclassification of a non-credible contingency event to a credible contingency event is to be advised to participants by the issue of a Market Notice.

Abnormal conditions are conditions posing added risks to the power system including without limitation severe weather conditions, lightning storms and bush fires. Whenever AEMO receives information on abnormal conditions AEMO will discuss the situation with the relevant TNSP to determine whether any non-credible contingency event is more likely to occur because of the existence of the abnormal condition. If abnormal conditions exist near a regional boundary, all relevant TNSPs will be consulted.

11.1 AEMO Responsibilities
AEMO is responsible for determining and declaring a non-credible contingency event to be a credible contingency event.

AEMO will notify all Market Participants of such a re-classification as soon as is practicable.

Following the re-classification, AEMO will ensure that it fulfils its power system security obligations to achieve and maintain the secure operating state of the power system for the revised technical envelope.

Every six months, AEMO will issue a report setting out its reasons for all decisions to re-classify non-credible contingency events to be credible contingency events. The report will include an explanation of how AEMO applied the relevant criteria used in the decision to reclassify these events. The report may also include AEMO’s analysis of re-classification trends during the relevant period and its appraisal of the appropriateness and effectiveness of the relevant criteria that were applied in the case of each reclassification decision.
11.2 Registered Participant, Network Service Provider and System Operator Responsibilities

In accordance with NER clause 4.8.1 *registered participants* must promptly advise AEMO or a relevant *System Operator* of any circumstance which could be expected to adversely affect the secure operation of the *power system* or any equipment owned or under the control of the *registered participant* or a *network service provider*.

For AEMO to discharge its *power system security* obligations, the *network service provider* (NSP) must cooperate with and assist AEMO by providing information that the NSP is aware of in a timely manner on present or anticipated threats to *power system security*.

A *System Operator* must carry out the rights, functions and obligations in respect of which it has been engaged or appointed by AEMO.

A *System Operator* must, to the extent the *System Operator* is aware, keep AEMO fully and timely informed as to:

- The state of the security of the *power system*
- Any present or anticipated risks to *power system security* such as bushfires

The information is to be provided by the NSP and *System Operator* to the extent it is aware of, or as requested by AEMO. Regular updates to the information will be required until the reclassification is revoked by AEMO.

The NSP and *System Operator* are not obliged to make any recommendations whether a reclassification should be made but AEMO does not discourage the NSP and *System Operator* from making a recommendation for a re-classification.

The NSP will be the primary contact with the state emergency services including the Country Fire Authority, Rural Fire Services etc. on the subject of bushfires. The NSP will provide AEMO with all the relevant information on bushfires. AEMO will not directly communicate with the state emergency services.

Figure 1 below provides a summary of actions required by AEMO for a reclassification event.
11.3 Reclassification due to Bushfires

Abnormal conditions such as bushfires may pose added risks to the power system and result in the tripping of both circuits of a double circuit transmission line or two adjacent single circuit transmission lines. The presence of abnormal conditions and an assessment of the risk posed to the power system may result in AEMO determining a non-credible contingency event to be a credible contingency event.

AEMO has developed the following criteria to facilitate the decision making process associated with reclassification of non-credible contingency events as credible contingency events during the presence of bushfires.

The primary focus of the process is the determination of the likelihood of the event. Decision making criteria for reclassification due to bushfires
\( P(r) \) = likelihood of tripping multiple circuits due to bushfires (e.g. both circuits of a double circuit line or two adjacent single circuits)

And \( X \) = the threshold value for the likelihood \( (r) \).

An \( (r) \geq X \), then AEMO will reclassify the non-credible contingency event, the tripping of multiple circuits as a credible contingency event.

\[ P(r) \geq X \]

Maintain a secure operation state by:
1. Dispatch
2. Directions and/or system reconfiguration (including sacrificial switching)
3. Load shedding (pre and/or post contingent)

**NOTE:** Priority order is in a descending direction with pre contingent load shedding deemed as the last resort.

\[ P(r) \geq X \]

**Figure 2** Decision making framework for re-classification due to bushfires
### Table 3  Factors and Weightings to Assess Impact of Bushfires on Circuits

<table>
<thead>
<tr>
<th>Time and date of assessment:</th>
<th>Distance of fire from circuit = km</th>
<th>Start time of risk =</th>
</tr>
</thead>
</table>

Transmission circuits being assessed:

<table>
<thead>
<tr>
<th>RISK FACTOR</th>
<th>IMMEDIATE ASSESSMENT</th>
<th>WEIGHTING</th>
<th>FORECAST ASSESSMENT</th>
<th>WEIGHTING</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRE CONFIRMATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Satellite hot spot indication only</td>
<td>-2</td>
<td>Confirmed fire</td>
<td>0</td>
<td>Fire confirmation may be via NSP or Fire Services.</td>
</tr>
<tr>
<td>FIRE OBSERVER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSP (Asset Owner) Observer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No assessment made</td>
<td>0</td>
<td>Not likely to impact</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Likely to impact</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Service Observer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No assessment made</td>
<td>0</td>
<td>Not likely to impact</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Likely to impact</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIRCUIT CHARACTERISTICS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjacent single circuits</td>
<td>1</td>
<td>Double circuits (single towers)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>WEATHER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Weather Warning level(^2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low-medium</td>
<td>1</td>
<td>High</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very High</td>
<td>3</td>
<td>Severe</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extreme (including total fire ban)</td>
<td>5</td>
<td>Catastrophic (Code Red)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>EASEMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal fuel load</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>1</td>
<td>High</td>
<td>2</td>
<td>Based on information from NSP, on-site personnel or via Indij Watch.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External (Adjacent fuel load)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grasslands</td>
<td>1</td>
<td>Shrubs</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plantations/dense bush(^1)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)Based on information from NSP, on-site personnel or via Indij Watch.  
\(^2\)Sourced from Bureau of Meteorology.
## IMMEDIATE ASSESSMENT
### FIRE < 1KM FROM THE TRANSMISSION CIRCUITS

**OPERATOR ACTIONS**
NSP will manually reclose tripped transmission lines within a maximum of 5 minutes.
- Yes
- No

**TOTAL WEIGHTING**


### FORECAST ASSESSMENT
### FIRE > 1 KM BUT < 5 KM FROM THE TRANSMISSION CIRCUITS

**OPERATOR ACTIONS**

**TOTAL WEIGHTING**

**OTHER INFORMATION**

**WAS A RECLASSIFICATION MADE?**

- Yes. Market Notice
- No

---

**Note 1**
Bushfires in Australia spread as a thin front of flame, with flames usually about as thick as they are high. Forest fires normally travel at one to three km/hr, have flames 10-20 metres high and thick, and will pass a spot in 30-60 seconds. Severe forest fires travel at up to 12 km/hr, with flames 100-150 metres high and thick. Grass fires generally travel about 3 – 10 km/hr, but speeds of around 25 km/hr have been recorded.

**Note 2**
Fire Weather warnings - Wind, temperature, humidity and rainfall all combine to affect the behaviour of bushfires. In Australia there is a system of assessing these in conjunction with the state of the available fuels to determine a measure of ‘fire danger’, or the difficulty of putting out any fires which may occur. The Bureau of Meteorology issues two types of advice to alert the public when conditions are likely to be dangerous – Fire Weather Warnings and Total Fire Ban Advices.

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Rules to be used in the reclassification process of non-credible contingency events as credible contingency events due to bushfires

In conjunction with the processes outlined in Figure 2 and Table 3, the following rules will be applied in the decision making process and include:

1. Individual records will be created with detailed information for each assessment conducted in the following circumstances.
   a) Assessment not to apply a reclassification
   b) Assessment to apply a reclassification.
   c) Assessment to remove a reclassification.

2. The primary focus is in circuit voltages ≥220 kV but this does not exclude assessments being performed for circuit voltages <220 kV if there is a material impact on system security.

3. If the information being sought on a particular factor is incomplete or indeterminate, then AEMO will make a determination for that factor until further information becomes available (unless specifically specified otherwise in Table 3).
4) If AEMO:
   ○ was not previously aware of a bushfire in the proximity of transmission circuits and consequently had not performed an assessment as to whether a reclassification was required and
   ○ has been advised of bushfires in that general area

Then, if one of these transmission circuit trips and auto re-closes successfully, AEMO would declare a reclassification.
When further information becomes available, AEMO would then undertake the normal assessment to determine whether to maintain or revoke the reclassification.
If the reclose is unsuccessful and a subsequent manual attempts fails or is not possible, then
   ○ System security will be reassessed taking into this unplanned outage and
   ○ An assessment of the need to reclassify multiple losses of some of the remaining circuits in the easement will be undertaken (refer Rule 5)

5) If there are multiple transmission circuits in an easement, the intent of the process is to identify and manage the double circuit or two adjacent single circuits most exposed to the bushfire front. These are deemed to be the critical elements requiring an assessment.
The choice of the critical transmission circuits requiring assessment will be subject to changes in conditions and information updates (e.g. if the location of bushfire front changes from one side of the easement to the other side, or if there are unplanned outages of circuits in the easement).

6) AEMO will request the NSP to seek information from the relevant fire authority to identify if the fire crews are using aerial spraying of fire retardants on or over the transmission circuits and if so, AEMO will declare a reclassification of the relevant transmission circuits. In the case where there a number of multiple circuits in the same easement, then Rule 5 will apply.

7) The presence of fire crews in an easement impacted by bushfires is likely to result in the auto re-close being suppressed on those transmission circuits in close proximity to the fire crews. This would impact on the factor in Table 3, Operator Actions – manual re-close.

8) AEMO will revoke the reclassification when the likelihood to reclassify reduces below the threshold specified in Table 3.

When AEMO has re-classified, invoked the re-classification constraints and identified any Dispatch and/or PreDispatch outcomes warranting further attention, AEMO will advise Market Participants and, in particular, the NSPs, of the outcomes and what options (generic examples detailed in Figure 2 and Table 3) are available to resolve the challenges.

The content of the AEMO Market Notices will focus on the reclassified contingency, what actions have been taken to maintain power system security but will not comment on the subject of connection point supply reliability as this area is in the NSP domain.

11.3.1 Review of each re-classification event triggered by bushfires

AEMO will review each reclassification event triggered by the presence of bushfires to ensure that the criteria developed under these Guidelines is appropriate and effective in its application to the reclassification of the simultaneous trip of a double circuit transmission line resulting from bushfires as a credible contingency event.

In accordance with NER 4.2.3B(b) every two years after the date of establishment of the bushfire reclassification criteria, AEMO must undertake a review of that criteria.

11.4 Reclassification due to Lightning

Under normal conditions the simultaneous trip of both circuits of a double circuit transmission line would be considered a non-credible contingency event.
During lightning storms AEMO may determine that the occurrence of that non-credible contingency event is reasonably possible and AEMO may reclassify that event to be a credible contingency event.

Lightning causing the trip of two adjacent single circuit transmission lines is considered to be highly unlikely and is generally not taken into consideration for reclassification.

### 11.4.1 Double Circuit Transmission Line Categories

#### Table 4 Lightning Assessment Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightning trip</td>
<td>Simultaneous three phase trip of a double circuit transmission line during a lightning storm which cannot be attributed to a cause other than lightning and is not an Exceptional Event.</td>
</tr>
<tr>
<td>Successful Single Pole ARC</td>
<td>One of two or Two lines that undergo a simultaneous single pole protection operation and auto reclose successfully are not to be moved from the possible to the probable category or probable to proven category and as a result no reclassification is required.</td>
</tr>
<tr>
<td>LTTW</td>
<td>Lightning Trip Time Window which is a rolling time period representing the previous three years or five years depending on the categories of vulnerable transmission lines.</td>
</tr>
<tr>
<td>Exceptional Event</td>
<td>Simultaneous trip of a double circuit transmission line during a lightning storm caused by an event that is far beyond what is usual in magnitude or degree for what could be reasonably expected to occur during a lightning storm</td>
</tr>
<tr>
<td>Vulnerable</td>
<td>Vulnerable transmission lines are double circuit transmission lines which fall into the categories for Probable or Proven</td>
</tr>
</tbody>
</table>

All double circuit transmission lines are categorised as Possible, Probable or Proven with respect of the likelihood of lightning trip. This process is shown in Figure 3.

**Possible**

All events are possible, however, if there is no evidence of the double circuit transmission line simultaneously tripping due to lightning during the LTTW and the lines are shielded by an Optic Fibre Ground Wire (OPGW) or Overhead Earth Wire (OHEW), then during lightning storms no action will be taken to reclassify the trip of the double circuit transmission line as a credible contingency event, since it is not considered ‘reasonably possible’ for reclassification purposes under the NER.

**Probable**

A double circuit transmission line that has experienced a lightning trip during the three years LTTW is categorized as probable.

This double circuit line will return to the possible category when there are no further lightning trips in the three years LTTW.

**Proven**

- Lines which are not shielded by an Optic Fibre Ground Wire (OPGW) or Overhead Earth Wire (OHEW).
- Lines where the TNSP has advised AEMO of a deterioration in relevant characteristics to the extent that the line should be categorized as proven.
- There have been two lightning trips during the first three years LTTW.
Double circuit transmission lines previously categorized as proven will remain in proven category until the circuits have gone five years without a trip (i.e. each further trip restarts the five years count). If the circuits do not trip for five years, the circuits will return to possible.

A double circuit line categorized as probable or proven can return to the possible category if it is demonstrated the asset characteristics have been improved to make the likelihood of a lightning trip no longer reasonably likely to occur.

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**Figure 3**  
*Double Circuit Transmission Line Categories*
11.4.2 Vulnerable Transmission Lines

A double circuit transmission line in this category is eligible to be reclassified as a credible contingency event during a lightning storm if a cloud to ground lightning strike is detected within a specified distance of the vulnerable lines. The list of vulnerable lines is shown in Table 5 below.

Table 5  Vulnerable Transmission Lines

<table>
<thead>
<tr>
<th>Region</th>
<th>Double Circuit Transmission Lines</th>
<th>LTTW End Date</th>
<th>LTTW End Date</th>
<th>Reason for Classification</th>
<th>Category (Probable or Proven)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New South Wales / Queensland</td>
<td>Dumaresq - Bulli Creek No. 8L and No. 8M 330 kV lines</td>
<td>25/08/2021</td>
<td>N/A</td>
<td>Tripped once in past 3 years</td>
<td>Probable</td>
</tr>
<tr>
<td>Queensland</td>
<td>Collinsville North – Proserpine No.7125 and No.7126 132 kV Lines</td>
<td>N/A</td>
<td>15/02/2023</td>
<td>Tripped in 5-year LTTW</td>
<td>Proven</td>
</tr>
<tr>
<td>Queensland</td>
<td>Tarong – Chinchilla No. 7183 and 7168 132 kV lines</td>
<td>N/A</td>
<td>20/02/2023</td>
<td>Tripped in 5-year LTTW</td>
<td>Proven</td>
</tr>
<tr>
<td>Queensland</td>
<td>Ross – Chalumbin No.857 and No.858 275 kV lines</td>
<td>N/A</td>
<td>21/01/2020</td>
<td>Tripped twice in 3-year LTTW (2015)</td>
<td>Proven</td>
</tr>
<tr>
<td>Queensland</td>
<td>Chalumbin – Turkinje No.7165 and No.7166 132 kV lines</td>
<td>N/A</td>
<td>27/01/2021</td>
<td>Tripped twice in 3-year LTTW (2014 &amp; 2016)</td>
<td>Proven</td>
</tr>
<tr>
<td>Queensland</td>
<td>Moranbah – Goonyella(^3) No.7369 and No.7370 132 kV lines</td>
<td>N/A</td>
<td>06/12/2019</td>
<td>Tripped twice in 3-year LTTW (2012 &amp; 2014)</td>
<td>Proven</td>
</tr>
<tr>
<td>Queensland</td>
<td>Collinsville – Stoney Creek No.7306 and Collinsville – Newlands No.7121 132 kV lines</td>
<td>N/A</td>
<td>05/02/2021</td>
<td>Tripped twice in 3-year LTTW (2016)</td>
<td>Proven</td>
</tr>
<tr>
<td>Queensland</td>
<td>Goonyella - North Goonyella Tee - Stoney Creek No. 7122 and the Goonyella - Newlands No. 7155 132 kV Line</td>
<td>26/02/2021</td>
<td>N/A</td>
<td>Tripped once in past 3 years</td>
<td>Probable</td>
</tr>
<tr>
<td>Queensland</td>
<td>Strathmore - Clare South No.7208 and Collinsville North - Tee King Creek - Clare South No.7128 132 kV Lines</td>
<td>09/01/2022</td>
<td>N/A</td>
<td>Tripped once in past 3 years</td>
<td>Probable</td>
</tr>
<tr>
<td>Tasmania</td>
<td>Chapel St – Liapootah No.1 and No.2 220 kV lines</td>
<td>N/A</td>
<td>Indefinite</td>
<td>No Shielding</td>
<td>Proven</td>
</tr>
<tr>
<td>Tasmania</td>
<td>Farrell – Reece No.1 and No.2 220 kV lines</td>
<td>N/A</td>
<td>31/07/2021</td>
<td>Tripped twice in 3-year LTTW (2015 &amp; 2016)</td>
<td>Proven</td>
</tr>
<tr>
<td>Tasmania</td>
<td>Farrell - Sheffield No.1 and No.2 220 kV lines</td>
<td>N/A</td>
<td>24/11/2022</td>
<td>Tripped in 5-year LTTW</td>
<td>Proven</td>
</tr>
</tbody>
</table>

\(^3\) Due to augmentation works relating to No.7122 and No.7155 132 kV lines the previous reclassification of these lines as vulnerable is now applicable to No.7369 and No.7370 132 kV lines respectively between Moranbah and Goonyella. The original No.7122 is now between T212 (Goonyella) and T178 (Stony Creek) with a tee to T137 (Nth Goonyella) and No.7155 is now between T212 and T069 (Newlands). No.7369 and No.7370 contains the sections of No.7122 and No.7155 that initiated the original reclassification.
<table>
<thead>
<tr>
<th>Region</th>
<th>Double Circuit Transmission Lines</th>
<th>LTTW End Date</th>
<th>LTTW End Date</th>
<th>Reason for Classification</th>
<th>Category (Probable or Proven)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasmania</td>
<td>Norwood – Scottsdale – Derby and Norwood – Scottsdale 110 kV lines</td>
<td>30/12/2019</td>
<td>N/A</td>
<td>Tripped once in past 3 years</td>
<td>Probable</td>
</tr>
<tr>
<td>Tasmania</td>
<td>Sheffield – Devonport and Sheffield – Wesley Vale 110 kV lines</td>
<td>18/02/2022</td>
<td>N/A</td>
<td>Tripped once in past 3 years</td>
<td>Probable</td>
</tr>
<tr>
<td>Tasmania</td>
<td>Tungatinah - New Norfolk tee Meadowbank No. 1 and No. 2 110 kV Lines</td>
<td>N/A</td>
<td>Indefinite</td>
<td>No Shielding</td>
<td>Proven</td>
</tr>
<tr>
<td>Victoria</td>
<td>Dederang – Glenrowan No.1 and No.3 220 kV lines</td>
<td>N/A</td>
<td>08/04/2022</td>
<td>Tripped twice in past 3 years (2015 &amp; 2017)</td>
<td>Proven</td>
</tr>
<tr>
<td>Victoria</td>
<td>Eldon PS – Mt Beauty No.1 and No.2 220 kV lines</td>
<td>N/A</td>
<td>31/12/2023</td>
<td>Tripped in 5-year LTTW</td>
<td>Proven</td>
</tr>
<tr>
<td>Victoria</td>
<td>Hazelwood PS – Rowville No.1 and No.2 220 kV lines</td>
<td>09/12/2021</td>
<td>N/A</td>
<td>Tripped once in past 3 years</td>
<td>Probable</td>
</tr>
</tbody>
</table>

11.4.3 Lightning Detection Zones

The Global Positioning and Tracking System (GPATS) is used to provide detection and location of cloud to ground lightning strikes. GPATS delivers ‘live’ data with a refresh rate of 1 second and provides full coverage of the transmission system.

Two (2) zones have been defined for the vulnerable transmission lines. The 2 zones constitute the lightning exclusion zones and are depicted in Figure 4.

- **lightning attachment zone (LAZ):** 20 km either side of the vulnerable double circuit transmission line, and

- **lightning warning zone (LWZ):** 20 km either side of the LAZ
11.4.4 Reclassification Criteria

11.4.4.1 Lightning detected within the LAZ

If lightning is detected within the LAZ as depicted in Figure 5; AEMO will immediately reclassify the loss of the vulnerable double circuit transmission lines and if necessary apply a reclassification constraint.
11.4.4.2 Lightning detected within the LWZ and moving towards lines

If lightning is detected within the LWZ only and the lightning storm is moving towards the vulnerable double circuit transmission line as depicted in Figure 6 – AEMO will reclassify the loss of the vulnerable double circuit transmission lines.

![Diagram of LWZ and LAZ with storm direction and lightning attachment zone]

**Figure 6** Lightning detected within the Lightning Warning Zone (LWZ) and is moving towards the lines

11.4.4.3 Lightning detected within the LWZ and moving away from lines

If lightning is detected within the LWZ only and the lightning storm is moving away from the vulnerable double circuit transmission line as depicted in Figure 7, AEMO will not reclassify but will continue to monitor the situation and manage any change in circumstance depending on where the lightning is detected.
11.4.5 Rules to be used in the Lightning Reclassification Process

In conjunction with the criteria outlined above the following rules will be applied in the decision making process.

- A decision to reclassify a non-credible contingency event to a credible contingency event will be based on cloud to ground lightning strikes only.

- If there are multiple transmission circuits in an easement, AEMO will consider it reasonably possible that the non-credible contingency event may impact both circuits of a double circuit transmission line, but not adjacent single circuits.

- If there are multiple double circuit transmission lines in an easement, AEMO will consider it reasonably possible that the non-credible contingency event may impact only one double circuit transmission line at any point in time. AEMO will decide which double circuit to reclassify based on its reasonable opinion of which simultaneous trip poses the more critical risk to the power system.

- Individual records will be created for each assessment.

- If the information being sought on a particular factor is incomplete or indeterminate, then AEMO will assume the worst case scenario for that factor until further information becomes available.

- If:
  - AEMO has reclassified a non-credible contingency event to a credible contingency event due to the detection of cloud to ground lightning in the LWZ, and has commenced a Ramping down of power transfer levels; and
  - the vulnerable transmission circuit trips and auto re-closes successfully

then AEMO would cease ramping and immediately apply the reclassification constraint to that vulnerable transmission circuit.

Figure 7  Lightning detected within the Lightning Warning Zone (LWZ) and is moving away from the lines
• If a vulnerable transmission circuit trips and auto re-closes successfully, AEMO would declare an immediate reclassification if the presence of lightning can be verified in either the LAZ or LWZ. AEMO will issue a Market Notice specifying the details of the reclassification event in accordance with NER clause 4.2.3A.

11.4.6 Cessation of a Reclassification
When a period of 30 minutes has elapsed from the last detected cloud to ground lightning strike in an exclusion zone (either the LAZ or LWZ) then the reclassification will be cancelled.

11.4.7 Review of each Reclassification Event Triggered by the Presence of Lightning
AEMO will review each reclassification event triggered by lightning to ensure that the criteria developed under these Guidelines is appropriate and effective in its application to the reclassification of the simultaneous trip of a double circuit transmission line resulting from a cloud to ground lightning strike as a credible contingency event.

In accordance with NER 4.2.3B(b) every two years after the date of establishment of the Lightning Trip reclassification criteria, AEMO must undertake a review of that criterion.

11.5 Reclassification due to “Other” Threats
Reclassification due to ‘other’ threats may include but is not limited to the following:

• Multiple generating unit disconnection
  Upon receiving advice that a threat exists, AEMO will make a decision on reclassification of a non-credible contingency event to a credible contingency event. AEMO may request sectionalising of generators with transmission in an attempt to minimise the impact on the power system. In making this determination AEMO will take advice from either the TNSP or the generator with regards to the likelihood of multiple generating unit or transmission line disconnections.

• Impact of pollution on transmission line insulators
  AEMO will take advice from the TNSP with regard to the likelihood of multiple transmission line disconnections arising from the effects of pollution on the transmission line insulators. Based on this advice AEMO will initiate a reclassification of a non-credible contingency event to a credible contingency event.

• Impact of Protection or Control Systems Malfunction
  AEMO will take advice from the TNSP / Generator with regard to the likelihood of multiple transmission line or generating unit disconnections arising from the impact of protection or control systems malfunction on plant. Based on this advice AEMO will initiate a reclassification of a non-credible contingency event to a credible contingency event.

11.5.1 Power system security Obligations during reclassification – Transmission Limits
In order to satisfy AEMO’s power system security obligations, if the loss of multiple generating units will result in transmission limits being exceeded, then the generating units under threat will be constrained to a level where satisfactory limits are not exceeded post contingent.

11.5.2 Power system security Obligations during reclassification – FCAS
In order to satisfy AEMO’s power system security obligations, if there is insufficient FCAS available to cater for the loss of multiple generating units, then generating units at risk will be constrained to a level where frequency standards can be met with the available FCAS.
If considered necessary the generating units at risk will be constrained from participation in the FCAS raise market. A reclassification Market Notice will be issued but will not necessarily advise of the specific type of threat or provide details of the threat.

**11.6 Reclassification Following a Non-Credible Event**

If a non-credible contingency event has occurred, AEMO must determine if this event is to be reclassified as a credible contingency event.

AEMO will take all reasonable attempts to seek information to determine if a future occurrence of this non-credible contingency event is reasonably possible under the prevailing conditions. Specifically, AEMO will seek information to determine if the condition that caused the non-credible contingency event has been resolved.

If AEMO is unable to obtain the appropriate level of information to determine if the non-credible contingency event is no longer reasonably possible, then AEMO will reclassify that event as a credible contingency event. AEMO will make this determination when the plant is returned to service.

**12 Management of Solar Storms - Geomagnetic Disturbances (GMD)**

Solar storms produce geomagnetic disturbances (GMD) that may pose added risks to the power system resulting from the introduction of Geomagnetic Induced Current (GIC). AEMO has developed the following criteria to facilitate the decision making process and manage power system security in the unlikely event of a GMD forecast which is large enough to adversely affect the power system.

Severe GMD events are forecast and notifications issued by the Bureau of Meteorology (BOM) as summarised in Section 12.1 “Severe Space Weather Forecasts for significant GICs”. The event involves the observation of a coronal mass ejection associated with a solar flare anticipated to impact the Earth within 48 hours. Heightened awareness of the power system, by AEMO, Generators and Network Service Providers, is recommended during this period of time.

There are two risks that result from the introduction of GICs to the power system:

- Loss of reactive power support, due to harmonic current, combined with increased reactive power consumption by transformers, which could lead to voltage instability and power system collapse, and
- Damage to power system assets, typically associated with transformers.

AEMO may initiate the following actions in response to a severe GMD on Australian Bureau of Meteorology’s advice:

1) AEMO may instruct the restoration of out of service transmission lines and transformers as well as discontinue planned transmission outages, including
   a) Interconnectors,
   b) Equipment impacting on main system transformer loadings,
2) AEMO will maximise reactive reserves across the power system.

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4 This action allows the GIC to be split between more transmission lines and transformers and also lowers the 50 Hz loading per transformer. This enables the transformers to run cooler and hence have more headroom for GIC heating effects and less saturation effects.
3) Request TNSPs to advise of revised transformer ratings, allowing the transformer to operate at cooler temperatures, to prepare for the onset of stray flux heating from the GIC.

4) Request TNSPs to advise of their intent to take out of service transformer(s) due to the high impact of the GIC.

In circumstances where a low intensity GMD is received but GIC is at alarm levels, as supplied by the TNSP, AEMO will take actions as if a severe GMD advice has been received.

12.1 Severe Space Weather Forecasts for significant GICs

The Australian Bureau of Meteorology's Space Weather branch (IPS Radio and Space Services) has developed a Severe Space Weather Service (SSWS) aimed at forecasting severe space weather events considered most hazardous to critical infrastructure such as the Australian power system.

The model produces forecasts (watch messages) based on solar data only (providing lead times > 12 hours) and updated forecasts with increased probability that utilise additional solar wind data but with a decreased warning lead time of only 30-60 minutes.

AEMO will initiate the mitigating actions outlined above in response to the notifications from the SSWS as summarised in the following tables:

Table 6 SSWS Notifications - Summary of Notifications, timeframes and AEMO Actions

<table>
<thead>
<tr>
<th>NOTIFICATION from SSWS</th>
<th>ETA (Forecast lead time)</th>
<th>ETD (Warning lead time)</th>
<th>AEMO Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Space Weather Watch</td>
<td>12hrs+</td>
<td>TBA</td>
<td>1. Issue a Market Notice; 2. Increased awareness for next 48 hours 3. Maintain increased awareness of GIC monitored equipment</td>
</tr>
<tr>
<td>Short Duration GIC Warning</td>
<td>NOW</td>
<td>30-60 mins.</td>
<td>1. Issue a Market Notice; 2. Maximise dynamic reactive reserves across the power system; 3. AEMO instruct restoration of transmission outages; 4. Maintain increased awareness for more warnings 24hrs 5. Maintain increased awareness of GIC monitoring equipment</td>
</tr>
</tbody>
</table>
13 Revision of the Basslink Technical envelope

When calculating Tasmanian FCAS requirements for the loss of Basslink a time delay is applied. This is referred to as the Loss of Link time (LOL).

13.1 Basslink reclassification

AEMO should not invoke Basslink loss of link (LOL) time = 650 ms (F-I.BL_650) constraint with the current reclassification on trip of Basslink interconnector and any transmission line in Tasmania in place. This applies to Basslink flows in either direction.

There is no need for additional FCAS when the technical envelope for Basslink LOL time is revised, and no need to issue a Market Notice.

14 Planned Outage Coordination

The criteria used by AEMO for granting permission to proceed with planned network outages is that at any time during the outage, the power system must be maintained in a secure and reliable operating state.

If the post-contingency power flow through a network element is above the continuous rating but within the short term rating, such outages will be permitted to proceed subject to TNSPs providing a suitable contingency plan detailing the method of bringing the power flow through the network element to the continuous rating within the required time frame.
14.1 Switching Time and Remaining Secure

A factor in the assessment of planned work is the concept of switching time, which is the time taken for a series of switching operations to occur.

During a planned switching sequence it is permitted for the power system to be in a satisfactory operating state, although not secure, for a period not exceeding five minutes. This also applies to changes in protection, control or secondary circuits during planned work.

The power system must be restored to a secure operating state within five minutes, if necessary by the implementation of an agreed plan. The plan must identify potential problems and the manner in which they will be managed and the steps to be taken to restore a secure operating state.

The Plan must be able to restore a secure operating state if a contingency event occurs, including a circuit breaker that fails to close. During planning of the work the sequence of operations should be reviewed to minimise the time that the power system is insecure. The conditions that need to be satisfied in order to utilise switching sequence time are as follows:

- The switching sequence is clearly detailed and understood and limited to no greater than five minutes and subject to the prevailing power system conditions.
- The relevant parties identify and acknowledge that the power system is insecure and develop a plan to manage any potential delays which may affect restoration of the power system to a secure operating state.

This approach is not intended for fault level control. The policy for fault level control is that the next switching step must relieve circuit breaker rupture levels.

14.2 Constraints Ramping and Permission to Proceed

Unless advised to the contrary AEMO will assume that all network outages will commence at the time specified in the AEMO Outage Scheduler (NOS). It should be noted that if an outage requires AEMO Permission to Proceed (PTP), then the TNSP is still required to contact AEMO prior to taking any equipment out of service.

It is the responsibility of the TNSP to advise AEMO of any change to the start time for a planned outage.

AEMO will invoke outage constraints and Network Outage Constraint ramping constraints to ensure ramping is complete at the requested outage start time.

The outage constraint must be in a PreDispatch run, to provide the necessary inputs to the ramping constraint. Once a suitable PreDispatch result is available the ramping constraints can be invoked. The default ramp time is 35 minutes but can be varied dependant on system conditions.

For further details refer to the Constraint Formulation Guidelines and Constraint Implementation Guidelines documents which are published on AEMO website at AEMO Congestion Related Policies and Processes.

Note 4  
Network Outage Constraint ramping also extends for six dispatch intervals beyond the start time of the outage constraint. This will ensure that the technical envelope for the outage remains current for a period long enough for the TNSP to complete the necessary switching.

The following rules apply.

14.2.1 Ramping Constraint has NOT Commenced

- If the TNSP advises of a revised (later) start time prior to the ramping constraint invoking then AEMO will adjust the outage start time and create a new ramping constraint.
• If the TNSP is unable to advise AEMO of a start time, all the constraints invoked for the outage will be revoked. The TNSP should contact AEMO when the outage is ready to commence. AEMO will then invoke the relevant outage constraints. Before PTP can be given a PreDispatch run must again take place to provide the necessary inputs to the ramping constraints. PTP will be given when line flows have been ramped to the outage conditions.

• If the TNSP requests an earlier start time for the outage and the ramping constraint has not been invoked, then only if there is sufficient time to allow the revised start time to be reflected in PreDispatch and with sufficient ramp time available, AEMO will agree to this earlier start time. PTP will be given when line flows have been ramped to the outage conditions.

14.2.2 Ramping Constraint has Commenced

• If the TNSP requests an earlier start time then this could be denied.

• If 30 minutes has expired from the planned start time and permission to proceed (PTP) has not been sought then the ramp will cease and a new ramp must be commenced prior to the outage proceeding at a later time. AEMO will adjust the outage constraint time accordingly. Before PTP can be given a PreDispatch run must again take place to provide the necessary inputs to the ramping constraints. PTP will be given when line flows have been ramped to the outage conditions.

• If PTP has been given for the scheduled start time and switching has not commenced within 15 minutes AEMO may advise the TNSP that unless switching is completed within the next 15 minutes then the ramp will expire and a new ramp must be commenced prior to the outage proceeding at a later time (refer to note in section 14.2).

• If the TNSP advises of a revised (later) start time of 30 minutes or less, the outage constraint start time may be altered and the ramping constraint end time will automatically be extended by that altered amount of time.

• If the TNSP advises of a revised (later) start time of greater than 30 minutes, the outage constraint start time may be altered however the ramping constraint will end immediately and a new ramping constraint must be created. AEMO will adjust the outage constraint time accordingly. Before PTP can be given a PreDispatch run must again take place to provide the necessary inputs to the ramping constraints. PTP will be given when line flows have been ramped to the outage conditions.

• If the TNSP is unable to advise AEMO of a start time, all the constraints invoked for the outage will be revoked and the ramping constraint will end immediately. The process in section 14.2.1 will then be followed.

15 Interconnector Rate of Change Limitations prior to Transmission Outages

Step changes in interconnector transfer limits may result in a situation where the total generator rate of change capability on either side of an interconnector is exceeded for a short time. To avoid a violation of the constraint equation or “overconstrained dispatch”, AEMO imposes maximum limits on the rate of change of inter-regional power flow. This can happen when transfer limits are reduced significantly at the start of transmission network outages.

Table 7 below specifies the maximum rates of change of inter-regional power flow to be applied at the start of planned or short notice transmission network outages. This process is used to reduce inter-regional power flow only and is not required for interconnector capacity increases.
Table 7  Interconnector Rate of Change

<table>
<thead>
<tr>
<th>Direction of flow prior to reduction</th>
<th>Max reduction in flow per dispatch interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queensland to NSW (QNI)</td>
<td>200 MW/5 min</td>
</tr>
<tr>
<td>NSW to Queensland (QNI)</td>
<td>200 MW/5 min</td>
</tr>
<tr>
<td>Queensland to NSW (Terranora)</td>
<td>80 MW/5 min</td>
</tr>
<tr>
<td>NSW to Queensland (Terranora)</td>
<td>80 MW/5 min</td>
</tr>
<tr>
<td>Victoria to South Australia (Heywood AC)</td>
<td>30 MW/5 min</td>
</tr>
<tr>
<td>South Australia to Victoria (Heywood AC)</td>
<td>50 MW/5 min</td>
</tr>
<tr>
<td>Victoria to South Australia (Murraylink)</td>
<td>25 MW/5 min</td>
</tr>
<tr>
<td>South Australia to Victoria (Murraylink)</td>
<td>40 MW/5 min</td>
</tr>
<tr>
<td>Tasmania to Victoria (Basslink)</td>
<td>200 MW/5 min</td>
</tr>
<tr>
<td>Victoria to Tasmania (Basslink)</td>
<td>200 MW/5 min</td>
</tr>
<tr>
<td>VIC to NSW</td>
<td>200 MW/5 min</td>
</tr>
<tr>
<td>NSW to VIC</td>
<td>200 MW/5 min</td>
</tr>
</tbody>
</table>

16 Protection System Outages

If a registered participant becomes aware that any relevant protection system or control system is defective or unavailable for service, that registered participant must advise AEMO. If AEMO considers it to be a threat to power system security, AEMO may direct that the equipment protected or operated by the relevant protection system or control system be taken out of operation or operated as AEMO directs.

16.1 Total Outage of Protection Schemes

If all the primary protection schemes on a transmission element are removed from service the transmission line is normally removed from service. An exception to this may arise if the outage of the transmission line would interrupt supply and adequate backup protection is available to maintain system security. Situations of this kind should be resolved between the NSP and AEMO.

16.2 Planned Outage of One Protection of a Duplicated Scheme

Normally the power system equipment can remain in service.

The duration of the outage for a transmission line should be kept to a minimum and, not greater than eight hours unless agreed by AEMO and the relevant NSPs. Refer NER Schedule S5.1.2.1 (d).

If the transmission line protection remains unserviceable after eight hours and provided there is agreement between AEMO and the relevant NSPs for the outage to continue, then follow the approach as for unplanned outages.

16.3 Unplanned Outage of One Protection of a Duplicated Scheme

The NER (refer S5.1.2.1(d)) may be interpreted to apply to planned outages for maintenance purposes and the following clarifies the approach for unplanned outages of one protection of a duplicated scheme.
Normally the *transmission element* can remain in service provided that the NSP provides reasonable assurance that the remaining protection will clear a fault in primary protection timeframe; and

The protection repair is being progressed with expected resolution within 24 hours, with the understanding that work starts as soon as is safe to do so and should be completed within this specified time.

If these conditions are not met then the affected *transmission element* must be taken out of service.

### 16.4 Degraded Clearing Times

Degraded or longer clearing times can result during outages of protection signalling or inter-tripping equipment. Degraded clearing times can also result if high speed primary protection such as distance or pilot wire protection is taken out of service and the alternative protection is a slower directional over current scheme. Temporary protection schemes can also result in longer clearing times. The effect of this on system security needs to be assessed in consultation with the TNSP.

Where there is a risk to system security and any of the following apply:

- High speed clearance of some faults is no longer possible.
- There are periods when the risk of fault on the *power system* is high.
- The degraded clearing times are to apply for extended periods.

Then:

- The *power system* must be operated to more restrictive limits which correspond to the longer clearing times, or;
- The protection settings must be reduced to provide faster clearing times. If this leads to loss of discrimination, operating limits must be reduced to correspond with the possibility of inappropriate operation, or;
- The affected *transmission element* must be taken out of service.

### 16.5 Outage of Additional Non-Duplicated Protection Schemes

Protection schemes required for the detection of special low probability events such as Directional Earth Fault Comparison schemes, designed to detect high impedance faults which may occur during bushfires, may be taken out of service, and the primary plant left in service. This action may only be taken provided the risk of this type of fault is not high and the outage is of short duration, that is, less than 8 hours unless agreed by AEMO and the relevant NSPs.

Outages of other types of protection schemes which may not be duplicated, such as transformer buchholz or differential protection, should be treated in a similar way.

### 16.6 Outage of Signalling Systems

Outages of signalling systems such as fast zone two blocking can cause loss of discrimination and suitable remedial measures should be agreed with the TNSP. These measures may include the temporary application of a block or removal of the fast zone two tripping feature.

Outages of accelerated inter-tripping on one protection scheme of a duplicated scheme normally will not result in loss of zone one clearing times on the protected *transmission element* and thus should not impact on system security.

Outages of direct or accelerated inter-tripping associated with Circuit Breaker Fail protection in "breaker and a half" switchyards may require opening of coupler circuit breakers provided this does not cause additional security problems.
Provided the system security issues have been adequately addressed the affected primary plant can remain in service.

16.7 Transfer Limit Reductions due to Protection Outages
Outages of protection or associated signalling equipment can lead to a reduction in transient stability transfer limits.

Various types of protection schemes designed to enhance system stability such as single pole tripping and reclosing or power swing blocking could also result in a reduction of safe power transfer limits if they are not available. Changes to these limits will be agreed between AEMO and the appropriate TNSP.

16.8 System Protection Services
Under frequency protection is designed to return system frequency to normal following multiple generation contingencies. The NER require 60% of the total load of a region to be connected to under frequency protection. This protection is distributed across the region and taking the under frequency scheme out of service at one substation has little effect on the overall scheme and the security of the power system.

Under voltage schemes are designed to protect smaller areas within the power system from under voltages during contingencies. The outage of these schemes will impact on the security of the power system but only for a limited number of contingencies. The outage will need to be assessed against other planned outages of system equipment and any known risk factors such as weather conditions.

There are special control schemes and devices that allow higher Inter-Regional and Intra-Regional transfer levels when they are in service. Outages of these schemes will be assessed to determine if new constraints need to be applied to the associated transfer limits.

16.9 Rules Requirements
NER clause 4.3.1 defines the responsibility AEMO has for system security.

NER clause 4.6.2. AEMO is required to co-ordinate, in consultation with Network Service Providers, the protection of power system plant which could affect power system security.

NER clause 4.6.5 defines AEMO’s responsibility to determine, in consultation with the Network Service Providers, the best course of action to adopt for partial, or complete, removal from service of the protection equipment protecting transmission lines. The NSP must comply with AEMO’s determination unless in their reasonable opinion it would threaten the safety of any person or cause material damage.

NER clause 4.8.2 defines a registered participant’s responsibility to advise AEMO of any relevant protection or control system that is defective or unavailable. If there is risk to system security AEMO can direct the affected plant to be taken out of service or to be operated in an appropriate manner. The registered participant must comply with a direction given by AEMO.

16.10 Follow up on Protection Operations
AEMO will request from the TNSP details of protection operations resulting from power system faults. This advice should include the protection schemes which have operated, fault clearing times and a statement by the TNSP as to whether the protection operation is normal or abnormal.

17 Voltage Control
AEMO will maintain voltage levels across the transmission network within the relevant limits set by the Network Service Providers and to a target voltage range.
Adequate reactive reserves are maintained to ensure the security of the transmission system in the event of a credible contingency.

There are several methods of voltage control available, but the two most commonly used are:

- Changing transformer taps
- Injecting or absorbing reactive power into connection points

Other methods include:

- Load shedding (automatic or manual)
- Network reconfiguration

The reactive power facilities available to AEMO include:

- Synchronous generator voltage controls
- Synchronous condensers
- Static VAr compensators (SVC)
- Shunt and series capacitors
- Shunt reactors
- Transformer tap changing

In addition to these facilities AEMO has entered into Reactive Power Ancillary Service Agreements with TNSPs and Generators.

17.1 Reactive Reserve

The amount of reactive reserve required depends on the power system conditions and the severity of the critical contingency. A requirement for both fast dynamic reactive reserve plant and static reactive plant exists.

Fast dynamic reactive reserve plant includes SVCs, generators, synchronous condensers and automatically switched shunt reactive plant. Static reactive plant consists of shunt capacitors and reactors used as base level voltage and reactive support.

17.2 Voltage Control Process

AEMO uses the Var Dispatch Scheduler (VDS) as the primary tool for dispatching reactive power devices in the NEM. It is an automated system that determines the dispatch of reactive power devices satisfying the specified objectives. Dispatch of reactive power devices are published to TNSPs and Generators in the form of electronic instructions.

VDS uses the following inputs to determine dispatch of reactive power devices selected for control by VDS:

- Availability of reactive power devices.
- Voltage limits and the desired voltage profiles across the NEM transmission network.
- Pre-contingency and post-contingency voltage violations identified in AEMO real time contingency analysis.
- VDS parameters assigning priorities for reactive power devices.

AEMO on-line staff monitor/verify the reactive power dispatch by VDS. AEMO and TNSPs will communicate with each other if adjustments to reactive power dispatch by VDS is required and AEMO will implement agreed changes to the reactive power dispatch.
18 Fault Level Control

Both AEMO and the TNSPs have input to the determination of fault levels and maintaining them within plant capabilities.

The TNSP is responsible for providing to AEMO the Short Circuit current ratings of all assets within AEMO’s area of control.

TNSPs have a NER obligation to provide AEMO with network modeling data which would enable AEMO to determine fault levels at all bus bars in the transmission system. TNSPs are also required to provide the contributions of any embedded generation that may influence the fault levels at those buses.

18.1 AEMO Responsibilities

AEMO’s roles and responsibilities are primarily determined by the NER which incorporates Power system security (Chapter 4) and Network Connection (Chapter 5). Some of these responsibilities include, but are not limited to:

- In consultation with the Network Service Providers, determine the short circuit fault current level at all busbars of the power system.
- Ensuring that there are processes in place, which allow the determination of short circuit fault currents levels in real time.
- Identifying any bus which could potentially be exposed to a short circuit fault current exceeding the fault current ratings of the circuit breakers associated with that busbar.
- Provide processes/plans to remove identified or potential short circuit fault current levels in excess of plant ratings.

AEMO’s RTNET (state estimator) application snaps the SCADA values in 5 min samples and solves the power flow case; the results of this analysis are used as a base case for the Real Time Short Circuit (RTSCT) application.

AEMO’s RTSCT module calculates three phase and single phase to earth fault current flows. Short circuit faults are defined for all station buses in the transmission network, specific faults are defined for other locations, remote from buses were short circuit currents may have the potential to exceed CB ratings.

These defined faults can be included or excluded from the Short Circuit process run as required. Normally all defined faults are included.
The RTSCT module can also be used in study mode to assess the impact of expected system changes or to review options for resolving situations were fault current ratings, may be expected to be exceeded.

18.2 Operational Policy

AEMO’s RTSCT analysis results indicate both the total short circuit current available from a defined fault and the individual current contributions from each of the input circuits to that fault, for both 3 phase and 1 phase short circuit faults.

AEMO will use the total fault current available at a specific bus to assess whether the short circuit breaking capacity of any CB, connected to that location, is exceeded. The assumption being, total fault current available at a bus is required to be broken by any CB attached to that bus.

On occasions where there may be discrepancies between AEMO’s RTSCT results and either a TNSP operating policy or TNSP online analysis results. AEMO will discuss options with the TNSP to provide a practical solution.

Where discrepancies are shown to be material and reasons for such discrepancies are not obvious AEMO will take the conservative path and revert to the existing TNSP policy, until the variance is resolved.

In the case of a planned outage it may be necessary to exceed fault levels for short periods during a switching sequence in order to avoid load interruption, plant overloads or where alternative approaches may impose other risks to the power system. The policy under these conditions requires that the next switching step must reduce the fault levels to within the fault current breaking capacity of the CBs.
19 Control of Power System Frequency and Time Error

19.1 Frequency Operating Standards
AEMO is responsible for controlling the power system frequency and time error according to the Frequency Operating Standard (FOS). In order to fulfil these obligations AEMO will, when required,

- Source additional FCAS by adjusting the requirement.
- Issue directions to participants to provide FCAS if the available FCAS offers are not sufficient to meet the power system requirements.
- Issue directions to participants to control the frequency and the time error according to the FOS.
- Issue Clause 4.8.9 Instructions for load shedding to control frequency according to the FOS.
- AEMO will not shed load to meet the time error standard but may direct generation if the time error increases beyond the Time Error Standard.

19.2 Frequency Control
AEMO dispatches Frequency Control Ancillary Services in order to:

- Control the minute to minute variations of power system frequency as a result of the continuous changes in load of the power system to within the Normal Frequency Band under steady load. This is known as the regulation duty.
- Ensure power system frequency variations resulting from various contingencies are controlled to the requirements of the frequency operating standard.

19.3 Regulation and time error control
Time error control is achieved using Automatic Generation Control (AGC).

In the dispatch time frame, AEMO will determine the amount of regulation FCAS for Mainland based on the time error. FCAS constraints will automatically set regulation FCAS requirement to 180/170 MW (raise/lower) if the time error is within the +/- 1.5 second band. For every 1 second deviation outside this time error band an extra 60 MW of regulation FCAS per 1 second deviation outside the band will be automatically added until an upper limit of 300 MW is reached.

Dispatch raise requirement (Mainland) = \( \min (300,180 + (-1 \times \min (-1.5, \text{Time Error}) - 1.5) \times 60) \)

Dispatch lower requirement (Mainland) = \( \min (300,170 + (\max (1.5, \text{Time Error}) - 1.5) \times 60) \)

The time error used is the average value of the QLD and NSW time error values from AEMO's Energy Management System.

Regulation for Tasmania is nominally set to 50 MW.

If the time error reaches +/- 10 seconds for Tasmania and AEMO reasonably believes that the time standard may be exceeded then AEMO may increase the amount of Regulation FCAS.

In the event of a regional separation, AEMO will realign the time error of the separated region after it has been synchronised to the rest of the power system. If multiple regions separate, AEMO will set an appropriate time error based on the event.

AEMO must issue a Market Notice after making adjustments to the time error.
19.4 Control of Frequency during Periods of Supply Scarcity

If following a contingency event there is insufficient FCAS available to cover the loss of a generating unit AEMO will take action according to AEMO’s Policy on the Management of Secure and Satisfactory Limits (see Section 5).

AEMO will:

- Issue directions for the provision of FCAS.
- Issue directions for a reduction in the size of the generation at risk.

If any of the above actions result in load shedding, AEMO will apply the supply scarcity Frequency Operating Standard.

The Frequency Operating Standard allows for a wider frequency range to apply during periods of supply scarcity. This revised frequency standard only applies to the mainland part of the NEM.

20 Use of Network Support and Control Ancillary Service

Network support and control ancillary services (NSCAS)\(^5\) is a service which provides AEMO with a capability to control the real or reactive power flow into or out of a transmission network in order to:

- Maintain the transmission network within its current, voltage or stability limits following a credible contingency event; or
- Enhance the value of spot market trading in conjunction with the central dispatch process.

There are three types of NSCAS:

- Network loading ancillary service (NLAS)
- Voltage control ancillary service (VCAS)
- Transient and oscillatory stability ancillary service (TOSAS)

It is to be noted that only a limited number of service providers are available and the geographical locations of these service providers dictates the effectiveness of the service provided.

Network loading ancillary service (NLAS) is the capability of reducing an active power flow from a transmission network in order to keep the current loading on transmission elements within their respective ratings following a credible contingency event in a transmission network.

Voltage control ancillary service (VCAS) is the capability to supply reactive power to, or absorb reactive power from, the transmission network in order to maintain the transmission network within its voltage and stability limits following a credible contingency event but excluding such capability provided within a transmission or distribution system or as a condition of connection.

Transient and oscillatory stability ancillary service (TOSAS) is the capability to control power flow into or out of the transmission network to maintain the transmission network within its transient or oscillatory limits and to maintain or increase power transfer capability by improving transient or oscillatory stability.

NSCAS may also be dispatched to provide a market benefit providing the benefit gained exceeds the cost of dispatching the service.

Refer to SO_OP_3708 Non Market Ancillary Services for more information.

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\(^5\) NSCAS was previously referred to as Network Control Ancillary Service (NCAS). AEMO has a number of existing NCAS contracts in place. These contracts will be dispatched as if they were NSCAS contracts until these contracts expire.
21 Application of thermal ratings in Dispatch

The power system security Working Group has endorsed the following approach in using thermal ratings in NEM dispatch systems.

Table 8  Application of Thermal Ratings

<table>
<thead>
<tr>
<th>Type of Rating</th>
<th>Method of Post-Contingency Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other than short term ratings</td>
<td>No action is required</td>
</tr>
<tr>
<td>15 min rating **</td>
<td>Constraint equations in EMMS</td>
</tr>
<tr>
<td></td>
<td>Automatic post-contingency actions</td>
</tr>
<tr>
<td></td>
<td>Manual (operator actions)</td>
</tr>
<tr>
<td>10 min rating</td>
<td>Automatic post-contingency actions</td>
</tr>
<tr>
<td></td>
<td>Pre-arranged Manual (operator) actions</td>
</tr>
<tr>
<td>5 minute or shorter term rating</td>
<td>Automatic post-contingency actions</td>
</tr>
<tr>
<td></td>
<td>“Specific” Manual (operator) actions</td>
</tr>
</tbody>
</table>

“Specific” manual action includes manual load shedding or any other pre-arranged specific operator actions that can be completed within 5 minutes. Operators will most probably be on standby to initiate the post contingency action.

** Subjected to meeting requirements specified by TNSPs.

22 Advice of Variance to interconnector transfer limits

A Market Notice will be issued for, but not limited to:

- any short notice (less than 1 hour notice) or unplanned outage which requires the invoking of constraints with interconnector terms on the LHS; or
- Non-physical loss related issues; or
- Interconnector control issues; or
- Other power system security related issues (i.e.: transient stability, etc.)

The Market Notice will include the following relevant points:

- The transmission element required out of service.
- The Region in which the transmission element is located.
- The constraint set name and invoke times.
- The interconnectors on the L.H.S. of the constraint equations.
- The applicable reason or issue requiring the invoking of constraint equations.

23 AEMO’s advice on power emergency conditions

AEMO must publish all relevant details promptly after AEMO becomes aware of any circumstance with respect to the power system which, in the reasonable opinion of AEMO, could be expected to materially adversely affect supply to or from registered participants. NER clause 4.8.3(b) specifies some of these circumstances.

AEMO will advise of any planned action that will be taken in response to these circumstances. AEMO will also advise if the decision is to take no action at the current time or to delay action to a future time in response to an emerging risk of such a situation.

Following the occurrence of a significant event:
Within 15 minutes of having confirmed and verified the event a Market Notice should be issued which includes the following information (if known at that time).

- Time of event
- General description of event
- Identify Transmission element(s) involved
- The Region in which the Transmission element(s) are located
- Identify any islands formed and identify the boundaries of those islands.
- Indication of volume of load shed and in which region.
- Approximate total amount of generation tripped in each region (NOT availability but dispatched volume tripped)
- Any further risks identified at that time.

If the Market Notice system is not operational, the AEMO Emergency Communications System (Whispir) will be used until the Market Notice system becomes operational.