RELIABILITY PANEL AEMC

REVIEW

Reliability Panel AEMC

FINAL REPORT

GENERATOR COMPLIANCE TEMPLATE REVIEW - 2019

19 DECEMBER 2019

INQUIRIES

Reliability Panel
c/- Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

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

Reference: REL0070

CITATION

Reliability Panel, Generator Compliance Template Review - 2019, Final report, 19 December 2019

ABOUT THE RELIABILITY PANEL

The Panel is a specialist body established by the Australian Energy Market Commission (AEMC) in accordance with section 38 of the National Electricity Law and the National Electricity Rules. The Panel comprises industry and consumer representatives. It is responsible for monitoring, reviewing and reporting on reliability, security and safety on the national electricity system, and advising the AEMC in respect of such matters.

RELIABILITY PANEL MEMBERS

Mr Charles Popple (Chairman), Chairman and AEMC Commissioner
Trevor Armstrong, Chief Operating Officer, Ausgrid
Stephen Clark, Technical and Economic Lead – Project Marinus, TasNetworks
Kathy Danaher, Chief Financial Officer and Executive Director, Sun Metals
Gavin Dufty, Manager Policy and Research, St Vincent de Paul Society, Victoria
John Titchen, Managing Director, Goldwind Australia
Chris Murphy, Strategic Advisor, Meridian Energy; General Manager - Energy Market Interfaces, Telstra
Damien Sanford, Chief Operations Officer, AEMO
Richard Wrightson, Executive General Manager, Wholesale Markets, AGL Energy

SUMMARY

1 This report sets out final recommendations from the Reliability Panel's (Panel) review of the template for generator compliance programs. It builds on the recommendations set out in the Panel's draft report following consideration of stakeholder submissions. Recommendations are substantially similar to those put forward in the draft report with some minor changes to incorporate stakeholder views.

2 On 26 February 2019, the Commission issued terms of reference for the Reliability Panel to conduct a review of the template for generator compliance programs.[1]

3 The template outlines principles and processes for generator compliance program development and specifies a range of test methods for consideration by generators when developing their compliance programs for each technical standard requirement in the rules.[2] The template sets out a number of test methods for each generator technical performance standard specified in the schedule to Chapter 4 of the NER which may be considered appropriate given the age, type, and capabilities of the generating system in question. These are listed in Table 1 of the template.

4 The template provides clarity on what constitutes good electricity industry practice with respect to technical standard compliance. By providing this guidance, it assists generators with developing and designing their compliance programs. While generators are responsible for instituting and maintaining their own compliance programs, they need to make sure their programs are consistent with the template.[3] The template may also assist the Australian Energy Regulator (AER) with its enforcement and monitoring of generators' compliance with the technical requirements under the NEM.

5 The last review of the template for generator compliance was in 2015 with the next scheduled review due in 2020.[4] In 2018, however, the Commission made the *Generator Technical Performance Standards* (GTPS) rule, which altered and added technical performance requirements applying to connecting generators in a range of areas.[5] In the final determination of the GTPS rule, the AEMC committed to directing the Reliability Panel to review the template for generator compliance prior to its next scheduled review.[6]

6 Therefore, this review both fulfils the requirements of a periodic review of the template as required under the rules as well as updating the template to reflect the changes made to generator technical requirements in the Generator Technical Performance Standards rule change.

7 The Panel engaged GHD Pty Ltd (GHD) to support the review by providing detailed technical advice. GHD performed a stakeholder survey on behalf of the Panel to identify options and

1 AEMC, terms of reference to the Reliability Panel, generator compliance template review - 2019.
2 Technical standards for generator compliance are set out in Schedule 5.2.5 of the NER.
3 Clause 4.15(c)(1) of the NER
4 Under the clause 8.8.3(ba) of the NER reviews of the template are every five years.
5 AEMC, Generator technical performance standards, rule determination, 27 September 2018.
6 Ibid.

make recommendations for changes to the template to address the review's scope. Building on the feedback gained through the stakeholder survey, GHD developed an initial set of recommended changes to the template. Those changes were further refined following feedback from members of a technical working group convened by the Panel.

8 On 19 September 2019 the Panel published a draft report setting out recommendations for changes to the template. The Panel's draft recommendations significantly reflected those made by GHD in their report to the Panel and considered by the technical reference group. Following publication of the draft report five submissions were received from:

- AEMO
- Snowy Hydro
- TasNetworks
- Hydro Tasmania, and
- the Clean Energy Council (CEC).

9 Stakeholder submissions were generally supportive of the changes proposed in the draft report. A number of issues were raised and changes proposed. Each of these issues and changes are addressed in sections 3 and 4 of this final report.

10 The following is a summary of the Panel's final recommendations on changes to the template for generator compliance programs. Final recommendations that have been added or changed since the draft report are presented first followed by those which are unchanged.

11 The template becomes effective on 19 December 2019.

BOX 1: FINAL RECOMMENDATIONS THAT HAVE BEEN ADDED OR AMENDED SINCE THE DRAFT REPORT

Definition of major event, significant disturbance, major disturbance

The Panel's final recommendation is to amend the template to define 'major event', 'significant disturbance', and 'major disturbance'.

The Panel's final recommendation also includes additional guidance to stakeholders in the interpretation of these terms. This additional guidance will be provided through explanation alongside the definitions of 'major event', and 'major disturbance'.

Clarify high speed monitoring as a suitable method for showing compliance with S5.2.5.13

The Panel's final recommendation is to clarify the applicability of high speed monitoring under method 3 by amending the suitable testing and monitoring methodology for method 3 to include high speed monitors, digital protection relays or; other data- logging equipment as required.

Validating and updating power system models

The Panel's final recommendation is to provide additional guidance for generators in section

2.9 of the template on finalising model validating following commission as part of the generator's compliance testing program, and provide information for generators on their obligations to update model information supplied to AEMO and the NSP should compliance testing indicate their generating system model is incomplete, inaccurate, or out of date.

Additional guidance on the generator compliance framework

The Panel's final recommendation is to update the template to delete reference to AER's generator performance standards information booklet published in August 2013, and provide the additional guidance on requirements for NSP and AEMO approval of plant control and protection settings under clause S5.2.2 of the NER.

Removing inappropriate technology bias

The Panel's final recommendation is to remove inappropriately technology specific language from S5.2.5.8 method 3 and S5.2.5.9 method 3, broaden the applicability of S5.2.5.8 method 2 to include both solar and wind farms, and amend S5.2.5.11 methods 2, 3, and 4 to include a reference to"other control systems designed to modulate active power response to a frequency disturbance" but also retain the existing reference to governor system performance.

BOX 2: FINAL RECOMMENDATIONS THAT ARE UNCHANGED SINCE THE DRAFT REPORT

Suggested frequency of testing in method 3 in S5.2.5.5

The Panel's final recommendation is to amend the suggested frequency of testing under S5.2.5.5 for method 3(a) to occur when the plant trips during or immediately following a significant voltage disturbance and at least one major event every 3 years where the generating system maintains continuous uninterrupted operation.

Compliance testing of multiple reactive power control modes

The Panel's final recommendation is to clearly provide for the testing of multiple reactive power control modes by requiring tests to address all control modes listed in the generator performance standard as commissioned control modes.

Test frequency applying to primary and secondary reactive power control modes

The Panel's final recommendation is to provide for reduced test frequency for modes of reactive power control that are not routinely used to control the output of the generator.

Feasibility of testing full reactive power capability

The Panel's final recommendation is to amend the basis for compliance assessment for methods 1, 2 and 3 for S5.2.5.1 to require a generating system to be capable of achieving reactive power requirements of the performance standards, subject to not exceeding network

voltage limits.

Accounting for the performance of remote equipment in compliance programs

The Panel's final recommendation is not to require compliance testing for remote equipment which is an element of the generator's performance standards but not behind the connection point, or controlled by the generator. The Panel's final recommendation is to include a new section 2.8 in the template providing guidance for generators on how to address any interdependencies between the generating system and this remote equipment within the generator's compliance program.

Clarifying the test frequency for method 4(a) of S5.2.5.3

The Panel's final recommendation is for the suggested frequency of testing under method 4(a) of S5.2.5.3 be clarified as being every three years by reviewing the response to a disturbance where the system frequency moves outside of the operational frequency tolerance band and after plant change.

Plant change in method 3 of S5.2.5.3

The Panel's final recommendation is to remove the specific reference to "control system settings or protection system change" as types of plant change from the suggested frequency of testing under method 3 of S5.2.5.3.

Fault throw test viability

The Panel's final recommendation is to remove method 1 for S5.2.5.5 (requiring direct testing of a generator response to disturbance by instigating a network trip) from the template.

Clarifying 'appropriate metering' for power quality

The Panel's final recommendation is to amend the suitable testing and monitoring methodology listed for methods 1 and 2 of S5.2.5.6 to require measurement of power quality using measurement transformers and transducers with sufficient frequency bandwidth.

Frequency of testing in S5.2.5.7

The Panel's final recommendation is to amend the frequency of testing advice for Method 3(a) of S5.2.5.7 to be on every event where frequency moves out of the operational frequency tolerance band or every 5 years (whichever is more frequent) and after plant change as appropriate to the technology of the relevant sub-system.

The definition of plant change

The Panel's final recommendation is to include changes in software and firmware as types of plant change, and clarify that changes to a generating system that would trigger the process described in clause 5.3.9 of the NER would also constitute a plant change for the template.

BOX 3: ISSUES IDENTIFIED THAT ARE BEYOND THE SCOPE OF THE REVIEW

In addition to those changes recommended to the template, the final report identifies several additional issues raised by stakeholders, which are beyond the scope of this review. These issues are presented to inform future work programs, or to inform any stakeholder looking to submit rule change requests to the AEMC. These issues include:

- Notification provisions requiring NSPs to inform generators of disturbances for triggering compliance testing
- Enhanced power system model update provisions including additional requirements for generators to evaluate validate performance for any large disturbance, and provide details and analysis including any model updates to AEMO within 3 months of that disturbance occurring.
- Development of a high speed monitoring standard setting out technical specifications and configuration requirements, and
- The role of the NSP in generator compliance testing, and the development of a compliance template and registered performance standards for NSP controlled plant.

CONTENTS

1 INTRODUCTION

On 26 February 2019, the Commission issued terms of reference for the Reliability Panel to conduct a review of the template for generator compliance programs (template).[7] This report sets out the Panel's final recommendations for this review.

Effective compliance with performance standards contributes to the delivery of a reliable and secure electricity supply to customers in the National Electricity Market (NEM). The template provides clarity on what constitutes good electricity industry practice with respect to assessing technical standard compliance.

While generators are responsible for instituting and maintaining their own compliance programs, they need to ensure their programs are consistent with the template. The template may also assist the Australian Energy Regulator (AER) with its enforcement and monitoring of generators' compliance with the technical requirements under the NEM.

1.1 Purpose of the review

The NER require the Reliability Panel (Panel) to determine, modify as necessary and publish the template.[8] The rules also require the Panel to undertake regular reviews of the template. Clause 8.8.3(ba) of the NER requires the Panel to conduct a review of the template at least every five years and at such other times as the AEMC may request.

The last review of the template for generator compliance was in 2015 with the next scheduled review due in 2020. In 2018, however, the Commission made the Generator Technical Performance Standards (GTPS) rule that altered and added technical performance requirements applying to connecting generators in a range of areas.[9] In the final determination of the GTPS rule, the AEMC committed to directing the Reliability Panel to review the template for generator compliance prior to its next scheduled review.[10] Further information on the changes to generating system performance standards made in the GTPS rule can be found of the AEMC website.[11]

1.2 The template and its role in compliance frameworks

1.2.1 Role and purpose of the template under the NER

Under the NER, registered participants have obligations to ensure that their plant meets or exceeds applicable performance standards and does not materially adversely affect power system security.[12] In that regard, a registered participant who controls or operates plant to which a performance standard applies must institute and maintain a compliance program.[13]

7 AEMC, Terms of reference to the Reliability Panel, generator compliance template review - 2019.
8 Clause 8.8.1(a)(2b) of the NER.
9 National Electricity Amendment (Generator Technical Performance Standards) Rule 2018.
10 AEMC, Generator technical performance standards rule, final determination, p. 246
11 https://www.aemc.gov.au/rule-changes/generator-technical-performance-standards
12 Clause 4.15(a) of the NER.
13 Clause 4.15(b) of the NER.

The template aims to provide guidance for stakeholders, particularly generators and the Australian Energy Regulator (AER), on what constitutes good electricity industry practice with respect to the development of programs demonstrating compliance with the performance standards.

The template outlines principles and processes for generator compliance program development and specifies a range of test methods for consideration by generators when developing their compliance programs.[14]

The NER requires generator compliance programs to:[15]

- be consistent with the template for generator compliance programs
- include procedures to monitor the performance of the plant in a manner that is consistent with good electricity industry practice[16]
- be modified to be consistent with any amendments made under clause 8.8.3(ba) to the template for generator compliance programs, by no later than 6 months after amendments to the template for generator compliance programs are published or by a date determined by the Reliability Panel, and
- be sufficient to provide reasonable assurance of ongoing compliance with each applicable performance standard.

Under the NER, the template for generator compliance programs must:[17]

- cover all performance standards, and
- define suitable testing and monitoring regimes for each performance standard so that a registered participant can select a regime that complies with its obligations above for its plant.

1.2.2 How the template supports effective generator compliance frameworks

The template is an important element of the overall compliance process applying to generators in the NEM. It supports:

- the AER's process of generator compliance audits, and
- the NER's self reporting non-compliance regime.

The template supports the AER's compliance monitoring by specifying a testing regime and record keeping sufficient for an auditor to provide a reasonable assurance opinion on a generator's performance standard compliance.[18] The NER provides for the audit of generator compliance by empowering the AER to request the records setting out written results from

14 Technical standards for generator compliance are set out in rules schedule S5.2.5.

15 Clause 4.15(c) of the NER.

16 Chapter 10 of the NER defines "good electricity industry practice" to mean: "The exercise of that degree of skill, diligence, prudence and foresight that reasonably would be expected from a significant proportion of operators of facilities forming part of the power system for the generation, transmission or supply of electricity under conditions comparable to those applicable to the relevant facility consistent with applicable regulatory instruments, reliability, safety and environmental protection. The determination of comparable conditions is to take into account factors such as the relative size, duty, age and technological status of the relevant facility and the applicable regulatory instruments."

17 Clause 4.15(ca) of the NER

18 Clause 4.15(c)(4) of the NER, and Section 15 of the National Electricity Law.

generator compliance testing consistent with the template requirements. The NER requires generators to maintain these compliance program records for a period of 7 years to further facilitate and auditing or investigations carried out by AEMO or the AER.[19]

The template also supports the NER's self reporting non-compliance regime. Clause 4.15(h) of the NER requires a generator to immediately notify AEMO when they become aware that their plant is breaching one of its performance standards. A robust compliance monitoring program will detect generating system non-compliance thereby allowing prompt notification and rectification.

Prompt notification is important for system security as it allows AEMO to assess the implications of the non-compliance on the operation of the power system and, where necessary, make adjustments to the technical envelope to ensure power system security can be maintained.

1.3 Requirements for the review

On 26 February 2019, the Commission issued terms of reference for the Reliability Panel to conduct a review of the template.[20] In undertaking this review, the AEMC requested the Panel to consider whether:[21]

- there have been any changes to technology and cost that should be reflected in the template
- stakeholder experiences with the template which indicate ways in which the template may be improved
- there are any other factors, including outcomes of power system incidents, that should be considered to further clarify and improve the template
- changes or additions to the template necessary to account for the changes to performance standards made in the GTPS rule, and
- any other material changes to the NER that impact the template or its use.

While the Commission was motivated to issue terms of reference to the Panel to address changes made in the GTPS rule, the review's terms of reference are not limited to exclusively considering changes required due to the GTPS rule. The Commission's terms of reference also cover those applying to a regular review of the template.

The review terms of reference also require the Panel to carry out this review of the template in accordance with the following process:

- publish notice of review, including particulars of the terms of reference for the review, and the deadlines for the receipt of any submissions and public meeting requests
- publish a draft report and invite submissions for a period of at least four weeks

19 Clause 4.15(d) of the NER.
20 AEMC, Terms of reference to the Reliability Panel, generator compliance template review - 2019.
21 Ibid.

- if a public meeting has been requested, notify stakeholders that a public meeting will be held. At least two weeks' notice of the public meeting must be given, and
- publish a final report and submit this report to the AEMC no later than eight weeks after the period for consultation on the draft report has closed.

1.4 Review process

The review has been progressed according to the following timeline:

- Review initiated - 13 March 2019
- Stakeholder survey conducted - March - April 2019
- Technical reference group meeting - 5 July 2019
- Publication of a draft report - 19 September 2019
- Publication of a final report - 19 December 2019

The Panel engaged GHD Pty Ltd (GHD) to support the review and conduct initial consultation with stakeholders. GHD conducted a survey of stakeholders on the Panel's behalf which included market bodies and market participants. A balance of generation technology types and new and existing market participants were included to provide a range of views and experiences. Network service providers, AEMO, and the AER were also represented.

Building on the feedback gained through the stakeholder survey, GHD then developed an initial set of recommended changes to the template. Those changes were further refined following feedback from members of a technical working group convened by the Panel. The working group was made up of representatives from the AER, AEMO, the Panel, and representatives from members of the Clean Energy Council, Energy Networks Australia, and the Australian Energy Council.

On 19 September 2019 the Panel published a draft report setting out recommendations for changes to the template. The Panel's draft recommendations significantly reflected those made by GHD in their report to the Panel and considered by the technical reference group. Following publication of the draft report five submissions were received from:

- AEMO
- Snowy Hydro
- TasNetworks
- Hydro Tasmania, and
- the Clean Energy Council (CEC).

Stakeholder submissions were generally supportive of the changes proposed in the draft report. A number of issues were raised and changes proposed. Each of these issues and changes are addressed in sections 3 and 4 of this final report. Stakeholder submissions are available on the review's homepage.[22]

No request was received for a public hearing.

22 https://www.aemc.gov.au/market-reviews-advice/generator-compliance-template-review-2019

2 ASSESSMENT FRAMEWORK

This section describes the assessment framework that the Panel has applied in undertaking this review. This includes a description of the Panel's general approach to conducting reviews of the template, the National Electricity Objective, and the assessment principles used applied by the Panel in coming to its draft decisions.

2.1 Panel's general approach to reviews of the template

The template is designed to assist registered participants who own or operate generating systems with developing and designing programs to demonstrate ongoing compliance with relevant performance standards. It is also intended to assist the AER with the enforcement and monitoring of the generators compliance with the technical requirements under the NER.

The template supports a flexible application of compliance programs within appropriate controls. It does not provide a prescriptive list of compliance choices. This is because the template covers different generation technologies, newly connecting and existing generation of varying types and ages. Because of its wide application, some flexibility in the compliance process is needed to accommodate the varying capabilities, types, and ages of the generators connected to the network.

A sufficiently flexible, and regularly reviewed, template may also provide for new technologies that enter the electricity market and other changes in future circumstances. Such flexibility help to minimise potential barriers to entry to the market that may exist for new generators in regards to demonstrating compliance with performance standards.

Accordingly, the Panel's review of the template considered:

- the clarity of the template
- balancing prescription and flexibility, and
- usefulness of the template in supporting compliance.

Each of these principles is further described in section 2.3.

2.2 National Electricity Objective

The Panel is required to have regard to the NEO in conducting the review. The NEO is set out in section 7 of the NEL as follows:

"The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

(a) price, quality, safety, reliability and security of supply of electricity;and

(b) the reliability, safety and security of the national electricity system."

For this review, the relevant aspect of the NEO is the efficient operation of electricity services for the long term interests of consumers of electricity, with respect to the security of the national electricity system.

2.3 Assessment principles

In its consideration of the NEO, the Panel also has had regard to the following factors in its review of the template.

Clarity of the template

The template should provide assistance to generators in developing compliance programs as required under the NER, and the AER in carrying out its compliance functions. Any amendments to the template should clarify how the provisions in the template should be applied to give effect to the template's overall role and purpose. The template may also help generators develop performance standard compliance programs that include monitoring procedures that they consider to be consistent with 'good electricity industry practice'.[23]

Balancing prescription and flexibility

The template should be able to be flexibly applied within appropriate controls. It should be sufficiently flexible to accommodate different generation technologies, and a broad range of generation plants which may have unique attributes and varying requirements. At the same time, the template should provide a basis for generators to develop compliance programs that are suited to their facilities, as required under the NER.

Compliance principles

To provide clarity on the development of the template and its application by generators and the AER, the Panel has regard to ten compliance principles when assessing potential amendments to the template. These principles are:

- Principle 1: Where plant system performance may be variable with time, as for example with plant protection, control and alarm (PCA) systems, generators are accountable for managing the functionality and integrity of systems and settings in accordance with the performance standards compliance program.
- Principle 2: The corollary of Principle 1 is that where plant parameters are not subject to variability with time, the compliance regime should be restricted to confirmation that the plant continues to perform as intended with repeat testing when there are reasonable grounds to believe that the plant performance may have changed.
- Principle 3: The materiality of the issue must be considered when contemplating a compliance testing regime.
- Principle 4**:** A generator's active use and implementation of a compliance program that is consistent with the approved template and the generator's compliance management framework will provide a reasonable assurance of compliance with the generator's registered performance standards.

23 Chapter 10 of the NER defines "good electricity industry practice" to mean: "The exercise of that degree of skill, diligence, prudence and foresight that reasonably would be expected from a significant proportion of operators of facilities forming part of the power system for the generation, transmission or supply of electricity under conditions comparable to those applicable to the relevant facility consistent with applicable regulatory instruments, reliability, safety and environmental protection. The determination of comparable conditions is to take into account factors such as the relative size, duty, age and technological status of the relevant facility and the applicable regulatory instruments."

- Principle 5**:** The template must therefore support the development of compliance programs which represent "good electricity industry practice". The template should specify the objectives and outcomes to be achieved by the testing or monitoring, and an appropriate test interval. The generator should exercise diligence and good electrical industry practice to determine the detailed methods and procedures to be employed for its plant.
- Principle 6**:** The compliance testing regime must be efficient, and reflect an equitable balance between risk management and the risk created by the test regime itself.
- Principle 7**:** Where appropriate, analysis of performance during an event or disturbance could be used to demonstrate compliance in lieu of a performance test.
- Principle 8**:** Where compliance to a performance standard cannot be directly tested, the compliance program should include a range of other compliance testing methods to provide reasonable assurance that the performance standard continues to be met.
- Principle 9**:** When developing a compliance program and operating under that program, a generator can only be reasonably held accountable for the compliance of its plant to its registered performance standards and to equipment settings approved or provided by AEMO and/or the transmission network service provider.
- Principle 10**:** Compliance programs should be reviewed and updated periodically.

3 TEMPLATE CHANGES IN RESPONSE TO THE GTPS RULE

The GTPS rule introduced significant changes to the generator performance standard in October 2018.[24] To identify adjustments to the template necessary to reflect these changes, GHD completed an initial review of the template against the updated generator performance standards. GHD's initial analysis was then consulted on via the stakeholder survey and the review's technical working group.

The Panel's found that existing methods described in the template were generally suitable for assessing ongoing compliance, considering the changes introduced through the GTPS rule. While the GTPS rule introduced more detailed and in some case more onerous generator performance standards, compliance with those revised performance standards can generally be assessed under existing test methods specified in the template.

The Panel's identified two areas as requiring adjustment to reflect changes made in the GTPS rule. Specifically, the methods for assessing compliance for performance standards S5.2.5.5 and S5.2.5.13. The following sections outline the Panel's final decisions in respect of these two performance standards given stakeholder views provided in submissions.

3.1 Recommendations on compliance with S5.2.5.5

S5.2.5.5 specifies the performance requirements for generating systems to ride through disturbances. The GTPS rule changed S5.2.5.5 to require a generating system to ride through multiple disturbances as well as requiring a generating system to inject or absorb reactive current to support power system voltages during a fault.

To incorporate these changes, the Panel's final recommendation is for changes to template arrangements in the following areas:

- Suggested frequency of testing in method 3
- Defining major event, significant disturbance, major disturbance

3.1.1 Definition of major event, significant disturbance, major disturbance

Existing methods for assessing response to disturbances following contingency events under S5.2.5.5 include requirements to investigate plant performance following 'significant disturbances' and 'major events'. The template also referred to 'major disturbance' in a number of areas.[25] None of these terms were defined in the existing template. The Panel identified uncertainty in interpreting what constitutes a 'major event', 'significant disturbance', or 'major disturbance' as an issue creating for generators in applying the template.

Draft recommendation

24 Additional information on the changes made in the GTPS rule can be found on the Commission's website at https://www.aemc.gov.au/rule-changes/generator-technical-performance-standards

25 S5.2.5.4 makes reference to a major voltage disturbance, S5.2.5.11 makes reference to major frequency disturbance.

The Panel's draft recommendation was to amend the template to define 'major event', 'significant disturbance', and 'major disturbance. The Panel decided to clarify the meaning of these terms in the template by adding the following definitions:

- *Significant disturbance* for the purposes of this template means a power system disturbance that significantly varies frequency, voltage or power quality at the connection point beyond normal system conditions. Significant disturbances provide a trigger for investigating plant trips to assess whether the trip indicates an inability of the generating system to remain in continuous uninterrupted operation as required by its performance standard.
- *Major disturbance* for the purposes of this template means a power system disturbance that the generator considers will provide a significant test of the ability of the generating system to remain in continuous uninterrupted operation as required by its performance standard, and
- *Major event* for the purposes of this template means an event on the power system that the generator considers best tests the ability of the generating system to meet its performance standard.

Stakeholder submissions

In its submission to the draft report, TasNetworks agreed with the rationale for changes to definitions such as 'major event', but considered the definitions included in the draft report were not totally clear and could be open to interpretation. TasNetworks suggests further detail be included in these definitions and/or be supplemented with further examples and context in the final report.[26]

Final recommendation

The Panel notes TasNetwork's request for further clarity and explanation on the respective function and role of the proposed definitions of 'major event', 'significant disturbance', 'major disturbance proposed'. To address TasNetworks concerns, the Panel considers additional guidance on these terms to be justified.

In addition to the following definitions of 'significant disturbance', 'major disturbance', and 'major event' the Panel recommends the following additional guidance, set out in the box below, explaining 'major disturbance', and 'major event' to assist stakeholders differentiate these terms from 'significant disturbance'.

RECOMMENDATION 1: FINAL RECOMMENDATIONS ON THE DEFINITION OF MAJOR EVENT, SIGNIFICANT DISTURBANCE, MAJOR DISTURBANCE

The Panel's final recommendation is to amend the template to define 'major event', 'significant disturbance', and 'major disturbance' as follows:

26 TasNetworks, submission to the draft report, p. 1.

- *Significant disturbance* for the purposes of this template means a power system disturbance that significantly varies frequency, voltage or power quality at the connection point beyond normal system conditions. Significant disturbances provide a trigger for investigating plant trips to assess whether the trip indicates an inability of the generating system to remain in continuous uninterrupted operation as required by its performance standard.
- *Major disturbance* for the purposes of this template means a power system disturbance that the generator considers will provide a significant test of the ability of the generating system to remain in continuous uninterrupted operation as required by its performance standard, and
- *Major event* for the purposes of this template means an event on the power system that the generator considers best tests the ability of the generating system to meet its performance standard.

The Panel's final recommendation is also to provide additional guidance to stakeholders in the interpretation of these defined terms. This additional guidance is set out below and will provide the following explanation of 'major event', and 'major disturbance' to assist stakeholders differentiate these terms from 'significant disturbances'.

- Unlike significant disturbances, *major disturbances* may not coincide with a plant trip. The template uses the term 'major disturbance' with methods that assess performance using high speed monitoring. These methods often require periodic assessment of performance and the major disturbance definition is intended to differentiate from significant disturbance requiring the generator to select a disturbance in the period that best tests the ability to meet the continuous uninterrupted operation obligations.
- *Major event* is used in the template for the methods to assess compliance with S5.2.5.5 response to disturbance following contingency events, S5.2.5.6 Quality of electricity generated and continuous uninterrupted operation, and S5.2.5.14 Active Power Control. The definition is intended to focus the compliance assessment on the event that provide the best test of the ability to meet their performance standards. The event will generally result in a major disturbance but this may not always be the case. Therefore the definition does not limit major events to just those that result in major disturbances.

3.1.2 Suggested frequency of testing in method 3 in S5.2.5.5

Method 3 of S5.2.5.5 provides for continuous monitoring using high speed recorders. The existing template suggested that method 3(a) be applied "on disturbances when the plant trips or at least one major event every 3 years". The testing frequency suggested for method 3(a) indicates that it would be adequate to just review performance following disturbances where the plant trips or to just test performance for one major event every 3 years, or some combination of these.

To confirm compliance with the new reactive current injection and absorption requirements under S5.2.5.5 of the GTPS rule, performance also needs to be assessed when the

generating system rides through the disturbance and not only on occasions when the plant trips. If compliance assessments only review performance following plant trips, performance may not be assessed for events where the generating system rides through the disturbance.

Draft recommendation

The Panel's draft recommendation was to amend the suggested frequency of testing under S5.2.5.5 for method 3(a), (applying to continuous monitoring using high speed recorders) to suggest testing occur "When the plant trips during or immediately following a significant voltage disturbance and at least one major event every 3 years when the generating system maintains continuous uninterrupted operation"

The Panel considered that changing the or, to an and, in the suggested testing frequency would clarify that assessments should also be performed when the generating system successfully rides through disturbances. This change would provide a basis on which to assess the compliance of generating system reactive current injection and absorption performance against amended performance standard obligations.

Stakeholder submissions

No stakeholders commented on the Panel's draft recommendation.

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation which is to amend the suggested frequency of testing under S5.2.5.5 for method 3(a) as indicated in the box below.

RECOMMENDATION 2: FINAL RECOMMENDATION FOR THE SUGGESTED FREQUENCY OF TESTING IN METHOD 3 IN S5.2.5.5

The Panel's final recommendation is to amend the suggested frequency of testing under S5.2.5.5 for method 3(a) to:

- When the plant trips during or immediately following a significant voltage disturbance and at least one major event every 3 years where the generating system maintains continuous uninterrupted operation.

3.2 Assessing compliance with S5.2.5.13

S5.2.5.13 specifies performance requirements for control of voltage and reactive power. The GTPS rule made a number of changes to performance requirements under S5.2.5.13 including a requirement for a generator connecting at the automatic access standard to have facilities to control reactive power in multiple modes being reactive, power factor, or voltage control modes.[27] The amended automatic access standard also requires generators to be able to switch between control modes.[28]

27 Clause S5.2.5.13(b)(2A) of the NER.

S5.2.5.13, as amended by the GTPS rule change, draws a distinction between a newly connecting generator having the capability to operate in multiple reactive power control modes and having those modes commissioned and in operation. While a generator connecting at the automatic access standard is required to have facilities allowing operation in all reactive power control modes,[29] it is only required to be able to operate in a set of modes that AEMO and the NSP require to be commissioned.[30] The rules require an initial operating mode, and other operating modes, to be recorded as part of the performance standard.

This section sets out the Panel's final recommendations to amend the template to address these new requirements by clarifying:

- compliance testing of multiple reactive power control modes, and
- suggested test frequency for primary and secondary control modes

3.2.1 Compliance testing of multiple reactive power control modes

The test methods specified in the existing template do not currently contemplate a scenario where a generating system might be required to operate in multiple reactive power control modes and switch between control modes on request. In order to align template provisions with amended technical standard requirements, the draft report proposed updates to the template test methods in S5.2.5.13.

Draft recommendations

The Panel considered a generator which is required to have control systems configured and commissioned to operate in the different reactive power control modes, and be able to switch between these modes on line / in real time, should validate the ongoing ability to deliver this control. If on the other hand the generator was only required to demonstrate that capability exists for multiple control modes, but to operate in the single control mode agreed with AEMO and the NSP, the Panel considered it reasonable for compliance assessments to only consider the single commissioned control mode.

The Panel's draft recommendation was to clearly provide for the testing of multiple reactive power control modes by adding the following note to the methods under S5.2.5.13 - "Tests should address all control modes listed in the generator performance standard as commissioned control modes."

Stakeholder submissions

No stakeholders commented on the Panel's draft recommendation.

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

---

28 Clause S5.2.5.13(g1) of the NER.
29 Clause S5.2.5.13(b)(2A) of the NER.
30 Clause S5.2.5.13(g1) of the NER.

RECOMMENDATION 3: FINAL RECOMMENDATION FOR COMPLIANCE TESTING OF MULTIPLE REACTIVE POWER CONTROL MODES

The Panel's final recommendation is to clearly provide for the testing of multiple reactive power control modes by adding the following note to the methods under S5.2.5.13:

- Tests should address all control modes listed in the generator performance standard as commissioned control modes.

3.2.2 Test frequency applying to primary and secondary control modes

S5.2.5.13, as amended by the GTPS rule, draws a distinction between a newly connecting generator having the capability to operate in multiple reactive power control modes and having those modes commissioned and in operation. The GTPS rule requires an initial operating mode, as agreed by AEMO and the NSP, to be specified in the connection agreement separate from other available modes.[31] These other available modes may be considered secondary commissioned operating modes that are only periodically required by AEMO and the NSP.

Draft recommendation

In making its draft recommendation, the Panel appreciated that generating systems will generally operate in a single reactive power control mode. While all required reactive power control modes should be subject to compliance testing, the Panel considered that the template should provide for reduced test frequency for control modes that the generator is seldom instructed to use.

The Panel's draft recommendation was to amend the suggested frequency of testing in S5.2.5.13 method 1 to suggest a test frequency of "every 4 years and after plant change. Testing frequency may be reduced for modes that are not routinely used to control the output of the generator."

Stakeholder submissions

No stakeholders commented on the Panel's draft recommendation.

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

RECOMMENDATION 4: FINAL RECOMMENDATIONS FOR TEST FREQUENCY APPLYING TO PRIMARY AND SECONDARY VOLTAGE CONTROL MODES

The Panel's final recommendation is to amend the suggested frequency of testing in

31 Clause S5.2.5.13(g1) of the NER.

S5.2.5.13 method 1 to suggest a test frequency of:

- every 4 years and after plant change. Testing frequency may be reduced for modes that are not routinely used to control the output of the generator.

4 OTHER CHANGES TO THE TEMPLATE

In addition to changes to address the GTPS rule change, the Panel made draft recommendations in response to issues identified by GHD and stakeholders through the survey and technical reference group.

This section presents the Panel's draft recommendations, key stakeholder views, and final recommendation in the following areas:

- Feasibility of testing full reactive power capability
- Performance of remote equipment
- Frequency of testing for S5.2.5.3
- References to the definition of plant change
- Fault throw test viability
- Clarifying 'appropriate metering'
- Frequency of testing for S5.2.5.7
- Definition of 'plant change'
- Alignment with Power System Models
- Notification of non-compliance process, and
- Removing technology bias.

The Panel's draft recommendations in respect of each of these issues are grouped according to the performance standards they primarily relate to.

4.1 Other changes applying to S5.2.5.1

S5.2.5.1 is the performance standard that specifies the reactive power capability required from a connecting generator. This section discusses and presents the Panel's final recommendations for two issues identified in respect of S5.2.5.1. These are:

- feasibility of testing full reactive power capability, and
- performance of remote equipment

4.1.1 Feasibility of testing full reactive power capability

S5.2.5.1 methods 1, 2 and 3 test a generating system's reactive power capability by adjusting the reactive power output to the maximum level agreed in the performance standard. These methods require the entire reactive power range of the generating system to be exercised.

Reactive power capability tests have implications for voltages in the power system and by extension system security during the test period. Methods 1, 2 and 3 specified for S5.2.5.1 may therefore not be achievable for some generators due to the impact on power system voltages. For large power stations with a single generating unit or for wind and solar farms

connected into relatively weak areas of the network, the network may not be able to accommodate the full reactive power range without breaching voltage limits.[32]

Draft recommendation

In developing its draft recommendation, the Panel noted that circumstances exist where the network is not always able to accommodate a generating system's full reactive power capability without adverse system impacts. In these circumstances, prior approval by the NSP and AEMO should be sought well in advance to have the best chance of being able to perform the test without creating adverse outcome for the network and surrounding power system. Stakeholder feedback confirmed that even with advanced notice, testing involving full reactive power range may not be possible.

The Panel did not consider generator compliance testing should present a risk to system security by producing network voltages that exceed limits. The Panel's draft recommendation was therefore to amend the basis for compliance assessment for methods 1, 2 and 3 of S5.2.5.1 to require a generating system to "be capable of achieving reactive power requirements of the performance standards, subject to not exceeding network voltage limits."

Stakeholder submissions

No stakeholders commented on the Panel's draft recommendation.

Final recommendations

The Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

RECOMMENDATION 5: FINAL RECOMMENDATIONS FOR THE FEASIBILITY OF TESTING FULL REACTIVE POWER CAPABILITY

The Panel's final recommendation is to amend the basis for compliance assessment for methods 1, 2 and 3 of S5.2.5.1 to require a generating system to:

- be capable of achieving reactive power requirements of the performance standards, subject to not exceeding network voltage limits.

4.1.2 Performance of remote equipment

S5.2.5.1 allows for performance standards to be met by reactive plant installed beyond the connection point. S5.2.5.1 specifically provides for a negotiated access standard that allows a generator to meet an agreed level of performance by funding the provision of reactive power capability via plant and equipment installed at a location which differs from the connection point.[33]

32 Generating systems with multiple units may be able to safely conduct such tests by using one unit to absorb reactive power produced by the unit under test, or using another unit to produce the reactive power being absorbed by the unit being tested.

33 Clause S5.2.5.1(d) of the NER.

The existing template didn't contemplate the performance of plant and equipment installed at a location which differs from the connection point in assessing compliance. This may be an issue if the performance of the generating system relies on the output of remotely located plant. If the remotely located plant is either unavailable or not performing as required, the generator may be unable to meet its performance standard requirements.

Draft recommendation

The Panel considered that all plant critical to achieving required levels of generating system performance should be subject to an appropriate compliance assessment process. The Panel however considered the obligation for developing and executing a compliance program for off-site plant should lie with the owner and operators of the off site asset rather than the generator itself.[34]

The Panel considered the generator's operating procedures should provide for the output of the generating system to be adjusted as necessary if the remote plant is unavailable. The performance standard, connection agreement or operating protocol should therefore specify an obligation for the operator of the remote plant to inform the generator if the plant is not available and control actions that the generator should take in response. The generator's compliance program should confirm this control scheme continues to operate as specified.

The Panel's draft recommendation was therefore to include a new section 2.8 in the template providing the following guidance for generators on this point:

- "Some of the performance standards specified in section S5.2.5 allow a generator to provide plant and equipment at the connection point that delivers a level of performance which is lower than the level of performance acceptable to AEMO and the relevant TNSP provided the generator arranges the provision of additional capability via plant and equipment located elsewhere in the power system. For example, S5.2.5.1 allows a generator to fund the provision of additional reactive power capability via plant and equipment installed at a location which differs from the connection point. The compliance program developed by the generator may not be required to assess the ongoing ability of the remote plant and equipment. Where a control system has been installed to ensure correct operation of the generator, should the remote equipment be unavailable, the functionality of that control system should be tested as part of the generator compliance program."

Stakeholder submissions

No stakeholders commented on the Panel's draft decision on this issue.

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

34 This applies to the case where the generator has contracted with the NSP or reached a commercial agreement with another market participant to provide the off-site facilities.

RECOMMENDATION 6: FINAL RECOMMENDATIONS FOR THE PERFORMANCE OF REMOTE EQUIPMENT

The Panel's final recommendation is to include a new section 2.8 in the template providing the following guidance for generators:

- "Some of the performance standards specified in section S5.2.5 allow a generator to provide plant and equipment at the connection point that delivers a level of performance which is lower than the level of performance acceptable to AEMO and the relevant TNSP provided the generator arranges the provision of additional capability via plant and equipment located elsewhere in the power system. For example, S5.2.5.1 allows a generator to fund the provision of additional reactive power capability via plant and equipment installed at a location which differs from the connection point. The compliance program developed by the generator may not be required to assess the ongoing ability of the remote plant and equipment. Where a control system has been installed to ensure correct operation of the generator, should the remote equipment be unavailable, the functionality of that control system should be tested as part of the generator compliance program."

4.2 Other changes applying to S5.2.5.3

S5.2.5.3 is the performance standard that applies to generating system response to frequency disturbances. This section discusses and presents the Panel's final recommendation on the following issues relevant to S5.2.5.3:

- clarification of test frequency, and
- references to the definition of plant change

4.2.1 Clarification of test frequency

S5.2.5.3 method 4(a) has a suggested test frequency of "every 3 years and after plant change". This provision does not provide guidance on the event trigger for testing. It is therefore unclear when in this 3 yearly period testing should occur.

Draft recommendation

The Panel considered that clarity was required on this point. In particular, the Panel considered that there needed to be a clear event trigger for S5.2.5.3 compliance testing. The Panel's draft recommendation was therefore to provide additional guidance on the suggested frequency of testing for method 4(a) of S5.2.5.3.

The Panel recommended the suggested frequency of testing under method 4(a) of S5.2.5.3 be clarified as being: "every three years by reviewing the response to a disturbance where the system frequency moves outside of the operational frequency tolerance band and after plant change."

Stakeholder submissions

No stakeholders commented on the Panel's draft recommendation.

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

> RECOMMENDATION 7: FINAL RECOMMENDATIONS FOR THE CLARIFICATION OF TEST FREQUENCY
>
> The Panel's final recommendation is for the suggested frequency of testing under method 4(a) of S5.2.5.3 be clarified as being:
>
> - every three years by reviewing the response to a disturbance where the system frequency moves outside of the operational frequency tolerance band and after plant change.

4.2.2 References to the definition of plant change

Plant change is defined in section 2.9 of the existing template and covers both changes to primary plant and changes to control and protection systems as types of plant change. In addition to this definition, which applies to all parts of the template, the suggested frequency of testing in method 3 of S5.2.5.3 requires testing following plant change "which may include control system settings or protection system change." Other references to plant change in the template do not include this stipulation.

Draft recommendation

The Panel considered it unclear why S5.2.5.3 method 3 in the template stipulated this requirement which is already covered by the overarching definition of plant change. The Panel considered this specific reference to control system settings and protection system change as types plant change in method 3 of S5.2.5.3 to be unnecessary and risk creating confusion.

The Panel's draft recommendation was therefore to remove the specific reference to "control system settings or protection system change" as types of plant change from the suggested frequency of testing under method 3 of S5.2.5.3.

Stakeholder comments

TasNetworks supported the removal of the excess stipulation surrounding the definition of plant change and considers this will avoid unnecessary confusion with this term.[35]

Final recommendation

Noting support in TasNetworks submission, the Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

35 TasNetworks, Submission to the draft report, p. 1

RECOMMENDATION 8: FINAL RECOMMENDATIONS FOR THE DEFINITION OF PLANT CHANGE

The Panel's final recommendation is to remove the specific reference to "control system settings or protection system change" as types of plant change from the suggested frequency of testing under method 3 of S5.2.5.3.

4.3 Other changes applying to S5.2.5.5

S5.2.5.5 is the performance standard that applies to generator response to disturbances following a power system contingency event. In addition to changes made to address the GTPS rule, the Panel made a draft recommendation applying to method 1 of S5.2.5.5 (direct testing by instigating a network trip). The Panel's final recommendation on this issue is presented in this section.

4.3.1 Fault throw test viability

Method 1 of S5.2.5.5 in the existing template required direct testing of performance by initiating a network trip. As 'network trip' was not defined in the template, the exact nature of this test was unclear. As initiating a network switching event in the absence of a fault is not considered to be a valid disturbance for testing compliance, 'performance by initiating a network trip' appears to require the deliberate application of a network fault (i.e. a fault throw test).

A fault deliberately applied to the network creates risks for power system security. A fault throw test should therefore not be conducted unless it is in a highly controlled manner with close involvement of both AEMO and the relevant NSP. GHD and stakeholders questioned whether such a test is advisable and appropriately undertaken as part of a generator's compliance testing regime.

Draft recommendation

The Panel noted that there are circumstances where a fault throw test may be appropriate. In particular, TasNetworks uses fault throw tests as part of the commissioning process for new generators. TasNetworks uses fault throw tests in commissioning given the criticality of such events within the Tasmanian network and the importance of being able to verify the measured generator response against the modelled response. In carrying out this test however, TasNetworks minimises the risk to system security and sets the network up under optimal test/control conditions.

While TasNetworks may use fault throw tests in commissioning new generators, the Panel noted that ongoing generator compliance testing is not comparable to commissioning testing. The Panel therefore did not consider the use of fault throw tests to be justified for generator compliance testing given the system security risks involved.

In developing its draft recommendation, the Panel was also not able to identify circumstances in which generators were using fault throw tests to assess compliance with S5.2.5.5. For

these reasons, the Panel's draft recommendation was to remove method 1 for S5.2.5.5 (requiring direct testing of a generator response to disturbance by instigating a network trip) from the template.

Stakeholder submissions

No stakeholders commented on the Panel's draft recommendation.

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

> RECOMMENDATION 9: FINAL RECOMMENDATIONS FOR FAULT THROW TEST VIABILITY
>
> The Panel's final recommendation is to remove method 1 for S5.2.5.5 (requiring direct testing of a generator response to disturbance by instigating a network trip) from the template.

4.4 Other changes applying to S5.2.5.6

S5.2.5.6 is the performance standard relating to the quality of electricity generated and continued uninterrupted operation. S5.2.5.6 specifies a requirement for generating systems to remain in continuous uninterrupted operation provided the power quality at the connection point remains within the level specified in the system standard. The Panel made a draft recommendation related to clarifying the meaning of 'appropriate metering' for the measurement of power quality. This section presents the Panel's final recommendation on this issue.

4.4.1 Clarifying 'appropriate metering'

Methods 1 and 2 of S5.2.5.6 specifies the monitoring of in-service performance using 'appropriate metering', however the term 'appropriate metering' is not defined. The Panel therefore identified uncertainty as to what types of metering and metering equipment qualifies as 'appropriate metering' for compliance testing of power quality.

The Panel also identified stakeholder views that appropriate metering has been generally interpreted to mean power quality metering. In addition to specialised power quality metering however, the Panel was made aware that high speed monitoring systems can provide continuous power quality measurements which may also be considered to be 'appropriate metering'.

Draft recommendation

In developing its draft recommendation, the Panel noted that metering power quality requires accurate harmonic measurements made using appropriate measurement transformers. Some commonly used measurement transformers, such as indicative voltage transformers, were noted as not being able to provide accurate measurement of harmonics at higher orders.

Metering using such measurement transformers may therefore not be appropriate metering irrespective of the measurement system being utilised.

The Panel's draft recommendation was therefore to provide further guidance on what constitutes 'appropriate metering' for the measurement of power quality under methods 1 and 2 of S5.2.5.6. Specifically, the Panel's draft recommendation was that suitable testing and monitoring methodology be revised to read: "monitoring in-service performance using power quality meters supplied via measurement transformers and transducers with sufficient frequency bandwidth."

Stakeholder submissions

No stakeholders commented on the Panel's draft recommendation.

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

> RECOMMENDATION 10: FINAL RECOMMENDATIONS FOR CLARIFYING 'APPROPRIATE METERING'
>
> The Panel's final recommendation is to amend the suitable testing and monitoring methodology listed for methods 1 and 2 of S5.2.5.6 to require the use of power quality meters supplied via measurement transformers and transducers with sufficient frequency bandwidth.

4.5 Other changes applying to S5.2.5.7

S5.2.5.7 is the technical performance standard applying to partial load rejection, which is the ability of a generating system to rapidly reduce generation in response to a rapid reduction in power system load. The Panel made a draft recommendation to clarify the frequency of testing specified in S5.2.5.7 method 1(a) and 3(a) and the event definition in method 3(a). This section presents the Panel's final recommendations on these issues.

4.5.1 Frequency of testing for S5.2.5.7

Suggested frequency of testing in the existing template is not consistent across methods. Method 1(a) of S5.2.5.7 in the existing template suggested testing occur "on every event where the frequency moves beyond the operational frequency tolerance band or every five years whichever is more frequent". Method 3(a) of S5.2.5.7 in contrast suggests testing "on every event or 10 years (whichever is more frequent) as appropriate to the technology of the relevant subsystem." Method 1(a) therefore includes an event trigger for testing, being a frequency excursion beyond 51 Hz on the mainland, and a default test frequency of 5 years. Method 3(a) on the other hand does not include an event trigger and utilises a default test period of 10 years.

Draft recommendation

The Panel considered whether the suggested testing frequency be unified for methods 1(a) and 3(a) to be a frequency excursion beyond 51 Hz on the mainland, and a 5-year default test period applied to both. In developing its draft recommendation, the Panel considered the implications of this change and whether this constituted an unreasonably high test burden.

The Panel considered that requiring testing on every event where the frequency moves beyond the operational frequency tolerance band is unlikely to represent an unreasonable test burden. Events where the frequency moves outside the operational frequency tolerance band are a relatively rare occurrence in the NEM, typically only occurring due to very large non-credible contingency.

In addition, section 2.7 of the template allows generators to utilise a testing frequency different from that suggested if justifiable. Therefore, unifying the test frequency and trigger requirements in methods 1(a) and 3(a) of S5.2.5.7 should not represent an undue additional burden for generators that can show that a more frequent test regime is not required by their plant.

The Panel's draft recommendation was therefore to amend the frequency of testing advice for Method 3(a) to read "on every event where frequency moves out of the operational frequency tolerance band or every 5 years (whichever is more frequent) and after plant change as appropriate to the technology of the relevant sub-system".

Stakeholder submissions

No stakeholders commented on the Panel's draft recommendation.

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

RECOMMENDATION 11: FINAL RECOMMENDATIONS FOR THE FREQUENCY OF TESTING IN S5.2.5.7

The Panel's final recommendation is to amend the frequency of testing advice for Method 3(a) of S5.2.5.7 to read:

- on every event where frequency moves out of the operational frequency tolerance band or every 5 years (whichever is more frequent) and after plant change as appropriate to the technology of the relevant sub-system.

4.6 Other changes applying to S5.2.5.13

S5.2.5.13 specifies performance requirements for control of voltage and reactive power. The Panel did not make a draft recommendation for any further changes to the template related to this NER clause, other than those specified in section 3.2 relating to updating the template to account for the GTPS rule.

In its submission to the Panel's draft report, Hydro Tasmania proposed an additional test method covering high speed monitoring for S5.2.5.13.

Stakeholder submissions

Hydro Tasmania proposed the addition of a specific method of high speed monitoring be added to bring S5.2.5.13 in line with the test methods for Clause S5.2.5.11 (frequency control), which includes high speed monitoring as a test method. Hydro Tasmania considered this change appropriate, as both utilise modern digital governor and excitation systems and their associated models provide the same technological capabilities to leverage off. In particular, Snowy Hydro proposed a new method 4 for S5.2.5.13 set out in the following figure:[36]

Performance Standard	Suitable testing and monitoring methodology	Suggested frequency of testing	Notes	Basis for compliance assessment
S5.2.5.13	Method 4 (of 4): Monitor in-service performance using high speed frequency data	After every major voltage disturbance	Appropriate to use where high speed monitors are available and models have been used in establishing compliance	Consistency of operation with the latest plant model provided in accordance with clause S5.2.4 if the models are available; OR consistency with past performance only if the models are not available

Final recommendation

The Panel considers it important to clarify the use of high speed monitoring as an applicable test method for demonstrating compliance with S5.2.5.13. The Panel is not aware of any technical reason why high speed monitoring is unable to assess performance with the requirements of S5.2.5.13 as long as configured appropriately.

The Panel however considers that the existing template already provides for high speed monitoring to demonstrate compliance with S5.2.5.13. Specifically, method 3 for S5.2.5.13 provides for the assessment of compliance using data captured by digital protection relays or other data logging equipment as required. While this method does not explicitly cite 'high speed monitoring', high speed monitors may be considered a form of data logging equipment and included under method 3.

The Panel has a general preference not to add additional methods that overlap with existing methods where clarification as to the interpretation of existing methods is an alternative. The

36 Hydro Tasmania, Submission to the draft report, p. 1.

Panel therefore considers there to be a case for clarifying that high speed monitoring is acceptable under method 3.

The Panel's final recommendation is therefore to clarify the applicability of high speed monitoring under method 3 by amending the suitable testing and monitoring methodology for method 3.

> RECOMMENDATION 12: FINAL RECOMMENDATIONS FOR AN AMENDED METHOD 3 FOR S5.2.5.13
>
> The Panel's final recommendation is for method 3 of S5.2.5.13 to read: "Performance of relevant sub- systems will be monitored using the following systems: high speed monitors, digital protection relays or; other data- logging equipment as required."
>
> Notes are to confirm that the test method is applicable to synchronous generators with appropriate monitoring systems installed and models have been used in compliance.

4.7 Other changes to template provisions

The Panel made draft recommendations on a range of changes of a general nature, and not specific to a particular performance standard. This section presents the Panel's final recommendations on the following:

- definition of plant change
- alignment with Power System Models
- notification of non-compliance process, and
- removing technology bias.

4.7.1 Alignment with power system models

A number of methods rely on use of "plant models used to establish initial compliance" to assess compliance against the performance of a model of the plant. These include method 2 of S5.2.5.3, method 2 of S5.2.5.4, method 3 of S5.2.5.5, method 1 of S5.2.5.8, methods 1 and 3 of S5.2.5.11, method 1 of S5.2.5.12, methods 1, 2, and 3 of S5.2.5.13 and method 3 of S5.2.9.

The Panel noted that "plant models used to establish initial compliance" could overlook new issues being identified through updated plant models. The Panel also noted stakeholders concern that a greater emphasis should be placed on ensuring that compliance testing not only acts to ensure the agreed performance standards are met, but also that the agreed generating system models used to verify those standards remain accurate.

The Panel was also made aware that testing performed during the R2 generator commissioning stage often does not sufficiently validate a generator model. This can arise if significant system events did not occur during the test period. The Panel considered that

when this occurs, it is reasonable to expect a generator to consider the need to finalise the model validation by collecting data via the compliance program.

Draft recommendation

The Panel agreed with stakeholder concerns and considered the use of up to date models to be necessary for establishing ongoing compliance. In addition, the Panel considered it reasonable for guidance to be added to the template regarding the provision of additional information addressing any gaps remaining in model validation testing performed as part of commissioning and R2 testing.

The Panel's draft recommendation was therefore to:

- replace references in the template to "the plant models used to establish initial compliance with the latest plant models provided under clause S5.2.4.", and
- include a new section 2.9 of the template to provide the following additional guidance to generators regarding model validation to address any gaps in R2 commissioning as part of the generator's compliance program.

  "When establishing the compliance program, a generator should consider whether any gaps remain in the model validation performed as part of commissioning and R2 testing. This could arise if significant system events did not occur during the test period resulting in incomplete model validation. In situations where the model validation is incomplete the generator should take this into account in developing the compliance program and where appropriate choose test methods that support gathering data necessary to demonstrate compliance and complete the validation of the model."

Stakeholder submissions

AEMO's submission to the Panel's draft report considered that generators should include in their compliance programs (specifically associated with S5.2.5.5) a requirement to:[37]

- validate performance for any large disturbance (that has occurred naturally), and
- provide details and analysis including any model updates to AEMO within 3 months of this disturbance occurring.

AEMO considered this to be particularly important in the case of power electronics interfaced plants because commissioning tests generally involve small perturbations that are unlikely to initiate and test performance of control systems that activate only during large disturbances.[38]

AEMO was also of the view that generators need to adopt a practice of regularly updating the model information provided to AEMO, to make sure it fully and accurately reflects all firmware upgrades, site-specific settings changes and related other matters.[39]

AEMO also considered that, given the importance of these models, where they are missing, incomplete or out of date, the affected generators are urged to procure and provide them to

37 AEMO, submission to the draft report, p. 1
38 AEMO, submission to the draft report, p. 2.
39 Ibid.

AEMO (and the relevant NSP as the case may be) at the earliest opportunity to avoid inaccurate representation of the power system.[40]

Final recommendation

The Panel agrees with AEMO on the importance of accurate and up to date generator models given their significance for AEMO's secure operation of the power system. The Panel notes that Clause S5.2.4(d) of the NER requires generators to provide updated information to AEMO under a number of circumstances including:

- within 3 months of commissioning tests or other tests undertaken in accordance with 5.7.3
- when the generator becomes aware that the information is incomplete, inaccurate, or out of date, or
- on request by AEMO or the relevant NSP considers that the information is incomplete, inaccurate, or out of date.

The Panel's draft recommendation provided additional guidance to generators regarding testing to address any gaps remaining in model validation following commissioning and R2 testing. This recommendation should assist generators to provide fully validated models, including the response to significant and major disturbances, to AEMO within 3 months of commissioning as required by clause S5.2.4(d)(1) of the NER.

The Panel also agrees that compliance testing programs should be sufficient to detect whether the generating system model is incomplete, inaccurate or out of date. Should this be the case, the generator then faces an obligation under Clause S5.2.4(d)(2) to provide updated models to AEMO and the relevant NSP. The Panel's final recommendation is therefore to provide additional guidance to generators on their existing obligations under the NER in this area.[41]

The Panel's final recommendation is therefore to extend the guidance provided in its draft recommendation to more clearly outline requirements for generators to implement a compliance testing program sufficient to detect if the generating system model is incomplete, inaccurate, or out of date.

RECOMMENDATION 13: FINAL RECOMMENDATIONS FOR ALIGNMENT WITH POWER SYSTEM MODELS

The Panel's final recommendation is to:

- replace references in the template to "the plant models used to establish initial compliance" with "the latest plant models provided under clause S5.2.4.", and

40 Ibid.

41 AEMO's request for generators to validate performance for any large disturbance (that has occurred naturally), and provide details and analysis including any model updates to AEMO within 3 months of this disturbance occurring is considered as an issue that falls outside of the scope of this review of the generator compliance template, and would require a rule change. This is discussed further in section 5.

provide the following additional guidance for generators in section 2.9 of the template:

- When establishing the compliance program, a generator should consider whether any gaps remain in the model validation performed as part of commissioning and R2 testing. This could arise if significant system events did not occur during the test period resulting in incomplete model validation. In situations where the model validation is incomplete the generator should take this into account in developing the compliance program and where appropriate choose test methods that support gathering data necessary to demonstrate compliance and complete the validation of the model.
- Completing model validation as part of the compliance program will facilitate the generator delivering updated, validated, models to AEMO and the relevant NSP within 3 months after commissioning tests have been completed, as required under Clause S5.2.4(d)(1) of the NER.
- A generator's compliance program should be sufficient to detect situations when the model information supplied to AEMO and the relevant NSP is incomplete, inaccurate, or out of date. Generators should be aware of their obligations under Clause S5.2.4(d)(2) of the NER to provide updated model information to AEMO and the relevant NSP when the generator become aware that this is the case.

4.7.2 Definition of plant change

In developing its draft recommendation, the Panel noted stakeholders concerns relating to the existing template's definition of plant change. In particular regarding the following two key issues:

- uncertainty whether changes including replacement of a piece of equipment with an identical piece of equipment with the same performance characteristics, constituted a plant change triggering a requirement for reassessing compliance, and
- whether changes in firmware/software (which includes remotely and automatically downloaded upgrades and patches) should qualify as plant changes, given their potential to, sometimes inadvertently, change plant performance.

Draft recommendation

The Panel considered that the definition of plant change should be consistent with the triggers that give rise to a clause 5.3.9 application in the NER. Clause 5.3.9 of the NER specifies the procedure to be followed by a generator proposing to alter a generating system and includes a list of alterations to equipment which triggers a requirement to reassess performance standards. The Panel considered that consistency with rule requirements in this area would reduce uncertainty in the interpretation of plant change for compliance program purposes. The Panel's draft recommendation was therefore to clarify that changes that trigger the process described in clause 5.3.9 of the NER would also constitute a plant change for template purposes.

The Panel identified software updates to be a material issue which required generator attention and careful assessment given their potential to affect a generator's performance. The Panel considered it important to balance the timely installation of patches to ensure cyber security and the need to confirm that any such change does not impact plant performance. Additional guidance in the template was therefore justified to raise awareness of the risk of a firmware/software change changing the performance of the plant.

The Panel's draft recommendation was therefore to include the following reference into the definition of plant change:

- "A plant change may include a change to software or firmware associated with digital control and protection systems"

The Panel's draft recommendation was also to provide additional guidance alongside this definition to clarify the treatment of software and firmware changes and the applicability of clause 5.3.9 requirements.

- "The generator should pay careful attention to software and firmware changes, and carefully assess whether they have the potential to modify the performance of the generating system. A software or firmware change that is assessed as having the potential to change the performance of the generating system should be treated as a plant change. Changes to a generating system that would trigger the process described in clause 5.3.9 of the NER would also constitute a plant change."

Stakeholder submissions

AEMO's submission to the draft report supported the Panel's draft recommendations which, in the context of clause 5.3.9 of the NER, provides for additional guidance under the template as to the treatment of changes in firmware or software associated with digital control and protection systems.[42]

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation as set out in the box below.

RECOMMENDATION 14: FINAL RECOMMENDATIONS FOR THE DEFINITION OF PLANT CHANGE

The Panel's final recommendation is to:

- include the following reference into the definition of plant change to incorporate changes in software and firmware as types of plant change
  - A plant change may include a change to software or firmware associated with digital control and protection systems

42 AEMO, submission to the draft report, p. 2.

- Provide the following additional guidance to assist generators interpret the definition of plant change, including the applicability of clause 5.3.9 triggers:
  - "The generator should pay careful attention to software and firmware changes, and carefully assess whether they have the potential to modify the performance of the generating system. A software or firmware change that is assessed as having the potential to change the performance of the generating system should be treated as a plant change. Changes to a generating system that would trigger the process described in clause 5.3.9 of the NER would also constitute a plant change."

4.7.3 Removing inappropriate technology bias.

Several references to technology specific language were present in the existing template, specifically:

- Test methods for performance standards S5.2.5.8, S5.2.5.9, and S5.2.5.11 contained notes that refer to turbine control parameters when they could apply to all generating system control parameters.
- S5.2.5.8 method 3 referred to wind farms and could be re-worded to include both solar and wind farms
- S5.2.5.11 methods 2 and 4 only applied to governor systems while method 3 limited analytical simulations to turbine controls and governors. This use of the term turbine and governor could also be interpreted as excluding active power controls on batteries and solar farms.

Draft recommendation

The Panel considered that the template should be as technology neutral as possible. Technology specific references should therefore only be used when they are fundamental to the use of the methods in question. In respect to each of the points above:

- The Panel considered reference to turbine control to be inappropriately technology specific when reference to generating unit control would covey the same meaning in a technologically neutral manner. The Panel therefore decided to remove reference to turbine control from S5.2.5.8 method 3 and S5.2.5.9 method 3 and instead reference changes to generating unit control.
- In the case of method 2 in S5.2.5.8 the Panel identified that the method should be applicable to both solar and wind farms and should be expanded. The Panel therefore decided to re-word the notes provided for S5.2.5.8 method 2 to include both solar and wind farms,
- The panel identified that method 1 of S5.2.5.11 appeared to cover off the performance of "non-governor plant" such as batteries and solar, while methods 2, 3 and 4 appeared to apply specifically to those generators that have a governor system for the control of frequency. In this case the Panel considered that a reference to governor system performance was justified but should be expanded to include other non-governor control

systems. The Panel decided to amend S5.2.5.11 methods 2,3, and 4 to include a reference to "other control systems designed to arrest frequency disturbances" but retain the existing reference to governor system performance.

Stakeholder submissions and Panel feedback

Panel members provided feedback requesting that draft references in S5.2.5.11 methods 2, 3, and 4 be further generalised to cover control system action that is not limited to arresting frequency.

Final recommendation

The Panel's draft recommendation is therefore adopted as its final recommendation except for S5.2.5.11 methods 2, 3, and 4 which will be amended to refer to "other control systems designed to modulate active power in response to a frequency disturbance" rather than the draft recommendation which referred to "other control systems designed to arrest frequency disturbances".

The Panel's final recommendation is set out in the box below.

RECOMMENDATION 15: FINAL RECOMMENDATIONS FOR REMOVING INAPPROPRIATE TECHNOLOGY BIAS

The Panel's final recommendation is to:

- remove reference to turbine control from S5.2.5.8 method 3 and S5.2.5.9 method 3 and instead reference changes to generating unit control
- re-word the notes provided for S5.2.5.8 method 2 to include both solar and wind farms, and
- amend S5.2.5.11 methods 2, 3, and 4 to include a reference to "other control systems designed to modulate active power in response to a frequency disturbance" but retain the existing reference to governor system performance.

4.7.4 General overview of the compliance framework

The existing template contains section 1.3 which provides a general overview of the compliance framework relevant to the role of the template and generator compliance testing programs. Section 1.3 of the template references the AER generator performance standards, information booklet published in August 2013. The AER advised that the reference to the generator performance standards information booklet should be removed as it is no longer current and is being updated.

Draft recommendation

The Panel's draft recommendation was to remove the reference to AER's generator performance standards information booklet published in August 2013 in section 1.3 of the template.

Stakeholder submissions

In its submission to the Panel's draft report, AEMO considered it important for the template to highlight that under S5.2.2 of the NER, control or protection system settings that are necessary to comply with performance standards cannot be changed without the approval of the relevant NSP, and AEMO if involving advisory matters under clause 5.3.4A(c) of the Rules.[43]

Final recommendation

The Panel agrees with AEMO that it is appropriate for generators to be reminded of their obligations under S5.2.2 to have control or protection system settings approved by the NSP and AEMO. Approval of control system settings is particularly relevant should a generator, through its compliance testing regime, identify changes to control system settings required to maintain compliance with their performance standards.

The Panel's final recommendation is therefore to update section 1.3 (General overview of the compliance framework) to remove the reference to AER's generator performance standards information booklet published in August 2013 and provide additional guidance to generators on their NER obligation to have any changes to control and protection settings approved by the NSP and AEMO.

RECOMMENDATION 16: FINAL RECOMMENDATION FOR CHANGES TO THE GENERAL OVERVIEW OF THE COMPLIANCE FRAMEWORK

The Panel's final recommendation is to update the template to delete reference to AER's generator performance standards information booklet published in August 2013, and provide the following additional guidance in section 1.3 of the template on requirements under clause S5.2.2 of the NER:

- Generators should be aware that clause S5.2.2 of the NER requires any changes to generating system control or protection system settings identified as necessary through compliance testing to be approved by the NSP and AEMO if involving advisory matters under clause 5.3.4A(c) of the Rules.

43 AEMO, submission to the draft report, p. 2.

5 OTHER ISSUES OUTSIDE THE SCOPE OF THE TEMPLATE REVIEW

This section presents a number of issues identified during the review which are related to the generator compliance and testing but are not considered within the scope of this review of the template.

These issues are discussed here to inform possible future work programs and/or the submitting of rule change requests from interested parties. The issues noted here as being outside the scope of this review of the template are:

- Notification and information provisions
- Power system model update provisions
- High Speed Monitoring standard, and
- the role of the NSP in generator compliance testing, and development of a compliance template and registered performance standards for NSP controlled plant.

5.1 Notification and information provisions

In its draft report, the Panel noted stakeholder views that it is difficult for generators to know when a major event has occurred by solely relying on triggers, protection operations and alarms that can be generated from quantities visible to the generator, particularly if the generator successfully rode through the fault. A number of stakeholders suggested that AEMO or the NSP may be better placed to identify when major events had occurred and, if that information was published in a timely manner, it could provide effective triggers for assessing compliance of performance during major events.

In its submission to the draft report, Snowy Hydro considered that unless either Australian Energy Market Operator (AEMO) or the Transmission Network Service Provider (TNSP) advise market participants of when such an event occurs then they are unable to know when to assess their performance.[44]

The Clean Energy Council's submission to the draft report supported the intent to create a requirement on NSPs to notify generators following the occurrence of a major event. The CEC however recognised that this potential change is out of scope of the review process and would need to be developed and progressed as an independent rule change request following the completion of this process. The CEC suggested the Panel outline in its final report which party it considers would be best placed to progress the rule change request to create this requirement.[45]

The Panel agrees with Snowy Hydro, that it may be difficult for participants to know when power system disturbances occur, unless advised by either AEMO or the relevant NSP. The Panel notes that while generators and NSP's and AEMO may engage on a voluntary basis to

44 Snowy Hydro, submission to the draft report, p. 1.

45 CEC, submission to the draft report, p. 1.

provide such information, a rule change would be required to implement any NER obligation on NSPs and AEMO in this area. The Panel would be happy to work with the CEC to develop a rule change request in this area.

5.2 Power system model update provisions

Section 4.7.1 considered arrangements regarding the provision of updated model information. The Panel's final recommendation was to:

- replace the references in the template to "the plant models used to establish initial compliance " with the latest plant models provided under clause S5.2.4.", and
- provide additional guidance for generators on:
  - addressing any gaps remaining in model validation testing performed as part of commissioning and R2 testing in the generator's compliance program, and
  - reminding generators of their obligations to provide updated model information to AEMO when their compliance testing indicates their generating system model is incomplete, inaccurate, or out of date.

AEMO's submission to the Panel's draft report considered that generators should include in their compliance programs (specifically associated with S5.2.5.5) a requirement to:[46]

- validate performance for any large disturbance (that has occurred naturally), and
- provide details and analysis including any model updates to AEMO within 3 months of this disturbance occurring.

The Panel agrees with AEMO as to the importance of accurate and up to date generator models given their significance for AEMO's secure operation of the power system. The Panel has recommended additional guidance for generators which will enhance their validation of models following R2 testing and remind them of their obligations to provide updated model information to AEMO when the generator becomes aware that the information is incomplete, inaccurate, or out of date.

Including a recommendation that generators validate performance for any large disturbance (that has occurred naturally), and provide details and analysis including any model updates to AEMO within 3 months of this disturbance occurring represents a significant change to existing template guidance.

On this occasion, the Panel has made a recommendation that clarify existing template arrangements and provide guidance on clear existing obligations under the rules. A recommendation that goes significantly beyond existing template arrangements, without an opportunity to consult with affected generators, is considered beyond the scope of the review to make such a recommendation at this time.

46 AEMO, submission to the draft report, p. 1.

5.3 High speed monitoring standard

Stakeholders reported that it is now common practice for new generators to install high speed monitors as they are not costly. The Panel understands that a combination of high speed monitoring with supporting plant design information (including models) is an effective means of assessing compliance with performance standards. Further, it is apparent that having high speed data that can capture transient responses from units during step changes is also valuable for internal generating system troubleshooting.

During the review the Panel became aware of that while high speed monitoring is being utilised as a standard approach for new generators there is a lack of specific guidance available to help generators configure and procure appropriate monitoring. Stakeholders suggested that there may be value in developing a high speed monitoring guideline or standard which would include information such as appropriate performance requirements for high speed monitors, configurations arrangements including advice on the appropriate location and distribution of monitors within a generating system and appropriate configuration of alarms, triggers, the amount of pre and post trigger data recorded.

In its submission to the panel's draft report, TasNetworks reiterated that further detail is required with regard to high speed monitoring (HSM). For example, what constitutes the minimum HSM requirement. In this respect, TasNetworks agrees with other commentators that development of a HSM standard would be beneficial.[47]

While the Panel agrees with stakeholders, including TasNetworks, that a high speed monitoring standard could deliver some benefits, the development of such a guideline, or standard, is not in line with the terms of reference provided and is out of scope for this review of the template (as set out in section 1.3). In any case, the Panel does not consider that the template is a document well suited to the specification of technical details specific to high speed monitoring. The template a document which provides high level and broad guidance on test methods without considering their specifics. Implementing a standard or guideline on high speed monitoring may be better achieved in a detailed technical document specific to that purpose. Such a document is more appropriately developed by parties with the relevant expertise and interests, such as AEMO and/or NSPs.

5.4 NSP related matters

Two key NSP related matters arose that the Panel considers are outside the scope of this review of the template. These issues are:

- the role of the NSP in generator compliance testing, and
- the development of a compliance template and registered performance standards for NSP controlled plant.

At present there is no formal requirement for generators to notify the NSP of compliance testing other than if a non-compliance is identified. In responses to GHD's survey, stakeholders considered a requirement that AEMO and the relevant NSP are explicitly

47 TasNetworks, submission to the draft report, p. 2.

informed of compliance testing in advance would create a more robust process, enabling a greater degree of cooperation across the industry to ensure compliance and maintain system security. NSP stakeholders considered this would allow them to plan the use of their engineering resources and to better identify any risks to network or customers as a result of compliance testing. Some NSPs expressed a similar desire to have greater visibility regarding the execution of compliance programs and the results achieved.

In addition to a role for NSPs in generator compliance testing, AEMO, in its submission, recommended that the AEMC and Reliability Panel should consider:[48]

- the development of a template for NSPs relating to their compliance program obligation under clause 5.7.4 of the Rules; and
- the need for registered performance standards and compliance program for any physical plant such as synchronous condensers, which are controlled or operated by NSPs and may affect power system security or the performance standards of generators.

While the Panel considers it worth considering changes on both of these issues, they are beyond the scope of this review as they would require a rule change to implement. The Panel notes AEMO's submission which states that AEMO has identified network plant standards as an area requiring review, and in 2020 will be assessing the need for a Rule change.[49]

48 AEMO, submission to the draft report, p. 2.

49 Ibid.

ABBREVIATIONS

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
Commission	See AEMC
MCE	Ministerial Council on Energy
NEL	National Electricity Law
NEO	National electricity objective
NERL	National Energy Retail Law
NERO	National energy retail objective
NGL	National Gas Law
NGO	National gas objective
Panel	Reliability Panel
CEC	Clean Energy Council
GTPS	Generator Technical Performance Standards
NSP	Network service provider
NER	National Electricity Rules
TNSP	Transmission Network Service Provider
NEM	National Electricity Market