

Reliability Panel AEMC

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# TEMPLATE FOR GENERATOR COMPLIANCE PROGRAMS

19 December 2019

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## **Citation**

Reliability Panel, Template for Generator Compliance Programs, 19 December 2019, Sydney

## **About the Reliability Panel**

The Reliability Panel (Panel) is a specialist body established by the AEMC and comprises industry and consumer representatives. It is responsible for monitoring, reviewing and reporting on reliability, security and safety of the national electricity system and advising the AEMC in respect of such matters. The Panel's responsibilities are specified in section 38 of the National Electricity Law.

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# Contents

<b>Contents</b> .....	<b>iii</b>
<b>Purpose of this document</b> .....	<b>iv</b>
<b>1 Supporting information for compliance programs</b> .....	<b>1</b>
<b>1.1 Introduction</b> .....	<b>1</b>
<b>1.2 Compliance principles</b> .....	<b>1</b>
<b>1.3 General overview of the compliance framework</b> .....	<b>2</b>
<b>1.4 Continuous plant monitoring</b> .....	<b>4</b>
<b>1.5 Dry stored generators</b> .....	<b>4</b>
<b>2 Table for developing generator compliance programs</b> .....	<b>6</b>
<b>2.1 Introduction</b> .....	<b>6</b>
<b>2.2 Applying the table</b> .....	<b>6</b>
<b>2.3 Pre-existing compliance</b> .....	<b>6</b>
<b>2.4 Power system security</b> .....	<b>6</b>
<b>2.5 Performance standards</b> .....	<b>7</b>
<b>2.6 Compliance methods</b> .....	<b>7</b>
<b>2.7 Frequency of tests</b> .....	<b>7</b>
<b>2.8 Performance of remote equipment</b> .....	<b>8</b>
<b>2.9 Model validation and model updates</b> .....	<b>8</b>
<b>2.10 Basis for compliance assessment</b> .....	<b>9</b>
<b>2.11 Defined terms</b> .....	<b>9</b>
<b>Table 1 Table to assist development of generator compliance programs</b> .....	<b>10</b>

## Purpose of this document

Under the National Electricity Rules (Rules), the Reliability Panel (Panel) must determine, modify as necessary, and publish the template for generator compliance programs (template).<sup>1</sup> The Rules also require the Panel to conduct a review of the template at least every five years from the date the template is determined, and at such times as the Australian Energy Market Commission (AEMC) may request.<sup>2</sup> Following such a review, the Panel may amend the template in accordance with any recommendations that it makes in a report that is submitted to the AEMC.<sup>3</sup>

Under the Rules, the template must:<sup>4</sup>

- 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 as set out in the Rules for its plant.

Registered participants have performance standards obligations requiring that their plant meets or exceed applicable performance standards and that their plant does not materially adversely affect power system security.<sup>5</sup> In that regard, a registered participant who controls or operates plant to which a performance standard applies, must institute and maintain a compliance program which:<sup>6</sup>

- is consistent with the template;
- includes procedures to monitor the performance of the plant in a manner that is consistent with good electricity industry practice;
- is modified to be consistent with any amendments made under clause 8.8.3(ba) of the Rules to the template, by no later than 6 months after amendments to the template are published, or by a date determined by the Panel; and
- provides reasonable assurance of ongoing compliance with each applicable performance standard.

The purpose of this document is to provide assistance and clarity to registered participants, particularly Generators, to develop performance standards compliance programs that include monitoring procedures that they consider to be consistent with good electricity industry practice. It is also intended to assist the Australian Energy Regulator (AER) with the enforcement and monitoring of the Generators' compliance with the technical requirements under the Rules. Effective compliance with

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1 Rules clause 8.8.1(a)(2b). The Panel must determine the template in accordance with clause 8.8.3 of the Rules.

2 Rules clause 8.8.3(ba).

3 Rules clause 8.8.3(j).

4 Rules clause 4.15(ca).

5 Rules clause 4.15(a).

6 Rules clause 4.15(b) and (c).

performance standards contributes to the delivery of reliable and secure electricity to customers in the National Electricity Market (NEM).

This document is structured as follows:

- Chapter 1 presents:
  - the ten compliance principles;
  - a general overview of the compliance framework;
  - information on continuous plant monitoring;
  - general information on dry-storage generators; and
- Chapter 2 presents:
  - a detailed table for developing generator compliance programs.

Further information on the template can be obtained by either emailing the Panel secretariat (telephone (02) 8296 7800, or email [panel@aemc.gov.au](mailto:panel@aemc.gov.au)), or by accessing previously published Panel reports for past reviews of the template from the Panel's website ([www.aemc.gov.au](http://www.aemc.gov.au)).



# 1 Supporting information for compliance programs

## 1.1 Introduction

This chapter presents material that may be considered useful by registered participants in terms of helping to inform their compliance programs.

## 1.2 Compliance principles

The Panel used the following compliance principles in developing its template. These principles should also be considered by generators in developing and modifying their compliance programs.

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 the 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.

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 electricity 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 (TNSP).

Principle 10: Compliance programs should be reviewed and updated periodically.

### 1.3 General overview of the compliance framework

It is important to recognise that the template is only one element of the broader compliance framework.

The Panel recognises that the template cannot be a prescriptive list of compliance choices. Such an approach would not be efficient, or representative of good electricity industry practice. The approach taken is to support a flexible application of the template with appropriate controls. The Panel, therefore, designed the template on the basis that it forms part of a Generator's overall compliance management process.

Provided below is a general overview of the compliance framework. However, registered participants are advised to seek their own independent professional advice as to the compliance framework that is specific to their individual circumstances and how it will be applied.

Generally speaking, the compliance framework should be viewed in the context of the connection arrangements that allow the Generator to connect to the electricity network. Under the Rules, a Generator must plan and design its facilities and ensure that they are operated to comply with the performance standards applicable to those facilities, its connection agreement which is applicable to those facilities, and the system standards.<sup>7</sup> Except in cases where a Generator's facilities meet all aspects of the 'automatic access standards', performance standards are generally negotiated and form part of a Generator's connection agreement with the relevant network service provider.<sup>8</sup>

Following the receipt of a proposed negotiated access standard, the relevant network service provider is required to consult with AEMO with regard to the proposed negotiated access standard.<sup>9</sup> AEMO then establishes and maintains a register of the

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<sup>7</sup> Rules clause 5.2.5(a).

<sup>8</sup> The automatic access standards, minimum access standards and performance criteria required for the connection of generators are set out in Rules schedule 5.2. These form the basis for specific performance standards that are registered with AEMO.

<sup>9</sup> Rules clause 5.3.4A.



performance standards that is applicable for that particular plant, as advised by the relevant network service provider or Generator.<sup>10</sup>

Under the Rules, a Generator is required to comply with the performance standards applicable to its facilities.<sup>11</sup> That is, it is required to comply with those standards that are set out in its connection agreement. A Generator is also required to develop and maintain a performance standards compliance program that is consistent with the template.<sup>12</sup> Such a program must be developed as soon as reasonably practicable, but no later than:

- six months after the day that AEMO gives notice to the registered participant of registration of the performance standards; or
- six months after the day on which the relevant plant commences operation.<sup>13</sup>

A Generator is also required to modify its compliance program to be consistent with any amendments made to the template by the Panel, by no later than 6 months after amendments to the template are published, or by a date determined by the Panel.<sup>14</sup>

The AER is responsible for monitoring whether Generators' compliance programs meet the mandatory requirements and for investigation of breaches, or possible breaches, of performance standards obligations under clause 4.15 of the Rules. A Generator is required to maintain compliance program records and other prescribed records<sup>15</sup> for seven years, and if requested, deliver such records to the AER within five business days or other specified period.<sup>16</sup>

A Generator is also required to immediately notify AEMO if its plant is breaching a performance standard or is likely to breach.<sup>17</sup> It must also notify AEMO and the relevant network service provider when the plant has returned to compliance with the relevant performance standard.<sup>18</sup> AEMO forwards a copy of all non-compliance notices to the AER and the relevant network service provider.

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.

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10 Rules clause 4.14(n).

11 Rules clauses 5.2.1(b)(2) and 5.2.5(a)(1).

12 Rules clause 4.15(c).

13 Rules clause 4.15(b).

14 Rules clause 4.15(c)(3).

15 Relating to tests to demonstrate compliance with connection requirements under clause 5.7.3 of the Rules.

16 Rules clause 4.15(e).

17 Rules clause 4.15(f).

18 Rules clause 4.15(h).

## 1.4 Continuous plant monitoring

Where plant is normally running (that is, not “peaking plant” that operates intermittently), continuous plant monitoring could have a number of benefits over periodic testing, or if used in conjunction with periodic testing. Benefits are likely to accrue not only in relation to demonstrating compliance with technical performance standards, but also in providing information to plant owners about the ongoing performance of their plant.

Continuous plant monitoring is increasingly becoming a more affordable option than it has been in the past. AEMO has advised the Panel that the adoption of affordable continuous plant monitoring options is increasingly an outcome of the connection negotiation process for new plants.<sup>19</sup>

Generators could also consider whether continuous high speed monitoring could be considered in lieu of staged testing in some instances where staged tests cannot be implemented, such as for response to system disturbances.

For a number of performance standards in Table 1 in Chapter 2 of this document, continuous plant monitoring has been included as an option for a suitable monitoring and testing methodology. Where continuous plant monitoring has not been included in the table, Generators should also consider the suitability of applying continuous plant monitoring as a monitoring and testing methodology in these other situations.

## 1.5 Dry stored generators

The term “dry stored” is used to identify the status of a generation facility (or plant) that is not in a state of readiness to allow it to be dispatched in the NEM, but remains physically intact, and, after a period of restoration, would be capable of being returned to service. Similar terminology used to refer to this state includes “care and maintenance” or “mothballing”.

The Rules require all generating facilities, including dry stored Generators, to develop and maintain compliance programs that are consistent with the template.<sup>20</sup> While the Rules do not prohibit a Generator from entering a period of “dry storage” and maintaining registration throughout, ongoing registration with AEMO obliges the Generator to retain compliance with the Rules.

When a generating plant is being prepared for a significant period of dry storage, a Generator should consider whether the plant’s existing compliance program for performance standards is appropriate. There are a range of factors that a Generator should consider before implementing any amendment to its existing compliance program for the plant in question, some of which may include:<sup>21</sup>

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<sup>19</sup> AEMO submission, 16 December 2014, p.2. Confirmed through feedback received via survey of from representative stakeholders completed by GHD in July 2019.

<sup>20</sup> Rules clause 4.15(c).

<sup>21</sup> These suggested range of factors have been based on information contained in the AEMO document, *Guidance for Dry-Stored Generators* (version 1, published 9 August 2013), as referenced in AEMO’s submission to the Issues Paper for the 2015 review.

- The period of time likely to elapse before the facility might be returned to service, and how the Generator would communicate any return to service arrangements to AEMO;
- How the Generator would inform AEMO of the status of the facility and the facility's expected time to return to service after a period of storage;
- When the Generator is preparing its dry stored plant for a return to service, any required testing that can be conducted off-line should occur prior to the plant's return to service. For example, this may include any steps that are considered necessary to verify plant changes that may have occurred during and after the period of storage, or where there has been a change to a performance standard. The Generator should also consider how and when it will advise AEMO of its plans to bring the plant back into service. The Generator should also keep all compliance related information up to date.
- If compliance testing is due, but the Generator has not been able to verify its compliance with all standards prior to re-synchronisation with the power system, then all residual verifications should be carried out as soon as practicable following re-synchronisation. For example, this may include making prior arrangements for the necessary tests to be carried out without avoidable delay after synchronisation in order to minimise risk to other power system users, and for the timing and results of tests to be independently verifiable at a later time. Consideration should also be given to whether certain tests need to be advised to AEMO and/or the relevant network service provider(s).

## **2 Table for developing generator compliance programs**

### **2.1 Introduction**

Table 1, included at the end of this chapter, has been provided to assist Generators to develop their own compliance programs ('the table'). The following material provides explanatory notes to this table and defines important terms used in its development. Generators should read this explanatory material before referring to the table as it provides important context for the application of the table's provisions.

The terms defined in section 2.9 of this chapter and underlined in the table, are only intended to be used for the purposes of the template. Italicised terms are defined in Chapter 10 of the Rules.

### **2.2 Applying the table**

The table provides a series of options for Generators to assist in developing compliance programs. It is not a prescriptive list of tests and methodologies to demonstrate compliance. The template has been designed on the basis that it is one of a number of resources that should be consulted in implementing and modifying a Generator's overall compliance management process.

The template is not designed to take the place of alternative advice. Generators should consider the compliance principles, set out in Chapter 1 of this document, most of which illustrate that Generators will need to exercise judgement in how best to apply the template to meet their compliance requirements.

### **2.3 Pre-existing compliance**

The table is designed on the assumption that any analysis undertaken at the time of connection and subsequent commissioning tests conducted by the Generator have established the plant's compliance with its performance standards. This is also assumed for older plant, that were connected in accordance with older versions of the Rules or Code. As a result, a Generator's connection agreements for older plant may, in some cases, specify the testing and monitoring requirements, which may be based on the need to maintain compliance with older versions of the Rules or Code that applied at the time when such connection agreements were established.

### **2.4 Power system security**

The AEMO power system security responsibilities are provided under clause 4.3.1 of the Rules. The Generator needs to take care that its compliance testing regime does not jeopardise power system security. Otherwise, under clause 4.8.1 of the Rules, the Generator must promptly advise AEMO or a relevant System Operator at the time that the Generator becomes aware, of any circumstance which could be expected to adversely affect the secure operation of the power system or any equipment owned or under the control of the Generator or a network service provider (NSP). Nothing in the table seeks to override these responsibilities and all testing should be devised and undertaken recognising the need to maintain power system security.

## 2.5 Performance standards

The Panel has sought to take into account all the relevant versions of the performance standards that may apply to a particular Generator. However, Generators should be aware in developing their compliance programs that the particular requirements under a performance standard may have changed over time. There may also have been changes in the version of the Rules, clause numbering and title in some places. At the time that this template was last updated, version 129 of the Rules was the latest version. Reference to version 129 of the Rules in the table should be taken to mean the latest version of the Rules unless there have been changes to the particular provision in the table. Until the template is next updated, Generators should base their compliance programs in regard to any such matters on other information in the template, the application of their management program and good electricity industry practice.

## 2.6 Compliance methods

The table lists a number of different compliance methods for the applicable performance standards. These different methods can be selected by the Generator to suit its specific plant characteristics. The method or methods on which a particular plant's compliance program is based should be selected within the broader compliance management framework of the Generator, and should include consideration of all relevant factors including:

- the technology of the plant, including whether its performance is likely to drift or degrade over a particular timeframe;
- experience with the particular generation technology, including manufacturer's advice;
- the connection point arrangement; and
- an assessment of the risk and costs of different testing methods, including consideration of the relative size of the plant.

## 2.7 Frequency of tests

In the table, the column titled, "Suggested frequency of testing", indicates the suggested cycle of recurrent tests for a particular method. The actual frequency of testing on which a particular plant's compliance program is based should be determined within the broader compliance management framework of the Generator, and should include consideration of all relevant factors including:

- the technology of the plant specific to that performance standard;
- experience with the particular generation technology;
- manufacturer's advice with respect to the particular model;<sup>29</sup> and

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<sup>29</sup> This could include considering any specific requirements related to the minimum number of operational hours required prior to undertaking 'major inspections'.

- an assessment of the frequency required to provide reasonable assurance of compliance.

The frequency may also be managed within the broader framework to integrate NEM compliance testing with safety and other compliance programs and the overall asset management program for the plant.<sup>30</sup> The actual frequency of testing may be described in terms of the:

- elapsed time;
- plant operating hours;
- MWhrs generated; or
- number of plant starts

between testing.

## **2.8 Performance of remote equipment**

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 should 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.

## **2.9 Model validation and model updates**

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.

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<sup>30</sup> Generators may need to consider whether plant that is less often employed should be subject to more rigorous compliance testing to ensure that it would operate when required.

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.

## 2.10 Basis for compliance assessment

In the table, the column titled, "Basis for compliance assessment", indicates the type of measure required as the benchmark for a particular method. The specific measure for the acceptance or otherwise of test results should be developed by the Generator when applying the template to develop their compliance program.

## 2.11 Defined terms

In the design of the template, it was decided that certain terms used in the table should be defined to aid clarity and assist Generators in using the template to develop their specific compliance programs:

**plant change** means when the replacement of components or equipment or the refurbishment or change of system takes place and that the relevant *Generator* considers that event may affect the plant's capability to meet the particular *performance standard*. A plant change may include a change to software or firmware associated with digital control and protection systems. An appropriate process needs to be established under the *Generator's* compliance management framework to ensure all changes to plant are noted and appropriately reviewed as to whether they constitute a plant change event in respect to each *performance standard*.

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.

**relevant sub-system** means any subcomponents which contribute to a *generating system* achieving its capability to meet the particular *performance standard* (e.g. excitation systems, connection equipment including associated reactive plant, auxiliary power supplies, protection relays, circuit breakers, etc.). An appropriate process needs to be established under the *Generator's* compliance management framework to identify what sub-systems are relevant to achieving and maintaining the plant's performance with respect to each *performance standard*.

Appropriate testing for relevant sub-systems needs to be devised taking into account:

- the technology of the particular sub-system, including whether its performance is likely to drift or degrade over a particular timeframe;
- experience with the particular generation technology;

- manufacturer's advice with respect to the particular model; and
- an assessment of the frequency required to provide reasonable assurance of compliance.

**routine testing** may require testing and calibration of equipment.

**type testing** means testing, on a regular basis, a reasonable sample of plant within a larger population of plant of the identical type and model.

**monitoring** means active routine monitoring of the system to ensure ongoing compliance and not just mere logging. All monitoring should include quantitative analysis to confirm plant performance against:

- past performance;
- known performance characteristics; or
- plant performance models.

This definition should not be confused with *monitoring equipment* as defined in the Rules.

**plant trip** for the purposes of this template means the trip of a *generating unit* or a *generating system*, or when a *generating system* consists of more than ten identical units, the trip of a significant number of those units or of critical ancillary plant.

**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.

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** 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.



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.

**Table 1 Table to assist development of generator compliance programs**

This table is intended as a guide to Generators that is one of a number of potential resources for developing and modifying compliance programs. It is not an exhaustive list of tests and methodologies, as new, and more effective, approaches may develop over time. Generators should consider the compliance principles set out in Chapter 1 of the document when applying this table. Chapters 1 and 2 of this document provide important context for the application of this table and emphasises that Generators should exercise their own judgement in determining how best to apply the template to meet their compliance requirements.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Reactive Power Capability</b> (as required under S5.2.5.1 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>26</sup>	Method 1 (of 5):  At rated power output, adjust the reactive power at the connection point to specified levels	Every 3 years and after <u>plant change</u>	Directly Measurable. Applies to synchronous and conventional plant, entire wind farms and solar farms	Be capable of achieving reactive power requirements of the performance standard subject to not exceeding network voltage limits.
	Method 2 (of 5):  Exercise the over and under excitation limits at as close to rated power output as practical	Every 3 years and after <u>plant change</u>	Directly Measurable. Applies to synchronous and conventional plant	Be capable of achieving reactive power requirements of the performance standard

<sup>24</sup> Where there is more than one method provided, only **one** method is required to be used.

<sup>25</sup> See section 2.7 of the template for more information on the factors to be considered when determining the actual frequency.

<sup>26</sup> This provision was amended in the Code on 9 August 2001 and on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Reactive Power Capability</b> (as required under S5.2.5.1 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>27</sup>				subject to not exceeding network voltage limits.
	Method 3 (of 5): Step testing of AVR limiters	Every 3 years and after <u>plant change</u>	Applies to conventional plant	Be capable of achieving reactive power requirements of the performance standard subject to not exceeding network voltage limits.
	Method 4 (of 5): (a) Capability will be tested by component: and	Testing of ancillary plant and <u>type testing</u> of sample turbines/solar installation following <u>plant change</u>	Applies to wind farms plant and solar farms	Be capable of achieving performance standard
	(b) Capability will be monitored using SCADA under normal wind and solar farm operation.	Annual review of a selection of events		Consistency with plant characteristics

<sup>27</sup> This provision was amended in the Code on 9 August 2001 and on 27 March 2003, and in version 13 of the Rules.

<b>Performance Standard/Rules/Code Provision</b>	<b>Suitable testing and monitoring methodology<sup>24</sup></b>	<b>Suggested frequency of testing<sup>25</sup></b>	<b>Notes</b>	<b>Basis for compliance assessment</b>
	Method 5 (of 5): Routine testing of <u>relevant sub-systems</u>	As appropriate to the technology of the <u>relevant sub-system</u>	Applicable to a wide range of generating plant and systems	Consistency with plant characteristics
<b>Power Factor Requirements</b> (as required under S5.3.5 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code)	Method 1 (of 1): Direct measurement and calculation of power factor when not generating	Every 3 years and following <u>plant change</u>	Only applies where there is a circuit breaker, allowing auxiliary supply to be drawn through the main connection point	Power factor within allowable range / specification
<b>Quality of Electricity Generated</b> (as required under S5.2.5.2 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>28</sup>	Method 1 (of 2): (a) Direct measurements using power quality meters to derive: i. voltage fluctuation levels; ii. voltage balance; and	Following <u>plant change</u>	Performance of generator and its contribution to power quality needs to be separated from the contribution of others	Achieve performance standard or demonstrate consistency with plant characteristics used in determining original compliance

<sup>28</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
	iii. harmonics, flicker and negative phase sequence voltage; and			
<b>Quality of Electricity Generated</b> (as required under S5.2.5.2 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>29</sup>	(b) Routine testing of any <u>relevant sub-systems</u> .	As appropriate to the technology of the <u>relevant sub-system</u>	Important when power quality at the connection point is dependent on ancillary plant of power electronic control systems	As above
	Method 2 (of 2): (a) Monitoring in-service performance through use of Power Quality Monitors; and	Routine monitoring Specific review every 3 years and following <u>plant change</u>		Monitors set against the performance standard are not raising alarms. Consistency with plant characteristics (no deterioration).
	(b) Testing and/or calibration of any <u>relevant sub-systems</u> .	As appropriate to the technology of the <u>relevant sub-system</u>	Important when power quality at the connection point is dependent on	Consistency with plant characteristics.

<sup>29</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
			ancillary plant of power electronic control systems	
<b>Response to Frequency Disturbances</b> (as required under S5.2.5.3 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>30</sup>	Method 1 (of 4): (a) Investigating <u>plant trips</u> that occur during significant frequency disturbances; and	On every event		Achieve performance standard
	(b) Routine testing and/or calibration of <u>relevant sub-systems</u> including: <ul style="list-style-type: none"> <li>i. testing of control system and/or protection system response to disturbances by the injection of simulated frequency / speed control signals; and</li> <li>ii. Routine tests of electrical / mechanical over speed devices.</li> </ul>	As appropriate to the technology of the <u>relevant sub-system</u>		As above

<sup>30</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<p><b>Response to Frequency Disturbances</b> (as required under S5.2.5.3 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code)<sup>31</sup></p>	<p>Method 2 (of 4):</p> <p>(a) Investigating system performance using high speed data recorders; and</p>	<p>Every event where the <u>plant trips</u> and disturbances where the frequency moves out of the <i>operational frequency tolerance band</i></p>	<p>Appropriate to use where high speed monitors are available and models have been used in establishing compliance</p>	<p>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 or sufficiently sophisticated.</p>
	<p>(b) Routine testing and/or calibration of <u>relevant sub-systems</u> including:</p> <p>i. testing of control system and/or protection system response to disturbances by the injection of simulated frequency / speed control signals; and</p>	<p>As appropriate to the technology of the <u>relevant sub-system</u></p>		<p>As above</p>

<sup>31</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
	ii. Routine tests of electrical / mechanical over speed devices.			
<b>Response to Frequency Disturbances</b> (as required under S5.2.5.3 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>32</sup>	Method 3 (of 4): (a) Verify the modelled performance of a sample of turbines/solar inverter units;	Following <u>plant change</u>	Only applicable to small asynchronous generators with digital controls that are aggregated and that do not materially differ in terms of their design and settings	Operation over the frequency range specified and agreed in the Generator Performance Standard
	(b) Verify the performance by testing response to an introduced disturbance;	<u>Type testing and verification</u> every 10 years	Each unit is not material and performance slippage is unlikely	Consistent with the performance standard registered at the connection point
	(c) Continuous monitoring (high speed) of performance at the connection point; and		Appropriate to use where high speed monitors are available and models have been used in establishing compliance	Operation over the frequency range specified and agreed in the Generator Performance Standard

<sup>32</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.



Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Response to Frequency Disturbances</b> (as required under S5.2.5.3 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>33</sup>	(d) Routine testing and/or calibration of <u>relevant sub-systems</u> including: <ul style="list-style-type: none"> <li>i. testing of control system response to disturbances by the injection of simulated frequency / speed control signals; and</li> <li>ii. Routine tests of electrical / mechanical over speed devices.</li> </ul>	As appropriate to the technology of the <u>relevant sub-system</u>		As above
	Method 4 (of 4): <ul style="list-style-type: none"> <li>(a) Performance of <u>relevant sub-systems</u> will be monitored using the following systems under normal machine operation: digital protection relays; other data-logging equipment as required; and</li> </ul>	Every 3 years by reviewing the response to a disturbance where the system frequency moves outside of the <i>operational frequency tolerance band</i> , and after plant change		Achieve performance standard

<sup>33</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
	(b) Routine testing and/or calibration and validation of <u>relevant sub-system</u> performance including: i. electrical protection; and ii. turbine protection.	As appropriate to the technology of the <u>relevant sub-system</u>		As above
<b>Response to Voltage Disturbances</b> (as required under: S5.2.5.4 in versions 13-129 and S5.2.5.3 in versions 1-12 of the Rules; and S5.2.5.3 in the initial Code, and all amended versions of the Code) <sup>34</sup>	Method 1 (of 3): (a) Investigating <u>plant trips</u> that occur during significant voltage disturbances; and	On every event		Achieve performance standard
	(b) Routine testing and/or calibration of <u>relevant sub-systems</u> including: i. AVR systems;	As appropriate to the technology of the <u>relevant sub-system</u>		Consistency with plant characteristics

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<sup>34</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<p><b>Response to Voltage Disturbances</b> (as required under: S5.2.5.4 in versions 13-129 and S5.2.5.3 in versions 1-12 of the Rules; and S5.2.5.3 in the initial Code, and all amended versions of the Code)<sup>35</sup></p>	<ul style="list-style-type: none"> <li>ii. Auxiliary power systems; and</li> <li>iii. Protection relays.</li> </ul>			
	<p>Method 2 (of 3):</p> <ul style="list-style-type: none"> <li>(a) Continuous high speed monitoring; and</li> </ul>	<p>On every event where the <u>plant trips</u> or on at least one major voltage disturbance every 3 years</p>	<p>Appropriate to use where high speed monitors are available and models have been used in establishing compliance</p>	<p>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</p>
	<ul style="list-style-type: none"> <li>(b) Routine testing and/or calibration of <u>relevant sub-systems</u> including: <ul style="list-style-type: none"> <li>i. AVR systems;</li> <li>ii. Auxiliary power systems; and</li> <li>iii. Protection relays.</li> </ul> </li> </ul>	<p>As appropriate to the technology of the <u>relevant sub-system</u></p>	<p>Where possible, testing of auxiliary power systems should include simulated disturbance testing</p>	<p>As above</p>

<sup>35</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
	Method 3 (of 3): (a) With the generator out of service, test the ability of nominated 415 V drives to sustain a specified voltage interruption; and	Every 4 years and after plant change	Applies only to 415 V drives	Successful ride through of system voltage disturbances, as per the agreed performance standard
	(b) In-service monitoring and investigation of any occurrence of a <u>plant trip</u> which may have been associated with a significant voltage disturbance.	On every event	This type of monitoring will be acceptable only if high speed monitoring is not available	As above
<b>Response to Disturbances following Contingency Events</b> (as required under S5.2.5.5 in versions 13-129 of the Rules) <sup>36</sup>	Method 1 (of 2): Investigate <u>plant trips</u> that occur during or immediately following major events; and	On every event		Achieve performance standard
	(a) Routine monitoring and testing and/or calibration of <u>relevant sub-systems</u> including suitable testing to	As appropriate to the technology of the <u>relevant sub-system</u>		As above

<sup>36</sup> This provision was amended in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Response to Disturbances following Contingency Events</b> (as required under S5.2.5.5 in versions 13-129 of the Rules) <sup>37</sup>	(b) confirm circuit breaker operating times.			
	Method 2 (of 2): Continuous monitoring using high speed recorders; and	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 <i>continuous uninterrupted operation</i> .	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
	(a) Routine monitoring and testing and/or calibration of <u>relevant sub-systems</u> .	As appropriate to the technology of the <u>relevant sub-system</u>		As above

<sup>37</sup> This provision was amended in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
	<p>Method 1 (of 2):</p> <p>(a) Direct measurements using power quality meters supplied via measurement transformers and transducers with sufficient frequency bandwidth to test:</p> <ul style="list-style-type: none"> <li>i. voltage fluctuation levels;</li> <li>ii. voltage balance; and</li> <li>iii. harmonics, flicker and negative phase sequence voltage prior to synchronisation</li> </ul> <p>(b) and to ensure protection settings align to the performance standard;</p>	Following <u>plant changes</u>		Achieve performance standard and ensure protection settings are consistent with the performance standard.
<b>Quality of Electricity Generated and Continuous Uninterrupted Operation</b>	Investigating <u>plant trips</u> to ensure the trip is not caused by power-quality protection (harmonics or voltage unbalance); and	Following each event		Achieve performance standard.

<b>Performance Standard/Rules/Code Provision</b>	<b>Suitable testing and monitoring methodology<sup>24</sup></b>	<b>Suggested frequency of testing<sup>25</sup></b>	<b>Notes</b>	<b>Basis for compliance assessment</b>
(as required under S5.2.5.6 in versions 13-129 of the Rules) <sup>38</sup>	(b) Routine monitoring and testing and/or calibration of any <u>relevant sub-systems</u> .	As appropriate to the technology of the <u>relevant sub-system</u>		As above
	Method 2 (of 2): (c) Continuous monitoring in-service performance using power quality meters supplied via measurement transformers and transducers with sufficient frequency bandwidth.	On significant disturbances when the plant trips including at least one major event every 3 years	Appropriate to use where suitable metering is available	Consistency of operation with plant performance specifications
<b>Quality of Electricity Generated and Continuous Uninterrupted Operation</b> (as required under S5.2.5.6 in versions 13-129 of the Rules) <sup>39</sup>	Method 1 (of 3): (a) Measure response of the generator to system over-frequency and analyse the unit performance; and	On every event where high frequency moves out of the operational frequency tolerance band or every five years (whichever is more frequent) and after plant change as	Directly measurable	Achieve performance standard

<sup>38</sup> This provision was amended in version 13 of the Rules.

<sup>39</sup> This provision was amended in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
		appropriate to the technology of the relevant sub-system		
<b>Partial Load Rejection</b> (as required under: S5.2.5.7 in versions 13-129 and S5.2.5.4 in versions 1-12 of the Rules; and S5.2.5.4 of the initial Code, and all amended versions of the Code) <sup>40</sup>	(b) Investigation of <u>plant trips</u> .	On every event		As above
	Method 2 (of 3): (a) Routine testing and/or calibration of <u>relevant sub-systems including</u> : i. Analytical simulation of generator, auxiliary systems and critical protections; and Secondary injection testing of critical protection systems; and	As appropriate to the technology of the <u>relevant sub-system</u>		Simulation demonstrates ride through of load rejection event specified in Performance Standard.

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<sup>40</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.



Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Partial Load Rejection</b> (as required under: S5.2.5.7 in versions 13-129 and S5.2.5.4 in versions 1-12 of the Rules; and S5.2.5.4 of the initial Code, and all amended versions of the Code) <sup>41</sup>	ii. Assess any <u>plant trip</u> for relationship to load rejection event.	On every event	<u>Type Test</u> permissible where multiple units are involved	Operation over the conditions specified and agreed in the Generator Performance Standard.
	Method 3 (of 3): (b) Response to partial load rejection to be assessed by in-service performance; and	On every event where frequency moves above the operational frequency tolerance band or every 5 years (whichever is more frequent) as appropriate to the technology of the relevant sub-system		Achieve performance standard.
	(a) Test for correct operation of turbine overspeed trips.	Every 4 years and after plant change	Overspeed protection checked off-line after major overhauls	That turbine trip operates to within acceptable tolerance of nominal trip setting for overspeed protection.

<sup>41</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
	Method 1 (of 3): (b) Continuous monitoring using high speed recorders;		Appropriate to use where high speed monitors are available, and models have been used in establishing compliance This may not be relevant where alarms are incorporated into the design of the recorder	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 if the models are not available.
<b>Protection from Power System Disturbances</b> (as required under S5.2.5.8 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>42</sup>	(a) Routine testing and/or calibration of <u>relevant sub-systems</u> including applicable protection relays; and (b)	As appropriate to the technology of the <u>relevant sub-system</u>		That protection system operated in accordance with design and the Performance Standard.
	(c) Investigate unit electrical protection trips.	On every event		As above

<sup>42</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Protection from Power System Disturbances</b> (as required under S5.2.5.8 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>43</sup>	Method 2 (of 3): (a) Routine testing and/or calibration of <u>relevant sub-systems including:</u> i. Injection of simulated signals (secondary injection) to demonstrate correct operation of the protection; and ii. Repair or recalibrate protection relays as required; and	As appropriate to the technology of the <u>relevant sub-system</u>		Achieve performance standard
	(b) Investigate <u>plant trips</u> .	On every event		As above
	Method 3 (of 3): Performance is monitored, in-service; and	At each major overhaul; and/or every 5 years by routine functional testing of unit	Applicable for generating systems with multiple	Performance is confirmed by the generating system maintaining <i>continuous uninterrupted operation</i>

<sup>43</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<p><b>Protection from Power System Disturbances</b> (as required under S5.2.5.8 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code)<sup>44</sup></p>		electrical protection systems and verification of database registered protection settings to occur annually	generating units (solar and wind farms) Changes to generating unit control parameters will be controlled such that the performance of the generating system and generating units is not compromised in relation to the generator performance standard Appropriate to use where data is available	during power system disturbance conditions where required under a provision of the Rules.
	(a) Routine testing and/or calibration of <u>relevant sub-systems</u> including testing by secondary injection all protection system relays, between the generating unit	As appropriate to the technology of the <u>relevant sub-system</u>		Performance will be assessed against the performance standard requirements.

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<sup>44</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
	terminals but within the generating system.			
	Method 1 (of 3): (a) Routine testing and/or calibration of protection systems including: i. CB opening times; and ii. Protection relay injection testing; and (b)	As appropriate to the technology of the protection system  At least every 5 years and after plant change	Directly measurable	Achieve performance standard
<b>Protection Systems that Impact on Power System Security</b> (as required under S5.2.5.9 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>45</sup>	(b) Confirmation from fault recorder records of actual performance.	Every <u>plant trip</u>		As above
	Method 2 (of 3): (a) Routine testing and/or calibration of <u>relevant sub-systems</u> including: i. protection system testing by secondary injection;	As appropriate to the technology of the <u>relevant sub-system</u>		That all protection relays operate satisfactorily and to within design tolerance of setting value.

<sup>45</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Protection Systems that Impact on Power System Security</b> (as required under S5.2.5.9 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>46</sup>	ii. checking of circuit breaker opening times; iii. redundancy of primary protection systems; and timing of trip signal issued by the breaker fail protection system; and	At least every 5 years and after plant change		
	iv. Assessment of protection system performance in the event of protection system operation.	On every event		That protection system is operated in accordance with design and the Performance Standard.
	Method 3 (of 3): (a) Performance is monitored, in-service, where data is available; (b)	At each major overhaul; and/or every 5 years by routine functional testing of unit electrical protection systems and verification of database registered	Changes to generating unit control parameters will be controlled such that the performance of the generating system and generating units is not compromised in relation to the	Performance is confirmed by assessing operation of protection systems against the requirements of the standard when a generating unit trips as a result of fault occurring between the generating

<sup>46</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Protection Systems that Impact on Power System Security</b> (as required under S5.2.5.9 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>47</sup>		protection settings to occur annually	Generator Performance Standard	unit stator and the connection point.
	Relevant testing and or/calibration of any <u>relevant sub-systems</u> including protection system relays shall be tested by secondary injection; and	As appropriate to the technology of the <u>relevant sub-system</u>		Performance will be assessed against the performance standard requirements following a unit trip as a result of a relevant system event in which the unit should have remained synchronised.
	(b) Verification of database registered protection settings to occur in conjunction with injection testing.  (c)	Every 5 years		As above
	Method 1 (of 1):			

<sup>47</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
	Routine testing and/or calibration of <u>relevant sub-systems</u> including protection system testing by secondary injection; and	As appropriate to the technology of the <u>relevant sub-system</u>  At least every 5 years and after plant change		That all protection relays operate satisfactorily and to within design tolerance of setting value.
<b>Asynchronous Operation of Synchronous Generating Units / Protection to Trip Plant for Unstable Operation</b> (as required under S5.2.5.10 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>48</sup>	(a) Assessment of protection system performance in the event of protection system operation or of asynchronous operation.	On every event		That protection system is operated in accordance with design and the Performance Standard.
	Method 1 (of 4): (b) Monitor in-service performance using high speed frequency data	After every major frequency disturbance	Appropriate to use where high speed monitors are available, and models have been used in establishing compliance or when plant has no capability of responding to frequency deviations	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

<sup>48</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.



Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
			ie asynchronous machines	
<b>Frequency Control / Frequency Responsiveness and/or Governor Stability and Governor System</b> (as required under: S5.2.5.11 in versions 1-129 of the Rules; S5.2.5.11 and S5.2.6.4 in the initial Code, and all amended versions of the Code before 27 March 2003; and S5.2.5.11 of all amended versions of the Code from 27 March 2003 onwards) <sup>49</sup>	Method 2 (of 4): Assessment of governor system performance, or the performance of other control systems designed to modulate the active power response to a frequency disturbance, during events involving significant variation to system frequency	On every event	Assessment takes into account inertial response, overall governor droop setting etc	That governor system response is within the tolerance specified by the Performance Standards
	Method 3 (of 4): Analytical simulation of turbine and governor systems, or other control systems designed to modulate active power in response to a frequency disturbance; and	<u>Type Test</u> permissible where multiple units are involved		Achieve performance standard
	(a) Assess generator response to disturbances using high speed recording data.	On every event where the frequency moves out of the operational tolerance		Consistency of operation with the latest plant model provided in accordance with clause

<sup>49</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Frequency Control / Frequency Responsiveness and/or Governor Stability and Governor System</b> (as required under: S5.2.5.11 in versions 1-129 of the Rules; S5.2.5.11 and S5.2.6.4 in the initial Code, and all amended versions of the Code before 27 March 2003; and S5.2.5.11 of all amended versions of the Code)		band or at least every four years and after plant change		S5.2.4 if the models are available; OR consistency with past performance only if the models are not available
	Method 4 (of 4): (b) Step response test of the governor, or other control systems designed to modulate active power in response to a frequency disturbance, to test damping and droop characteristics; and	Every 4 years and after plant change		Plant performance complies with the Generator Performance Standard
	(a) Routine calibration tests. (b)	Every 4 years		As above

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
from 27 March 2003 onwards) <sup>50</sup>				
	Method 1 (of 1): Monitor in-service performance for relevant performance characteristics not otherwise tested; and	Following <u>plant changes</u>	Generator can only be held responsible for ensuring the performance of their generating system as it contributes to meeting this standard	Consistency of operation the latest plant model provided in accordance with clause S5.2.4 if the models are available; OR consistency with past performance if the models are not available
<b>Stability / Impact on Network Capability</b>	(a) Routine monitoring and testing and/or calibration of <u>relevant sub-systems</u> including suitable testing to	As appropriate to the technology of the <u>relevant sub-system</u>		As above

<sup>50</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

<b>Performance Standard/Rules/Code Provision</b>	<b>Suitable testing and monitoring methodology<sup>24</sup></b>	<b>Suggested frequency of testing<sup>25</sup></b>	<b>Notes</b>	<b>Basis for compliance assessment</b>
(as required under S5.2.5.12 in versions 1-129 of the Rules, and all amended versions of the Code from 27 March 2003 onwards) <sup>51</sup>	confirm power system stabiliser performance (if relevant).			
	Method 1 (of 3): (b) Transfer function measurements and step response tests with the unit unsynchronised and at full load; and	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	Tests should address all control modes specified in the generator performance standard as commissioned control modes.	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 if the models are not available
<b>Voltage and Reactive Power Control / Excitation Control System</b> (as required under: S5.2.5.13 in versions 1-129 of the Rules; S5.2.5.13 and S5.2.6.5 in the initial Code, and all amended versions of the Code before 27	(a) Assess the stability of limiter operation; and	Every 4 years and after plant change for the primary commissioned control mode		As above
	(b) Monitoring in-service performance or undertake	On every event or every 4 years for the primary		As above

<sup>51</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

<b>Performance Standard/Rules/Code Provision</b>	<b>Suitable testing and monitoring methodology<sup>24</sup></b>	<b>Suggested frequency of testing<sup>25</sup></b>	<b>Notes</b>	<b>Basis for compliance assessment</b>
<p>March 2003; and S5.2.5.13 of all amended versions of the Code from 27 March 2003 onwards)<sup>52</sup></p> <p><b>Voltage and Reactive Power Control / Excitation Control System</b></p> <p>(as required under: S5.2.5.13 in versions 1-129 of the Rules; S5.2.5.13 and S5.2.6.5 in the initial Code, and all amended versions of the Code before 27 March 2003; and S5.2.5.13 of all amended versions of the Code from 27 March 2003 onwards)<sup>53</sup></p>	transfer function measurements.	commissioned control mode		
	Method 2 (of 3): (c) AVR step response tests; and	Every 4 years and after plant change for the primary commissioned control mode		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 if the models are not available
	(a) AVR step response test of OEL and UEL operation; and	Every 4 years and after plant change for the primary commissioned control mode		As above
	(b) AVR and PSS transfer function measurements	Every 4 years and after plant change for the primary		As above

<sup>52</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

<sup>53</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<p><b>Voltage and Reactive Power Control / Excitation Control System</b></p>	<p>over required frequency range.</p>	<p>commissioned control mode</p>		
<p>(as required under: S5.2.5.13 in versions 1-129 of the Rules; S5.2.5.13 and S5.2.6.5 in the initial Code, and all amended versions of the Code before 27 March 2003; and S5.2.5.13 of all amended versions of the Code from 27 March 2003 onwards)<sup>54</sup></p>	<p>Method 3 (of 3):</p> <p>(c) Performance of <u>relevant sub-systems</u> will be monitored using the following systems: high speed monitors, digital protection relays; other data-logging equipment as required</p>	<p>As appropriate to the technology of the <u>relevant sub-system</u></p>	<p>Applicable for synchronous generators, wind and solar farms with appropriate monitoring systems installed and models have been used in establishing compliance.</p> <p>Changes to generating unit control parameters will be controlled such that the performance of the generating system and generating units is not compromised in</p>	<p>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 if the models are not available</p>

<sup>54</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
			relation to the Generator Performance Standard	
	Method 1 (of 2): One-off installation	Following <u>plant change</u>		Achieve performance standard
<b>Active Power Control</b> (as required under S5.2.5.14 in versions 13-129 of the Rules) <sup>55</sup>	Method 2 (of 2): Monitor non-compliance with dispatch market systems	After major event		Achieve performance standard
	Method 1 (of 2): Calibration of Transducers; and	Following <u>plant change</u> and every 5 years		Confirmation at each end of the communications system by both parties
<b>Remote Monitoring</b> (as required under S5.2.6.1 in versions 1-129 of the Rules, the initial Code, and all amended versions of the Code) <sup>56</sup>	(a) Verification of the accuracy of transmitted data.	Following <u>plant change</u> and every 5 years		As above
	Method 2 (of 2): (a) SCADA monitored values and farm panel metering will be routinely checked; and	Every 5 years	Applicable for Wind and Solar Farms	Achieve performance standard

<sup>55</sup> This provision was amended in version 13 of the Rules.

<sup>56</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
	(b)			
	The calibration of transducers and Wind and Solar Farms panel metering will be checked.	At each major outage or once every 5 years		As above
	Method 1 (of 1): (b) Confirmation of the availability of communication links, including any backup links with AEMO; and	Annual and after plant change		Achieve performance standard
<b>Communications Equipment</b> (as required under: S5.2.6.2 in versions 13-129 and S5.2.6.3 in versions 1-12 of the Rules; and S5.2.6.3 of the initial Code, and all amended versions of the Code) <sup>57</sup>	(a) Testing of <u>relevant sub-systems</u> including any power backup or UPS system.	As appropriate to the technology of the <u>relevant sub-system</u>		As above
	Method 1 (of 2): (b) Metering of active and reactive power at the auxiliary supply connection point; and	Every 4 years and after plant change	Only applicable when auxiliary supplies are taken from some other point different to generator connection point	Power factor, quality of supply and protection and control requirements within allowable range / specification

<sup>57</sup> This provision was amended in version 13 of the Rules.



Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
			Access Standards must be established under clause S5.3.5	
<b>Power Station Auxiliary Transformers / Supplies</b> (as required under: S5.2.7 in versions 13-129 and S5.2.8 in versions 1-12 of the Rules; and S5.2.8 of the initial Code, and all amended versions of the Code) <sup>58</sup>	(a) Testing and/or calibration of any <u>relevant sub-systems</u> including capacitor banks and circuit breakers.	As appropriate to the technology of the <u>relevant sub-system</u>		Performance to specification
<b>Power Station Auxiliary Transformers / Supplies</b> (as required under: S5.2.7 in versions 13-129 and S5.2.8 in versions 1-12 of the Rules; and S5.2.8 of the initial Code, and all amended versions of the Code) <sup>59</sup>	Method 2 (of 2): (b) Performance will be monitored as part of condition monitoring and maintenance routines		This standard only applies to generating systems that takes auxiliary supplies from a separate supply. Unit auxiliary supplies on wind farms are taken from within connection point when units are on-line. Very small wind farm station service auxiliary load	Achieve performance standard

<sup>58</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

<sup>59</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
			requirements are considered negligible under NEM CMP requirements.	
	Method 1 (of 3): Monitoring in-service performance during faults near the connection point; and	Review following any event		Calculation confirms current fault current contribution
<b>Fault Level / Current</b> (as required under: S5.2.8 in versions 13-129 and S5.2.9 in versions 1-12 of the Rules; and S5.2.9 in all amended versions of the Code from 27 March 2003 onwards) <sup>60</sup>	(a) Review and recalculation of fault levels; and	Following <u>plant change</u>		As above
	(b) Routine testing of any <u>relevant sub-systems</u> .	As appropriate to the technology of the <u>relevant sub-system</u>		As above
	Method 2 (of 3): (c) Modelling and simulation of plant characteristics to make sure the plant is capable of meeting agreed standards; and	Following <u>plant change</u>		Calculation confirms current fault current contribution

<sup>60</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology <sup>24</sup>	Suggested frequency of testing <sup>25</sup>	Notes	Basis for compliance assessment
<b>Fault Level / Current</b> (as required under: S5.2.8 in versions 13-129 and S5.2.9 in versions 1-12 of the Rules; and S5.2.9 in all amended versions of the Code from 27 March 2003 onwards) <sup>61</sup>	(a) Monitoring of generator contribution on fault event.	Review following any event		As above
	Method 3 (of 3): (b) Performance of <u>relevant sub-systems</u> will be monitored using the following systems: digital protection relays; other data-logging equipment as required; and	As appropriate to the technology of the <u>relevant sub-system</u>		Achieve performance standard.
	(a) Where recorded data is available, comparison to be made of measured fault currents and computer simulations; and	Following a fault		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 if the models are not available.
	(b) Review and recalculation of fault levels.	Following <u>plant change</u>		As above
	(c)			

<sup>61</sup> This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

