Template for Generator Compliance Programs

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Inquiries

Ian Woodward
Chairman of the Reliability Panel
The Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

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

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About the AEMC

The Council of Australian Governments, through its Ministerial Council on Energy (MCE), established the Australian Energy Market Commission (AEMC) in July 2005 to be the Rule maker for national energy markets. The AEMC is currently responsible for Rules and policy advice covering the National Electricity Market and elements of the natural gas markets. It is a statutory authority. Our key responsibilities are to consider Rule change proposals, conduct energy market reviews and provide policy advice to the MCE as requested, or on AEMC initiative.

About the AEMC Reliability Panel

The AEMC Reliability Panel (Panel) is a specialist body within the AEMC and comprises industry and consumer representatives. It is responsible for monitoring, reviewing and reporting on the safety, security and reliability 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 (NEL).

Disclaimer

The views and recommendations set out in this document are those of the Panel and are not necessarily those of the AEMC.

Contents

Notes to this document

Compliance with technical standards is crucial to ensuring power system security in the National Electricity Market (NEM). Ensuring high levels of compliance with effective standards is fundamental to the safe and reliable operation of the power system within the power system's technical envelope. If this were not the case, the risk of a major power system incident would materially increase.[a]

Clause 8.8.1(a)(2b) of the National Electricity Rules (Rules) includes requirements for the Reliability Panel (Panel) to develop a template for generator compliance programs (template) based on a public consultation process. The template seeks to define "good electricity industry practice" in the management of generator plant performance and adherence to standards (but does not of itself fully define nor guarantee good electricity industry practice), and hence provides certainty for Generators as to what is required of their compliance programs. Generators must develop and maintain compliance programs in line with the template.

Clause 8.8.3(ba) of the Rules also provides an ongoing role for the Panel including an obligation to review the template at least every three years or as the AEMC directs. The Panel intends to regularly review the template in order to ensure its consistency with the Rules and to provide a continual improvement focus.

In November 2008, the Commission provided Terms of Reference to the Panel requiring it to conduct this review as required under clause 8.8.3 of the Rules. A copy of the Terms of Reference is provided in Appendix A of this Final Report.

The Panel has undertaken an extensive consultation process in developing the template. This process included:

- forming an ad-hoc Working Group under the direction of Panel to assist in the development of the template. The Working Group was chaired by a member of the Panel and had representation from the NGF, the Clean Energy Council, Transmission Network Service Providers, the AER and AEMO. Members of the Working Group have contributed their extensive experience to the development task;

- giving notice to all Registered Participants of the Panel's review to develop the template in accordance to clause 8.8.3(d) of the Rules and publishing an Issues Paper on 22 January 2009. Submissions closed on 6 March 2009;

- publishing a Draft Report on 8 May 2009. Submissions closed on 19 June 2009; and

- holding a meeting which was open to all Registered Participants on its draft template at the office of the AEMC on 12 June 2009.

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a Final Report of the AEMC Review of Enforcement of and Compliance with Technical Standards (dated 1 September 2006), p.4.

On 31 July 2009, the Panel submitted to the AEMC its Final Report on the template for generator compliance programs for publication in accordance with clause 8.8.3(j) of the Rules. The Panel, for the reasons as set out in Chapter 2 of the Final Report, has determined that the template consist of the table of compliance measures and explanatory material set out in chapters 3 and 4 of the Final Report. These chapters of the Final Report have therefore had minor reformatting and renumbering to constitute this template. For further details on the Panel's development and determination of the template, refer to the Final Report.

All enquiries on this template should be addressed to Charles Hoang on (02) 8296 7800.

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1 Principles for the development of the template for generator compliance programs and guidelines for its application to compliance programs

1.1 Introduction

This Chapter first outlines the principles the AEMC Reliability Panel (Panel) adopted in developing the template for generator compliance programs (template). In addition to providing background to the process of developing this template, the documenting of these principles should be a guide to future revision and development of the template.

The Chapter also provides guidance to assist Generators develop their own compliance programs. Compliance programs must be consistent with the template and include procedures to monitor the performance of plant in a manner that is consistent with good electricity industry practice. The Panel considered that good practice requires Generators to refine the template within an appropriate compliance management setting to their specific plant characteristics.

1.2 Compliance principles

The Panel used the following compliance principles in developing its template. These are recommended to be used as a guide in future reviews of the template.

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 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 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 8: 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 TNSP.

Principle 9: Compliance programs should be reviewed and updated periodically.

1.3 The nature of the template and its application

A clear objective of the template is to provide clarity to all parties as to what constitutes good electricity industry practice with respect to technical standards compliance. The work of the Panel in developing the template and most submissions on the Panel's development of the template, however, highlight the difficulty of establishing a single template for the diverse range of plant in the NEM. The submission by PacificHydro reinforces this point stating that:[1]

> "The requirement to develop and mandate a template creates a significant challenge. Such a template must be broad enough to cover the various technologies; allow for different types of connection points; and avoid being overly prescriptive, as this in itself could design in compliance failure for generators."

Considering the principles under which the template is to be developed and in light of:

- the variety of technology of generating plant in the NEM;
- the different ages and sizes of that plant;
- the plant specific attributes of the generating plant and its potential impacts on the network; and

1 PacificHydro submission on the Issues Paper (AEMC Reliability Panel 2009, Template for Generator Compliance Programs, Issues Paper, 22 January 2009, Sydney), 9 March 2009, p.1.

- the differing technical standards (or registered performance standards) to which they must comply,

the Panel recognised that the template cannot be a prescriptive list of compliance choices. Such an approach would not be efficient nor 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. This is consistent with the NGF submission which envisioned a role for the template within a "quality assurance framework".[2]

It is also broadly consistent with the proposals by PacificHydro. PacificHydro suggested that the Australian Standard for Compliance Programs (AS 3806-2006) should be used as a starting point and it should be assumed that companies are using AS 3806 already in their compliance systems.[3] PacificHydro argued that the specific technical principles should not be contrary to, nor overwrite, any of the principles contained in AS 3806.[4]

The following section outlines the nature of such a framework and the following chapter provides a table to assist Generators in developing their compliance programs.

1.4 The framework for the development of a compliance program

The Panel recognised that the Rules requires Generators to implement compliance programs that are consistent with the template but not a carbon copy of the template. The template is not an exhaustive document and is intended to assist Generators to design its own compliance programs. It is recognised that as each Generator may have its own particular requirements for their plant, the Generator is responsible for developing its own compliance program. The development of the compliance program and its ongoing application must, however, be within an appropriate framework.

In its submission[5], AEMO (formerly NEMMCO) proposed that the framework for compliance programs be further clarified in the form of a "multi-faceted approach".

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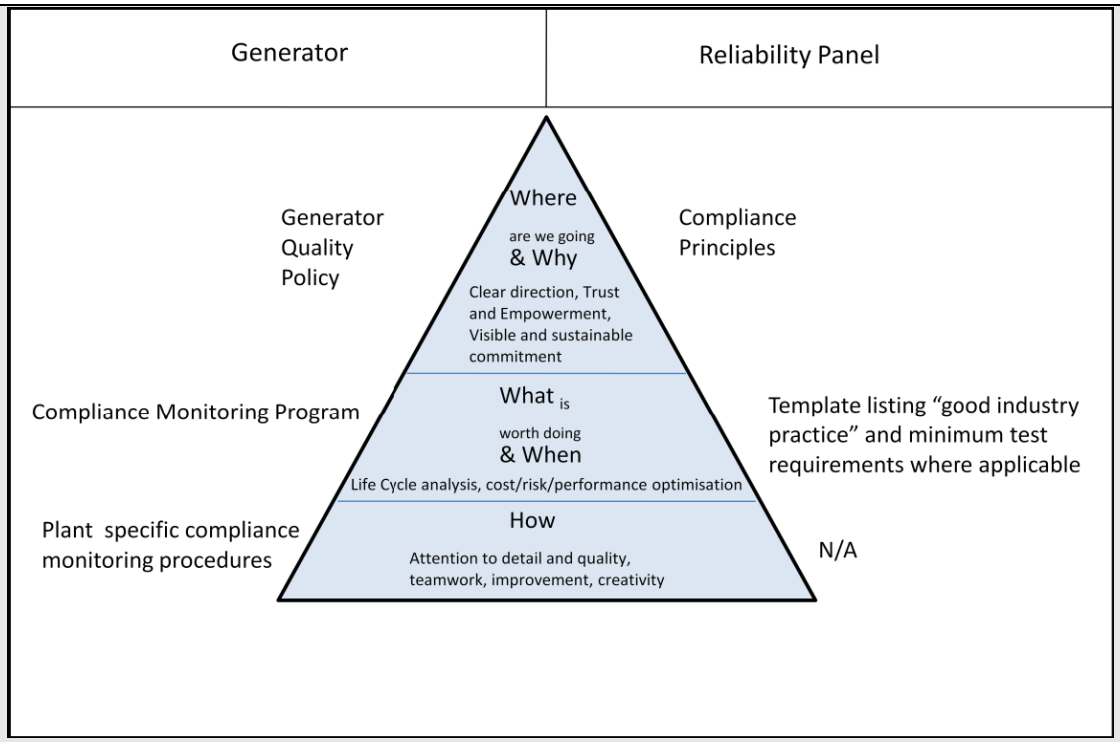
2 NGF submission on the Issues Paper (AEMC Reliability Panel 2009, Template for Generator Compliance Programs, Issues Paper, 22 January 2009, Sydney), 6 March 2009, p.1.

3 PacificHydro submission on the Issues Paper (AEMC Reliability Panel 2009, Template for Generator Compliance Programs, Issues Paper, 22 January 2009, Sydney), 9 March 2009, Pp.1-2.

4 PacificHydro submission on the Issues Paper (AEMC Reliability Panel 2009, Template for Generator Compliance Programs, Issues Paper, 22 January 2009, Sydney), 9 March 2009, Pp.1-2.

5 AEMO submission on the Issues Paper (AEMC Reliability Panel 2009, Template for Generator Compliance Programs, Issues Paper, 22 January 2009, Sydney), 6 March 2009, p.5.

The figure below summarises AEMO's proposed approach and the following extract from their submission[6] describes the proposal in more detail.



"The figure indicates a tiered approach. Documentation to be put in place by the Reliability Panel is indicated on the right hand side of the triangle, while the documentation the generators will need to have in place in response to this is indicated to the left.

The compliance principles that the Panel now asks the generators to follow will be based on internationally recognised quality management system principles such as can be found in the ISO9000, 9001 and 9004 set of standards. This set of compliance principles will need to be followed in the establishment, implementation and maintenance of the Generator Compliance Program. The concept of the suitability of testing and monitoring regimes for each performance standard as per Rule 4.15(ca) is therefore taken to a higher level. Generators will have to show that their processes are well managed and that there are sufficient supporting systems in place with regards to resourcing for, execution and review of all the processes supporting the achievement of performance standard targets.

At the next level the Reliability Panel will be responsible for putting a more detailed template in place. This template will indicate which tests and monitoring techniques constitute good electricity industry practice for each performance standard area for different technologies.

At the top tier on the generator side there is a quality management policy that will

6 AEMO submission on the Issues Paper (AEMC Reliability Panel 2009, Template for Generator Compliance Programs, Issues Paper, 22 January 2009, Sydney), 6 March 2009, Pp.5-6.

have to show:

- the processes needed for the establishment, implementation and maintenance of the Generator Compliance Program
- the sequence and interaction of these processes,
- the determination of criteria and methods needed to ensure that both the operation and control of these processes are effective,
- the availability of resources and information necessary to support the operation and monitoring of these processes,
- that these processes are monitored, measured and analysed, and
- actions necessary to achieve planned results and continual improvement of these processes are implemented.

The resulting Generator Performance Standard Compliance Plan will then consist of a document detailing the systems and processes in place to ensure the generators ability to consistently meet regulatory requirements. The compliance program should stipulate how the processes are managed in terms of issues such as records and document control, handling of non-conformances and management review. The design and implementation of a generator's specific compliance program will be influenced by varying needs, particular technologies, the products provided, the processes employed and be manageable irrespective of the size and structure of the organisation. The plan should also include an assessment plan that stipulates the specified monitoring and test procedures including required frequency of testing. At the bottom of the tier on the generator side there should be a set of compliance monitoring procedures for each test the compliance program prescribes. These will include step by step instructions including the following:

- input and output requirements (for example specifications, resources and records to be kept),
- activities within the processes,
- verification and validation of processes and products,
- analysis of the process including dependability,
- identification, assessment and mitigation of risk,
- corrective and preventive actions,
- opportunities and actions for process improvement, and
- control of changes to processes and products."

The Panel decided not to mandate a particular management approach or standard, knowing that different organisations have their own approaches or are certified to various standards. However, in the context of developing the template, the Panel considered that AEMO's general proposal in clarifying the compliance program framework will assist it in determining the scope of the template and avoid duplicating other processes within the framework.

1.5 The need for documentation within the overall compliance arrangements

While the Panel did not intend to mandate a particular management approach, any appropriate management would have a number of characteristics. One of those would be to record and document decisions. In addition to being necessary for proper management control, documentation will be necessary within the broader NEM compliance arrangements.

The overall compliance arrangements in the Rules and the NEL rely on participation of Generators, AEMO and the AER. For the framework of compliance programs to function effectively, in addition to the Panel's role in developing and reviewing the template, it was anticipated by the AEMC in its final Rule determination that:[7]

- Registered Participants (Generators) will institute and maintain generator compliance programs based on the template;
- the AER will regularly conduct spot audits of selected Generators' compliance programs as part of its compliance monitoring activities; and
- Generators will engage with external auditors to independently audit their compliance programs to determine whether they are required to amend their compliance programs and amend if required.

7 AEMC 2008, Performance Standard Compliance of Generators, Rule Determination (23 October 2008, Sydney), p.v.

2 Table for developing generator compliance programs

2.1 Introduction

A table to assist Generators to develop their own compliance programs ('the table') is provided at the end of this Chapter. The following material provides explanatory notes to this table and defines important terms used in its development. The terms defined in section 2.8 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 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, the testing and monitoring is, in some cases, based on the need to maintain compliance.

2.3 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 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.

2.4 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 and Code, clause numbering and title in some places. At the time that this template was written, version 30 of the Rules was the latest version. Reference to version 30 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 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.

2.5 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.

2.6 Frequency of tests

In the table, there is a column titled "Frequency". This column 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; and
- 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. 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.

2.7 Basis for compliance assessment

In the table, there is a column titled "Basis for compliance assessment". 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. This column indicates the type of measure required as the benchmark for a particular method.

2.8 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*. 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*.

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.

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.

2.9 Table to assist development of generator compliance programs

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
Reactive Power Capability (as required under S5.2.5.1 in versions 1-30 of the Rules, the initial Code, and all amended versions of the Code)[8]	Method 1: At rated power output, adjust the reactive power capability to specified levels	Every 3 years and after plant change	Directly Measurable. Applies to synchronous and conventional plant.	Achieve reactive power requirements of the performance standard
	Method 2: Exercise the over and under excitation limits at as close to rated power output as practical	Every 3 years and after plant change	Directly Measurable. Applies to synchronous and conventional plant.	Achieve reactive power requirements of the performance standard
	Method 3: Step testing of AVR limiters	Every 3 years and after plant change	Applies to conventional plant	Achieve reactive power requirements of the performance standard

8 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	Frequency	Notes	Basis for compliance assessment
	Method 4: (a) Capability will be tested by component	Testing of ancillary plant and type testing of sample turbines following plant change	Applies to wind farms plant	Achieve performance standard
	(b) Capability will be monitored using SCADA under normal wind farm operation	Annual review of a selection of events		Consistency with plant characteristics
	Method 5: Routine testing of relevant sub-systems	As appropriate to the technology of the relevant sub-system	Applicable to a wide range of generating plant and systems	Consistency with plant characteristics
Power Factor Requirements (as required under S5.3.5 in versions 1-30 of the Rules, the initial Code, and all amended versions of the Code)	Direct measurement and calculation of power factor when not generating	Every 3 years and following plant change	Only applies where there is a circuit breaker, allowing auxiliary supply to be drawn through the	Actual capability directly demonstrated

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
			main connection point	
Quality of Electricity Generated (as required under S5.2.5.2 in versions 1-30 of the Rules, the initial Code, and all amended versions of the Code)[9]	Method 1: (a) Direct measurements using power quality meters to derive: i. voltage fluctuation levels ii. voltage balance iii. harmonics, flicker and negative phase sequence voltage prior to synchronisation (b) Routine testing of any relevant sub-systems	Following plant change As appropriate to the technology of the relevant sub-system	Performance of generator and its contribution to power quality needs to be separated from the contribution of others. Important when power quality at the connection point is dependent on ancillary plant of power electronic control	Achieve performance standard or demonstrate consistency with plant characteristics used in determining original compliance

9 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	Frequency	Notes	Basis for compliance assessment
			systems.	
	Method 2: (a) Monitoring in-service performance through use of Power Quality Monitors	Routine monitoring Specific review every 3 years and following plant change		Monitors set against the performance standard are not raising alarms. Consistency with plant characteristics (no deterioration).
	(b) Testing of any relevant sub-systems	As appropriate to the technology of the relevant sub-system	Important when power quality at the connection point is dependent on ancillary plant of power electronic control systems.	Consistency with plant characteristics.
Response to Frequency Disturbances (as required under S5.2.5.3 in versions 1-30 of the Rules, the	Method 1: (a) Investigating plant trips that occur during significant frequency	On every event		Achieve performance standard

10 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**	**Frequency**	**Notes**	**Basis for compliance assessment**
initial Code, and all amended versions of the Code)[10]	disturbances (b) Routine testing of relevant sub-systems including: i. testing of control system response to disturbances by the injection of simulated frequency / speed control signals ii. Routine tests of electrical / mechanical over speed devices	As appropriate to the technology of the relevant sub-system		
	Method 2: (a) Investigating system performance using high speed data recorders	Every event where the plant trips and disturbances where the frequency moves out of the *operational frequency tolerance band*	Appropriate to use where high speed monitors are available and models have been used in establishing compliance	Consistency of operation with plant models used to establish initial compliance if the models are available; OR consistency with past performance only if the

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	(b) Routine testing of relevant sub-systems including: i. testing of control system response to disturbances by the injection of simulated frequency / speed control signals ii. Routine tests of electrical / mechanical over speed devices	As appropriate to the technology of the relevant sub-system		models are not available
	Method 3: (a) Verify the modelled performance of a sample of turbines	Following plant change	Only applicable to small asynchronous generators with digital controls that are aggregated.	Operation over the frequency range specified and agreed in the Generator Performance Standard

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	(b) Verify the performance at the connection point by testing response to an introduced disturbance	Type testing and verification every 10 years	Each unit is not material and performance slippage is unlikely.	
	(c) Continuous monitoring (high speed) of performance at the connection point		Appropriate to use where high speed monitors are available and models have been used in establishing compliance.	
	(d) Routine testing of relevant sub-systems including: i. testing of control system response to disturbances by the injection of simulated frequency / speed control signals ii. Routine tests of electrical /	As appropriate to the technology of the relevant sub-system		

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	mechanical over speed devices			
	Method 4: (a) Performance of relevant sub-systems will be monitored using the following systems under normal machine operation: digital protection relays; other data-logging equipment as required (b) Routine testing and validation of relevant sub-system performance including: i. electrical protection; and ii. turbine protection	Every 3 years As appropriate to the technology of the relevant sub-system		Achieve performance standard

Performance Standard/Rules/Code Provision	**Suitable testing and monitoring methodology**	**Frequency**	**Notes**	**Basis for compliance assessment**
Response to Voltage Disturbances (as required under: S5.2.5.3 in versions 1-12 of the Rules, and S5.2.5.4 in versions 13-30 of the Rules; and S5.2.5.3 in the initial Code, and all amended versions of the Code)[11]	Method 1: (a) Investigating plant trips that occur during significant voltage disturbances (b) Routine testing of relevant sub-systems including: i. AVR systems ii. Auxiliary power systems iii. Protection relays	On every event As appropriate to the technology of the relevant sub-system		Consistency with plant characteristics
	Method 2: (a) Continuous high speed monitoring	On every event where the plant trips or on at least one major voltage disturbance every 3	Appropriate to use where high speed monitors are available and models have been used in establishing	Consistency of operation with plant models used to establish initial compliance if the models are available; OR

11 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	Frequency	Notes	Basis for compliance assessment
		years	compliance.	consistency with past performance only if the models are not available
	(b) Routine testing of relevant sub-systems including: i. AVR systems ii. Auxiliary power systems iii. Protection relays	As appropriate to the technology of the relevant sub-system	Where possible, testing of auxiliary power systems should include simulated disturbance testing.	
	Method 3: (a) With the generator out of service, test the ability of nominated 415 V drives to sustain a specified voltage interruption	Every 4 years	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 plant trip which may have been associated	On every event	This type of monitoring will be acceptable only if high speed monitoring is not available.	

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	with a system voltage disturbance			
Response to Disturbances following Contingency Events (as required under S5.2.5.5 in versions 13-30 of the Rules)[12]	Method 1: Direct testing by instigating a network trip	Following plant changes	Preferred method where possible and where risks can be managed	Achieve performance standard
	Method 2: (a) Investigate plant trips that occur during or immediately following major system events (b) Routine monitoring and testing of relevant sub-systems including suitable testing to confirm circuit breaker operating times	On every event As appropriate to the technology of the relevant sub-system		Achieve performance standard
	Method 3:			

12 This provision was amended in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	(a) Continuous monitoring using high speed recorders	On disturbances when the plant trips or at least one major event every 3 years	Appropriate to use where high speed monitors are available and models have been used in establishing compliance	Consistency of operation with plant models used to establish initial compliance if the models are available; OR consistency with past performance only if the models are not available
	(b) Routine monitoring and testing of relevant sub-systems	As appropriate to the technology of the relevant sub-system		
Quality of Electricity Generated and Continuous Uninterrupted Operation (as required under S5.2.5.6 in versions 13-30 of the Rules)[13]	Method 1: (a) Direct measurements using power quality meters to test: i. voltage fluctuation levels ii. voltage balance	Following plant changes		Achieve performance standard and ensure protection settings are consistent with the performance standard.

13 This provision was amended in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	iii. harmonics, flicker and negative phase sequence voltage prior to synchronisation and to ensure protection settings align to the performance standard			
	(b) Investigating plant trips to ensure the trip is not caused by power-quality protection (harmonics or voltage unbalance)	Following each event		Achieve performance standard.
	(c) Routine monitoring and testing of any relevant sub-systems	As appropriate to the technology of the relevant sub-system		
	Method 2: Monitoring in-service performance using	On disturbances when the plant trips including at least	Appropriate to use where suitable	Consistency of operation with plant performance

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	appropriate metering	one major event every 3 years	metering is available	specifications
Partial Load Rejection (as required under: S5.2.5.4 in versions 1-12 of the Rules, and S5.2.5.7 in versions 13-30 of the Rules; and S5.2.5.4 of the initial Code, and all amended versions of the Code)[14]	Method 1: (a) Measure response of the generator to system over-frequency and analyse the unit performance (b) Investigation of plant trips	On every event	Directly measurable	Achieve performance standard
	Method 2: (a) Routine testing of relevant sub-systems including: i. Analytical simulation of generator, auxiliary systems and critical protections	As appropriate to the technology of the relevant sub-system		Simulation demonstrates ride through of load rejection event specified in Performance Standard.

14 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	Frequency	Notes	Basis for compliance assessment
	ii. Secondary injection testing of critical protection systems (b) Assess any plant trip for relationship to load rejection event	On every event	Type Test permissible where multiple units are involved	Operation over the conditions specified and agreed in the Generator Performance Standard.
	Method 3: (a) Response to partial load rejection to be assessed by in-service performance (b) Test for correct operation of turbine overspeed trips	Every 4 years	Overspeed protection checked off-line after major overhauls	Achieve performance standard. That turbine trip operates to within acceptable tolerance of nominal trip setting for overspeed protection.
Protection from Power System Disturbances	Method 1: (a) Continuous monitoring		Appropriate to use	Consistency of operation

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
(as required under S5.2.5.8 in versions 1-30 of the Rules, the initial Code, and all amended versions of the Code)[15]	using high speed recorders		where high speed monitors are available and models have been used in establishing compliance	with plant models used to establish initial compliance if the models are available; OR consistency with past performance if the models are not available.
	(b) Routine testing of relevant sub-systems including applicable protection relays	As appropriate to the technology of the relevant sub-system		That protection system operated in accordance with design and the Performance Standard.
	(c) Investigate unit electrical protection trips	On every event		
	Method 2: (a) Routine testing of relevant sub-systems including: i. Injection of simulated signals	As appropriate to the technology of the relevant sub-system		Achieve performance standard

15 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	Frequency	Notes	Basis for compliance assessment
	(secondary injection) to demonstrate correct operation of the protection ii. Repair or recalibrate protection relays as required (b) Investigate plant trips	On every event		
	Method 3: (a) Performance is monitored, in-service	At each major overhaul; and/or every 5 years by routine functional testing of unit electrical protection systems and verification of database registered protection settings to occur annually	Applicable for wind farms. Changes to turbine 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.	Performance is confirmed by the generating system remaining synchronised during power system disturbance conditions where required under a provision of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	(b) Routine testing of relevant sub-systems including testing by secondary injection all protection system relays, between the generating unit terminals but within the generating system	As appropriate to the technology of the relevant sub-system	Appropriate to use where data is available.	Performance will be assessed against the performance standard requirements.
Protection Systems that Impact on Power System Security (as required under S5.2.5.9 in versions 1-30 of the Rules, the initial Code, and all amended versions of the Code)[16]	Method 1: (a) Routine testing of protection systems including: i. CB opening times; ii. Protection relay injection testing. (b) Confirmation from	As appropriate to the technology of the protection system Every plant trip	Directly measurable	Achieve performance standard

16 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	Frequency	Notes	Basis for compliance assessment
	fault recorder records of actual performance			
	Method 2: (a) Routine testing of relevant sub-systems including: i. protection system testing by secondary injection ii. checking of circuit breaker opening times iii. redundancy of primary protection systems iv. timing of trip signal issued by the breaker fail protection system (b) Assessment of protection system performance in the	As appropriate to the technology of the relevant sub-system On every event		That all protection relays operate satisfactorily and to within design tolerance of setting value. That protection system is operated in accordance with design and the

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	event of protection system operation			Performance Standard.
	Method 3: (a) Performance is monitored, in-service, where data is available.	At each major overhaul; and/or every 5 years by routine functional testing of unit electrical protection systems and verification of database registered protection settings to occur annually	Changes to turbine 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	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 unit stator and the connection point.
	(b) Relevant testing of any relevant sub-systems including protection system relays shall be tested by secondary injection	As appropriate to the technology of the relevant sub-system		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.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	(c) Verification of database registered protection settings to occur in conjunction with injection testing			
Asynchronous Operation of Synchronous Generating Units / Protection to Trip Plant for Unstable Operation (as required under S5.2.5.10 in versions 1-30 of the Rules, the initial Code, and all amended versions of the Code)[17]	Method 1: (a) Routine testing of relevant sub-systems including protection system testing by secondary injection (b) Assessment of protection system performance in the event of protection system operation or of asynchronous operation	As appropriate to the technology of the relevant sub-system On every event		That all protection relays operate satisfactorily and to within design tolerance of setting value. That protection system is operated in accordance with design and the Performance Standard.
Frequency Control / Frequency	Method 1:			

[17] 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	Frequency	Notes	Basis for compliance assessment
Responsiveness and/or Governor Stability and Governor System (as required under: S5.2.5.11 in versions 1-30 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)[18]	Monitor in-service performance using high speed frequency data		Appropriate to use where high speed monitors are available and models have been used in establishing compliance	Consistency of operation with plant models used to establish initial compliance if the models are available; OR consistency with past performance only if the models are not available
	Method 2: Assessment of governor system performance 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: (a) Analytical simulation of turbine and governor systems	Type Test permissible where multiple units are involved		

[18] 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**	**Frequency**	**Notes**	**Basis for compliance assessment**
	(b) Assess generator response to disturbances using high speed recording data	Ongoing		Consistency of operation with plant models used to establish initial compliance if the models are available; OR consistency with past performance only if the models are not available
	Method 4: (a) Step response test of the governor to test damping and droop characteristics (b) Routine calibration tests	Every 4 years Every 4 years		Plant performance complies with the Generator Performance Standard
Stability / Impact on Network Capability (as required under S5.2.5.12 in versions 1-30 of the Rules, and all amended versions of the	Method 1: (a) Monitor in-service performance for relevant performance characteristics not	Following plant changes	Generator can only be held responsible for ensuring the performance of their	Consistency of operation with plant models used to establish initial compliance if the models

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
Code from 27 March 2003 onwards)[19]	otherwise tested (b) Routine monitoring and testing of relevant sub-systems including suitable testing to confirm power system stabiliser performance (if relevant)	 As appropriate to the technology of the relevant sub-system	generating system as it contributes to meeting this standard	are available; OR consistency with past performance if the models are not available
Excitation Control System / Voltage and Reactive Power Control (as required under: S5.2.5.13 in versions 1-30 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	Method 1: (a) Transfer function measurements and step response tests with the unit unsynchronised and at full load	Every 4 years		Consistency of operation with plant models used to establish initial compliance if the models are available; OR consistency with past performance if the models

19 This provision was amended in the Code on 27 March 2003, and in version 13 of the Rules.

20 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	Frequency	Notes	Basis for compliance assessment
March 2003; and S5.2.5.13 of all amended versions of the Code from 27 March 2003 onwards)[20]	(b) Assess the stability of limiter operation (c) Monitoring in-service performance or undertake transfer function measurements			are not available
	Method 2: (a) AVR step response tests (b) AVR step response test of OEL and UEL operation (c) AVR and PSS transfer function measurements over	Every 4 years		Consistency of operation with plant models used to establish initial compliance if the models are available; OR consistency with past performance if the models are not available

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	required frequency range			
	Method 3: Performance of relevant sub-systems will be monitored using the following systems: digital protection relays; other data-logging equipment as required	As appropriate to the technology of the relevant sub-system	Applicable for Wind Farms. Changes to turbine 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.	Consistency of operation with plant models used to establish initial compliance if the models are available; OR consistency with past performance if the models are not available
Active Power Control (as required under S5.2.5.14 in versions 13-30 of the Rules)[21]	Method 1: One-off installation	Following plant change		Achieve performance standard
	Method 2:			

21 This provision was amended in version 13 of the Rules.

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
	Monitor non-compliance with dispatch market systems			Achieve performance standard
Remote Monitoring (as required under S5.2.6.1 in versions 1-30 of the Rules, the initial Code, and all amended versions of the Code)[22]	Method 1: (a) Calibration of Transducers (b) Verification of the accuracy of transmitted data	Following plant change and every 5 years		Confirmation at each end of the communications system by both parties
	Method 2: (a) SCADA monitored values and farm panel metering will be routinely checked (b) The calibration of transducers and Wind Farm panel metering will be checked	Every 5 years At each major outage or once every 5 years	Applicable for Wind Farms	Achieve performance standard

[22] 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	Frequency	Notes	Basis for compliance assessment
Communications Equipment (as required under: S5.2.6.3 in versions 1-12 of the Rules, and S5.2.6.2 in versions 13-30 of the Rules; and S5.2.6.3 of the initial Code, and all amended versions of the Code)[23]	Method 1: (a) Confirmation of the availability of communication links, including any backup links with AEMO (b) Testing of relevant sub-systems including any power backup or UPS system	Annual As appropriate to the technology of the relevant sub-system		Achieve performance standard
Power Station Auxiliary Transformers / Supplies (as required under: S5.2.8 in versions 1-12 of the Rules, and S5.2.7 in versions 13-30 of the Rules; and S5.2.8 of the initial Code, and all amended versions of the Code)[24]	Method 1: (a) Metering of active and reactive power at the auxiliary supply connection point	Every 4 years	Only applicable when auxiliary supplies are taken from some other point different to generator connection point. Access Standards must	Power factor, quality of supply and protection and control requirements within allowable range / specification

23 This provision was amended in version 13 of the Rules.

24 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	Frequency	Notes	Basis for compliance assessment
			be established under clause S5.3.5.	
	(b) Testing of any relevant sub-systems including capacitor banks and circuit breakers	As appropriate to the technology of the relevant sub-system		Performance to specification
	Method 2: 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 requirements are considered negligible under NEM CMP requirements.	Achieve performance standard

Performance Standard/Rules/Code Provision	Suitable testing and monitoring methodology	Frequency	Notes	Basis for compliance assessment
Fault Level / Current (as required under: S5.2.9 in versions 1-12 of the Rules, and S5.2.8 in versions 13-30 of the Rules; and S5.2.9 in all amended versions of the Code from 27 March 2003 onwards)[25]	Method 1: (a) Monitoring in-service performance during faults near the connection point (b) Review and recalculation of fault levels (c) Routine testing of any relevant sub-systems	Review following any event Following plant change As appropriate to the technology of the relevant sub-system		Calculation confirms current fault current contribution
	Method 2: (a) Modelling and simulation of plant characteristics to make sure the plant is capable of meeting agreed standards	Following plant change		Calculation confirms current fault current contribution

25 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	Frequency	Notes	Basis for compliance assessment
	(b) Monitoring of generator contribution on fault event	Review following any event		
	Method 3: (a) Performance of relevant sub-systems will be monitored using the following systems: digital protection relays; other data-logging equipment as required	As appropriate to the technology of the relevant sub-system		Achieve performance standard.
	(b) Where recorded data is available, comparison to be made of measured fault currents and computer simulations	Following a fault		Consistency of operation with plant models used to establish initial compliance if the models are available; OR consistency with past performance if the models are not available.
	(c) Review and recalculation of fault levels	Following plant change		