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| Generator Performance Standard (GPS) Report Template  [Facility Name (Size) GPS R0]      20 March 2024 |

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Contents

[Important notice v](#_Toc163831534)

[Instructions for using this template vi](#_Toc163831535)

[Abbreviations vii](#_Toc163831536)

[1. Executive Summary 1](#_Toc163831537)

[2. Introduction 2](#_Toc163831538)

[3. GPS Compliance Assessment Results 4](#_Toc163831539)

[3.1 Assessment of Clause A12.2 – Active Power Capability 4](#_Toc163831540)

[3.2 Assessment of Clause A12.3 – Reactive Power Capability 4](#_Toc163831541)

[3.3 Assessment of Clause A12.4 – Voltage and Reactive Power Control 4](#_Toc163831542)

[3.3.1 Assessment of Clause A12.4 – Voltage Control Mode 5](#_Toc163831543)

[3.3.2 Assessment of Clause A12.4 – Reactive Power Control Mode 5](#_Toc163831544)

[3.3.3 Assessment of Clause A12.4 – Power Factor Control Mode 5](#_Toc163831545)

[3.4 Assessment of Clause A12.5 – Active Power Control 5](#_Toc163831546)

[3.5 Assessment of Clause A12.6 – Inertia and Frequency Control 5](#_Toc163831547)

[3.6 Assessment of Clause A12.7 – Frequency Disturbance Ride Through 5](#_Toc163831548)

[3.7 Assessment of Clause A12.8 – Voltage Disturbance Ride Through 5](#_Toc163831549)

[3.8 Assessment of Clause A12.9 – Multi-Disturbance Ride Through 5](#_Toc163831550)

[3.8.1 Assessment of Clause A12.9 – Balance Faults 6](#_Toc163831551)

[3.8.2 Assessment of Clause A12.9 – Unbalance Faults 6](#_Toc163831552)

[3.8.3 Assessment of Clause A12.9 – Over-voltage Events 6](#_Toc163831553)

[3.8.4 Assessment of Clause A12.9 – Continuous Uninterrupted Operation for series of disturbances 6](#_Toc163831554)

[3.9 Assessment of Clause A12.10 – Partial Load Rejection 6](#_Toc163831555)

[3.10 Assessment of Clause A12.11 – Disturbance Ride Through Quality of Supply 6](#_Toc163831556)

[3.11 Assessment of Clause A12.12 – Quality of Electricity Generated 6](#_Toc163831557)

[3.12 Assessment of Clause A12.13 – Generation Protection System 7](#_Toc163831558)

[3.13 Assessment of Clause A12.14 – Remote Monitoring Requirement 7](#_Toc163831559)

[3.14 Assessment of Clause A12.15 – Remote Control Requirement 7](#_Toc163831560)

[3.15 Assessment of Clause A12.16 – Communication Equipment Requirement 7](#_Toc163831561)

[3.16 Assessment of Clause A12.17 – Generating System Model 7](#_Toc163831562)

[4. References 8](#_Toc163831563)

[**Appendix A** A-1](#_Toc163831564)

Important notice

Purpose

Western Power has prepared this Template to provide information to Market Participants for developing a Generator Performance Standard Report.

Disclaimer

This report is not binding on Western Power or Western Power personnel, and Western Power is not liable for any error or omission, which is made as a reasonable and prudent person, in this work.

The results of any assessment, advice provided or any associated network or non-network investment proposals herein are subject to, amongst other things, receiving internal, regulatory, environmental, government and other stakeholder approval. As this assessment has been conducted with the best available information at the time, further investigation may be required, including system studies, environment or other stakeholder approvals, among others should the information change up to the point where an Access Offer is made.

Western Power accepts and bears no risk or responsibility for any loss or damage suffered by any party that is caused, contributed to, by, or in connection with the use of the information within this document or any other document which refers to or mentions this document. Any use of this information is at the sole risk of the user.

Instructions for using this template

Market Participants must submit Generator Performance Standard Report that is consistent with the format presented in this template.

The red text in this template contains explanatory notes to assist Market Participants in providing required information, red text must be deleted prior to the submission of a Generator Performance Standard Report to Western Power.

*Italicised* text contains examples. They are to be deleted or modified prior to the submission of Generator Performance Standard Report to Western Power.

Abbreviations

[Provide a list of abbreviations and acronyms used throughout this document. Defined terms are identified in this document by capitals.]

|  |  |
| --- | --- |
| Term | Definition |
| AEMO | Australian Energy Market Operator |
| GPS | Generator Performance Standards |
| MP | Market Participant |
| NSP | Network Service Provider |
| POC | Point of Connection |
| WEM | Wholesale Electricity Market |
| WP | Western Power |

# Executive Summary

[Provide project background, and a summary of compliance check results against each Generator Performance Standards clause as captured in the Appendix 12 of the latest version of WEM Rules. All the information in below subsections is to be provided by Market Participant (MP) unless mentioned otherwise.]

# Introduction

[Provide project background, single line diagram and the information on the software packages used for the compliance assessment of each Clause, i.e. PowerFactory and/or PSCAD]

*In 2021, the Wholesale Electricity Market (WEM) Rules introduced the Generator Performance Standards*

*(GPS) for Market Participants responsible for a Transmission Connected Generating System connected to the South-West Interconnected System (SWIS). GPS is described in Chapter 3A and Appendix 12 of the WEM Rules and other associated documentations [1].*

*In accordance with WEM Rules clause 3A.4.4, Western Power developed the “Generator Performance Standards: Guideline for the Assessment of Technical Requirements” [3], which provides the Market Participants with the detailed assessment methodology against each clause of Appendix 12 of the WEM Rules with respect to the type of the Generating System.*

*In addition, Western Power has provided the Market Participant with sufficient information, i.e. GPS Input Package[[1]](#footnote-2), to perform the compliance assessment and provide performance level of the Generating System against each clause of GPS – i.e. Appendix 12 of the WEM Rules.*

*The Market Participant has:*

* + 1. *requested AEMO to provide the Maximum Temperature at the site location and all temperature dependant clauses are assessed at ambient temperature and all temperatures up to and including the Maximum Temperature;*
    2. *prepared one draft Generator Performance Standards Report (R0, R1, or R2 GPS depending on the project connection status – current document) for validation by Western Power and subsequently AEMO / one final Generator Performance Standards Report (R0, R1, or R2 GPS depending on the project connection status) for approval by Western Power and AEMO;*
    3. *along with each version of the report, submitted below items to Western Power:*
       1. *GPS template [4];*
       2. *temperature dependant data of the facility, submitted in the same format as per the template spreadsheet [5];*
       3. *separate files attached to the GPS report that include all simulation results for the relevant clauses. The documents are to be named after the clause number, for example Attachment B (A12.3), Attachment C (A12.4), etc;*
       4. *Unencrypted PowerFactory Model of the Generating System including behind the meter reactive plant (if any). Refer to the Facility Model Guidelines for further details [6];*
       5. *PSCAD model of the Generating System if used for the assessment of Clause A12.9 including behind the meter reactive plant (if any). Refer to Facility Model Guidelines for further details [6];*
       6. *any other relevant documents that are used as a reference for justification of the performance level and compliance assessment of the facility. For example, the Power Quality Assessment Report.*
          1. *The key activities do not include:*
* *Any activities not specifically listed in the above scope.*

*After each GPS submission, Western Power will:*

* 1. *review the draft Generator Performance Standards Report prepared by the Market Participant, the Unencrypted Generating System Model as well as other complementary documents submitted along with the GPS Package and provide comments in the GPS Assessment Validation Spreadsheet;*
  2. *upload the received GPS package on AEMO’s portal along with GPS Assessment Validation Spreadsheet;*
  3. *consolidate the comments provided by WP and AEMO in the GPS Assessment Validation Spreadsheet;*
  4. *submit the consolidated comments via the GPS Validation Spreadsheet to the Market Participant and initiate discussion with MP if required for that submission;*
  5. *review and, at Western Power and AEMO’s absolute discretion, approve the final Generator Performance Standards Report.*
     + - 1. *Note that if the submitted GPS package is deemed to be* ***incomplete****, Western Power will notify the Market Participant.*

# GPS Compliance Assessment Results

## Assessment of Clause A12.2 – Active Power Capability

[Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.2.

One of the main items to be provided in this section would be the Active Power Capability which must include Temperature Dependency Data up to and including the Maximum Temperature, which must include the Rated Maximum Active Power, and including ambient temperatures above the Maximum Temperature after which the Active Power capability is reduced:

(a) for the Generating System measured at the Connection Point; and

(b) for each Synchronous Generating Unit measured at the Generating Unit terminal.

Separate to this report, the Active Power temperature dependant data at the Point of Connection (POC) needs to be provided using the “Temperature Dependant Data Template” [4].]

## Assessment of Clause A12.3 – Reactive Power Capability

[Provide briefing on the assessment methodology and alignment with the GPS Guideline. The methodology should be provided for different control modes including voltage, and reactive power control mode. The assessment methodology will be different when the facility is operating in different control modes, hence the methodology that have been applied to produce the Performance Chart at the Connection Point must be provided for different control modes including voltage, and reactive power control mode and explained in detail in this section. Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.3.

One of the main items to be provided in this section would be the Reactive Power Capability Curves at POC, the Generator Performance Standard must include a Generator Performance Chart, including data up to and including the Maximum Temperature, and including ambient temperatures above the Maximum Temperature after which the performance is reduced.

Separate to this report, the Reactive Power temperature dependant data at POC needs to be provided using the “Temperature Dependant Data Template” [4].]

## Assessment of Clause A12.4 – Voltage and Reactive Power Control

[Provide briefing on the assessment methodology and alignment with the GPS Guideline. The methodology should be provided for different control modes including voltage, reactive power, and power factor control mode. Refer to Table 3.7 of the GPS Guideline for further details on the study cases and other criteria required for the assessment of this clause. Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.4.

One of the main items to be provided in this section would be tabulated *Rise Time* and *Settling Time* for all of the simulated study cases in each control mode.

Note that the Clauses relevant to the Power System Stability and Power Oscillation Damping such as A12.4.2.2.(a), A12.4.2.2. (b), A12.4.2.2.(c), and A12.4.2.13 are to be assessed using the Wide Area Model South-West Inter-connected System (SWIS) Base Model and shall be assessed by Network Service Provider (NSP). A standard Statement of Compliance can be provided for the R0 GPS submission.]

### Assessment of Clause A12.4 – Voltage Control Mode

[Provide assessment results when the Generating System operates in voltage control mode.]

### Assessment of Clause A12.4 – Reactive Power Control Mode

[Provide assessment results when the Generating System operates in reactive power control mode.]

### Assessment of Clause A12.4 – Power Factor Control Mode

[Provide assessment results when the Generating System operates in power factor control mode.]

## Assessment of Clause A12.5 – Active Power Control

[Provide briefing on the assessment methodology and alignment with the GPS Guideline. Refer to Table 3.9 of the GPS Guideline for further details on the study cases and other criteria required for the assessment of this clause. Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.5.]

## Assessment of Clause A12.6 – Inertia and Frequency Control

[Provide briefing on the assessment methodology and alignment with the GPS Guideline. Refer to Table 3.11 of the GPS Guideline for further details on the study cases and other criteria required for the assessment of this clause. Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.6.]

## Assessment of Clause A12.7 – Frequency Disturbance Ride Through

[Provide briefing on the assessment methodology and alignment with the GPS Guideline. Refer to Table 3.13 of the GPS Guideline for further details on the study cases and other criteria required for the assessment of this clause. Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.7.]

## Assessment of Clause A12.8 – Voltage Disturbance Ride Through

[Provide briefing on the assessment methodology and alignment with the GPS Guideline. The assessment results should be provided for different control modes including voltage, reactive power, and power factor control mode. Refer to Table 3.14 of the GPS Guideline for further details on the study cases required for the assessment of this clause. Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.8.]

## Assessment of Clause A12.9 – Multi-Disturbance Ride Through

[Provide briefing on the assessment methodology and alignment with the GPS Guideline. The assessment results should be provided for different control modes including voltage, reactive power, and power factor control mode. Refer to Table 3.17 of the GPS Guideline for further details on the study cases required for the assessment of this clause. Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.9.]

### Assessment of Clause A12.9 – Balance Faults

[Provide assessment results for all of balance fault cases.

One of the main items to be provided in this section would be tabulated *k-factor*, *Rise Time* and *Settling* *Time* for all of the simulated study cases in each control mode. Refer to Section 3.9.2.1 of the GPS Guideline for further details on the calculation of k-factor for balance faults.]

### Assessment of Clause A12.9 – Unbalance Faults

[Provide assessment results for all of unbalance fault cases.

One of the main items to be provided in this section would be tabulated *k-factor*, ratio of negative sequence to positive sequence reactive current, Rise Time and Settling Time for all of the simulated study cases in each control mode. Refer to Section 3.9.2.1 of the GPS Guideline for further details on the calculation of k-factor for unbalance faults.]

### Assessment of Clause A12.9 – Over-voltage Events

[Provide assessment results for all of over-voltage cases.

One of the main items to be provided in this section would be tabulated *k-factor*, ratio of negative sequence to positive sequence reactive current, *Rise Time* and *Settling Time* for all of the simulated study cases in each control mode. Refer to Table 3-19 of the GPS Guideline for further details on the study cases required for the assessment of this clause.]

### Assessment of Clause A12.9 – Continuous Uninterrupted Operation for series of disturbances

[Provide assessment results for series of disturbances as defined in GPS Clauses A12.9.2.3 and A12.9.3.3.

Refer to Table 3-21 and 3-33 of the GPS Guideline for further details on the study cases required for the assessment of this clause.]

## Assessment of Clause A12.10 – Partial Load Rejection

[Provide briefing on the assessment methodology and alignment with the GPS Guideline. Refer to Table 3.24 of the GPS Guideline for further details on the study cases required for the assessment of this clause. Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.10.]

## Assessment of Clause A12.11 – Disturbance Ride Through Quality of Supply

[Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.11.]

## Assessment of Clause A12.12 – Quality of Electricity Generated

[Provide briefing on the assessment methodology and alignment with the GPS Guideline. Refer to Section 3.12 of the GPS Guideline for further details on the assessment methodology for the Power Quality (PQ) assessment. Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.12.

Power Quality emission of the Generating System is to be assessed against the PQ limits provided by NSP at the POC and submitted via a separate report attached to the GPS report – i.e. Power Quality Report.]

## Assessment of Clause A12.13 – Generation Protection System

[Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.13.

All the protection settings including the inverter protection settings and anti-islanding settings are to be provided to NSP via a separate report attached to the GPS report – i.e. Protection Design Report.]

## Assessment of Clause A12.14 – Remote Monitoring Requirement

[Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.14.]

## Assessment of Clause A12.15 – Remote Control Requirement

[Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.15.]

## Assessment of Clause A12.16 – Communication Equipment Requirement

[Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.16.]

## Assessment of Clause A12.17 – Generating System Model

[Provide justifications for the Performance Level and the Statement of Compliance for each clause under A12.11.

The model is to be assessed against the Facility Model Guidelines provided by NSP [6]. Below items are to be considered when submitting the model to NSP:

* Encrypted and Unencrypted PowerFactory Model of the Generating System is to be submitted along with the R0 GPS package.
* The model aggregation methodology should be provided as part of the GPS package as per the requirement of Facility Model Guidelines [6]. Note that the inverters are to be paralleled at each collector group. Replacing the parallel inverters with one inverter with equivalent MVA at the collector groups is not accepted.
* The model should include the dynamic model of any other plants connected behind the meter which is required to comply with other Clauses of GPS such as:
  + Any reactive plant connected behind the meter to meet the requirement of the reactive power capability (Clause A12.3) at Maximum Temperature;
  + Any reactive plant connected behind the meter to meet the requirement of Power Quality Assessment (Clause A12.12.).
* Note that as per the requirements of Technical Rules Clause behind the meter connection of mechanical switching reactive plant is not accepted.]

# References

1. [AEMO | Wholesale Electricity Market Rules, 13 December 2023](https://www.wa.gov.au/system/files/2024-01/wholesale_electricity_market_rules-13_december_2023.pdf)
2. [Western Power | Technical Rules](https://www.westernpower.com.au/siteassets/documents/documents-and-policies/technical-rules-20161201.pdf)
3. [Western Power | Generator Performance Standards: Guideline for the Assessment of Technical Requirements](https://www.westernpower.com.au/siteassets/documents/documents-and-policies/generator-performance-standards/generator-performance-standards-guidelines-for-the-assessment-of-technical-requirements-20230130.pdf)
4. [Western Power | GPS Template Spreadsheet](https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.westernpower.com.au%2Fsiteassets%2Fdocuments%2Fdocuments-and-policies%2Fgenerator-performance-standards%2Fgenerator-performance-standard-template-v5-20231128.xlsx&wdOrigin=BROWSELINK)
5. Western Power | Temperature Dependant Data [Template](https://www.westernpower.com.au/resources-education/manuals-guides-standards/generator-performance-standards/)
6. [Western Power | Facility Model Guidelines](https://www.westernpower.com.au/siteassets/documents/generator-and-load-model-guidelines-20210125.pdf)
7. 1. Connection Option Single Line Diagram
   2. Complementary Data for Assessment of Clause A12.3

[A separate attachment (Attachment A) to be provided for the complementary data/simulation results for the assessment of this clause.]

* 1. Complementary Data for Assessment of Clause A12.4

[A separate attachment (Attachment B) to be provided for the complementary data/simulation results for the assessment of this clause.]

* 1. Complementary Data for Assessment of Clause A12.6

[A separate attachment (Attachment C) to be provided for the complementary data/simulation results for the assessment of this clause.]

* 1. Complementary Data for Assessment of Clause A12.7

[A separate attachment (Attachment D) to be provided for the complementary data/simulation results for the assessment of this clause.]

* 1. Complementary Data for Assessment of Clause A12.8

[A separate attachment (Attachment E) to be provided for the complementary data/simulation results for the assessment of this clause.]

* 1. Complementary Data for Assessment of Clause A12.9 – Balance Fault

[A separate attachment (Attachment F) to be provided for the complementary data/simulation results for the assessment of this clause.]

* 1. Complementary Data for Assessment of Clause A12.9 – Unbalance Fault

[A separate attachment (Attachment G) to be provided for the complementary data/simulation results for the assessment of this clause.]

* 1. Complementary Data for Assessment of Clause A12.12

[A separate attachment (Attachment H) to be provided to include the Power Quality (PQ) assessment report against the PQ limits provide by the NSP to MP.]

* 1. Complementary Data for Assessment of Clause A12.13

[A separate attachment (Attachment I) to be provided to include the Protection Design report.]

1. GPS Input package includes the Fault Levels at the Point of Connection (POC), Power Quality Allocation Limits and Frequency Sweep at POC (if requested) [↑](#footnote-ref-2)