Relevant Generator Modification Guideline

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Contents

Acronyms & abbreviations

The following table provides a list of abbreviations and acronyms used throughout this Guideline.

Acronym / term / abbreviation	Meaning
AEMO	Australian Energy Market Operator
AVR	Automatic Voltage Regulator
ERA	Economic Regulation Authority
GPS	Generator Performance Standard
MW	Megawatt
CCGT	Combined cycle gas turbine
SCADA	Supervisory control and data acquisition
WEM	Wholesale Electricity Market
RGM	Relevant Generator Modification
Potential RGM	Potential Relevant Generator Modification
PPC	Power plant controller
WEM Rules	The Wholesale Electricity Market Rules established under the Electricity Industry (Wholesale Electricity Market) Regulations 2004 (WA)
Technical Rules	The Technical Rules prepared in accordance with the Electricity Networks Access Code 2004 (WA)

This Guideline uses terms defined in Chapter 11 and Appendix 12 of the WEM Rules. The following table provides a list of terms used in this document that take the meaning provided in the WEM Rules.

For ease of reference, the list of terms includes the meaning as given in the version of the WEM Rules at the time this Guidelines was published. However, these terms take the definition provided in the most up to date WEM Rules at the time the Guideline is being applied.

Term	Meaning
Existing Transmission Connected Generating System	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means a Transmission Connected Generating System for which an Arrangement for Access has been executed prior to the Tranche 1 Commencement Date other than an Exempt Transmission Connected Generating System." Note: Tranche 1 Commencement Date "Means the Trading Day commencing at 8:00 AM on 1 February 2021."]
Facility	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Any of the facilities described in clause 2.29.1."]
Generator Monitoring Plan:	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means a monitoring plan for a Transmission Connected Generating System in respect of the Registered Generator Performance Standards that apply to the Transmission Connected Generating System."]

Term	Meaning
Generating System	The meaning given in Appendix 12 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "As described in the Technical Rules." The Technical Rules as of 1 December 2016 provided the following definition "A system comprising one or more generating units."]
Generator Performance Standard	The meaning given in Appendix 12 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means either the Ideal Generator Performance Standard or Negotiated Generator Performance Standard in respect of a Technical Requirement."
Generating Unit	The meaning given in Appendix 12 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "As described in the Technical Rules." The Technical Rules as of 1 December 2016 provided the following definition "The equipment used to generate electricity and all the related equipment essential to its functioning as a single entity."]
Ideal Generator Performance Standard	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means the ideal generator performance standard in respect of a Technical Requirement as specified in Appendix 12."]
Market Participant:	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "A Rule Participant that is a Market Generator or a Market Customer."]
Minimum Generator Performance Standard	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means the minimum generator performance standard in respect of a Technical Requirement as specified in Appendix 12."
Negotiated Generator Performance Standard	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means a standard or technical level of performance in respect of a Technical Requirement that represents a variation from the Ideal Generator Performance Standard but is no less than the Minimum Generator Performance Standard that has been approved and registered in accordance with the process in Chapter 3A."]
Potential Relevant Generator Modification	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Has the meaning given in clause 3A.13.1."]
Rectification Plan	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means a plan submitted by a Market Participant responsible for a Transmission Connected Generating System in respect of a Transmission Connected Generating System, an alternative Rectification Plan proposed by AEMO or amended Rectification Plan under section 3A.11."]
Registered Generator Performance Standard	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means: (a) in respect of a Transmission Connected Generating System other than an Existing Transmission Connected Generating System, an Ideal Generator Performance Standard or a Negotiated Generator Performance Standard that has been approved and registered in accordance with the process in Chapter 3A; and (b) in respect of an Existing Transmission Connected Generating System, the standard or technical level of performance in respect of a Technical Requirement that is an Agreed Generator Performance Standard under section 1.40 and deemed to be a Registered Generator Performance Standard under clause 1.40.31."]
Technical Requirement	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means each Technical Requirement for a Transmission Connected Generating System specified in Appendix 12."
Template Generator Monitoring Plan	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means the template Generator Monitoring Plan set out in the WEM Procedure referred to in clause 3A.6.2 as amended from time to time."

Term	Meaning
Test	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means a Commissioning Test or a Reserve Capacity Test."
Transmission Connected Generating System	The meaning given in Chapter 11 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "Means generating works connected to a transmission system in the SWIS."]
Remote Control Equipment or RCE	The meaning given in Appendix 12 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "As described in the Technical Rules." The Technical Rules as of 1 December 2016 provided the following definition "Equipment installed to enable the Network Service Provider to control a generating unit circuit breaker or other circuit breaker remotely"]
Remote Monitoring Equipment or RME	The meaning given in Appendix 12 of the WEM Rules. [The definition in WEM Rules as of 1 June 2022, was "As described in the Technical Rules." The Technical Rules as of 1 December 2016 provided the following definition "Equipment installed to enable the monitoring of other equipment from a remote control centre and includes a remote terminal unit (RTU)."

1. Introduction

1.1 Background

From 1 February 2021, the generator performance requirements for both new and existing Market Participants with Generating Systems connected to Western Power's transmission system in the SWIS moved from the Technical Rules[1] to Chapter 3A and Appendix 12 of the Wholesale Electricity Market Rules (WEM Rules). Under the WEM Rules the performance requirements are referred to as the Generator Performance Standards (GPS).

When the generator performance requirements were transferred to the WEM Rules, provisions were introduced that provide for agreed GPS to be updated when changes are made to generating units or generating works that have the potential to affect the characteristics, performance or capacity of the Generating System. These provisions are referred to as the Relevant Generator Modification (RGM) framework.

1.2 Purpose of this Guideline

This Guideline is designed to provide information and guidance to Market Participants on the RGM framework. Specifically, this Guideline identifies alterations to 'Transmission Connected Generating Systems' that Western Power and the Australian Energy Market Operator (AEMO) considers are Potential RGMs and the circumstances, factors or other considerations that may result in a Potential RGM being declared a RGM.

Consistent with the clause 3A.13.2 of the WEM Rules and the limitations set out in section 1.4 of this Guideline, this Guideline provides examples and guiding information only.

This Guideline has been developed in consultation with AEMO.

1.3 Application of this Guideline

This Guideline applies to Transmission Connected Generating Systems and Exempt Transmission Connected Generating Systems. It applies to changes to these systems after:

- an initial set of GPS have been agreed in the case of Transmission Connected Generating Systems; or
- an exemption has been granted in the case of Exempt Transmission Connected Generating Systems.

This Guideline does not apply to an Existing Transmission Connected Generating System until, in accordance with clauses 1.39.1 and 1.39.13 of the WEM Rules, that Existing Transmission Connected Generating System has:

a) a Registered GPS for each Technical Requirement in accordance with section 1.40 of the WEM Rules; and

b) a Generator Monitoring Plan approved by AEMO in accordance with section 1.41 of the WEM Rules or determined by an arbitrator in accordance with the dispute resolution mechanism contained in section 1.42 of the WEM Rules.

[1] The Technical Rules prepared by the Western Power as the Network Service Provider under Chapter 12 of the Electricity Networks Access Code 2004 (WA).

1.4 Limitations

This Guideline is intended to provide guidance and examples only. It does not include a comprehensive list of the changes the Western Power and AEMO may declare a RGM.

The information in the Guidelines does not preclude the requirement for the Market Participant to notify the Network Operator of any Potential RGM. The guidance does not bind the Network Operator to make decisions that are consistent with the Guideline.

Legal disclaimer

This Guideline has been developed in accordance with the version of the WEM Rules published on 12 April 2022. However, it should be read in conjunction with the most up-to-date version of the WEM Rules.

The information and advice provided is designed to guide Market Participants on how they may change their Generating Systems in accordance with the RGM framework set out in the WEM Rules. It is not meant to be used to inform business or investment decisions by Market Participants or any other third parties.

Western Power accepts no liability for any subsequent non-compliance or technical issues pertaining to the interpretation of information provided in this Guideline.

1.5 Related documents

The WEM Rules provide the requirements and background information to this Guideline and are available on the Energy Policy WA website.

The following WEM Procedures and supporting documents are associated with this Guideline:

- Documents available on the AEMO website:
  - WEM Procedure: Generator Monitoring Plans (WEM Rule 3A.6.2)
  - WEM Procedure: Communications and Control Systems[2] (WEM Rule 2.1A.2(h))
- Documents available on the Energy Policy WA website[3]:
  - WEM Procedure: Dispute Resolution Mechanism for Existing Transmission Connected Generating Systems (WEM Rule 1.42.10)
- Documents available on Western Power's website[4]:
  - Generator Performance Standards Template
  - Generator Performance Standard Trigger Event Template
  - WEM Procedure: Generation System Model Submission and Maintenance
  - WEM Procedure: Generator Performance Standards for Existing Transmission Connected Generating Systems

The Technical Rules[5] also provide background information to this Guideline and are available on the Economic Regulation Authority's (ERA) website.

[2] Communications and Control Systems
[3] WEM Procedure (www.wa.gov.au)
[4] Generator Performance Standards | Western Power
[5] Technical Rules

1.6 Further guidance

Where a Market Participant requires further clarity on this Guideline or the WEM Rules related to generator performance, enquiries should be directed to systems.analysis@westernpower.com.au.

2. Relevant Generation Modification framework

The RGM framework seeks to identify, then filter and appropriately manage changes to Transmission Connected Generating Systems that have the potential to affect a Market Participant's Registered GPS.

The process provides a proactive way for Market Participants to ensure the Registered GPS held by Western Power and AEMO are reflective of the actual equipment, capacity and capabilities of their Facility.

The framework sits alongside broader obligations in the WEM Rules, including the compliance framework.

Figure 2-1 provides an overview of the RGM framework process.

2.1 Potential Relevant Generator Modifications

All modifications to a Generating System or a part thereof that have the potential to affect the characteristics, performance or capacity of the Generating System are Potential RGMs. Such changes are necessarily captured as Potential RGMs because they can alter the expected performance of the Generating System with respect to Technical Requirements set out in the WEM Rules.

In general, changes to equipment and process directly involved in power generation and power transfer or the management of power generation or transfer are Potential RGMs. Whereas changes to equipment that are only indirectly involved in power generation and power transfer are less likely to be Potential RGMs. Market Participants should note Western Power may request information about all changes (section 4). Examples of equipment **indirectly** involved in power generation and power transfer that Western Power may seek further information on include:

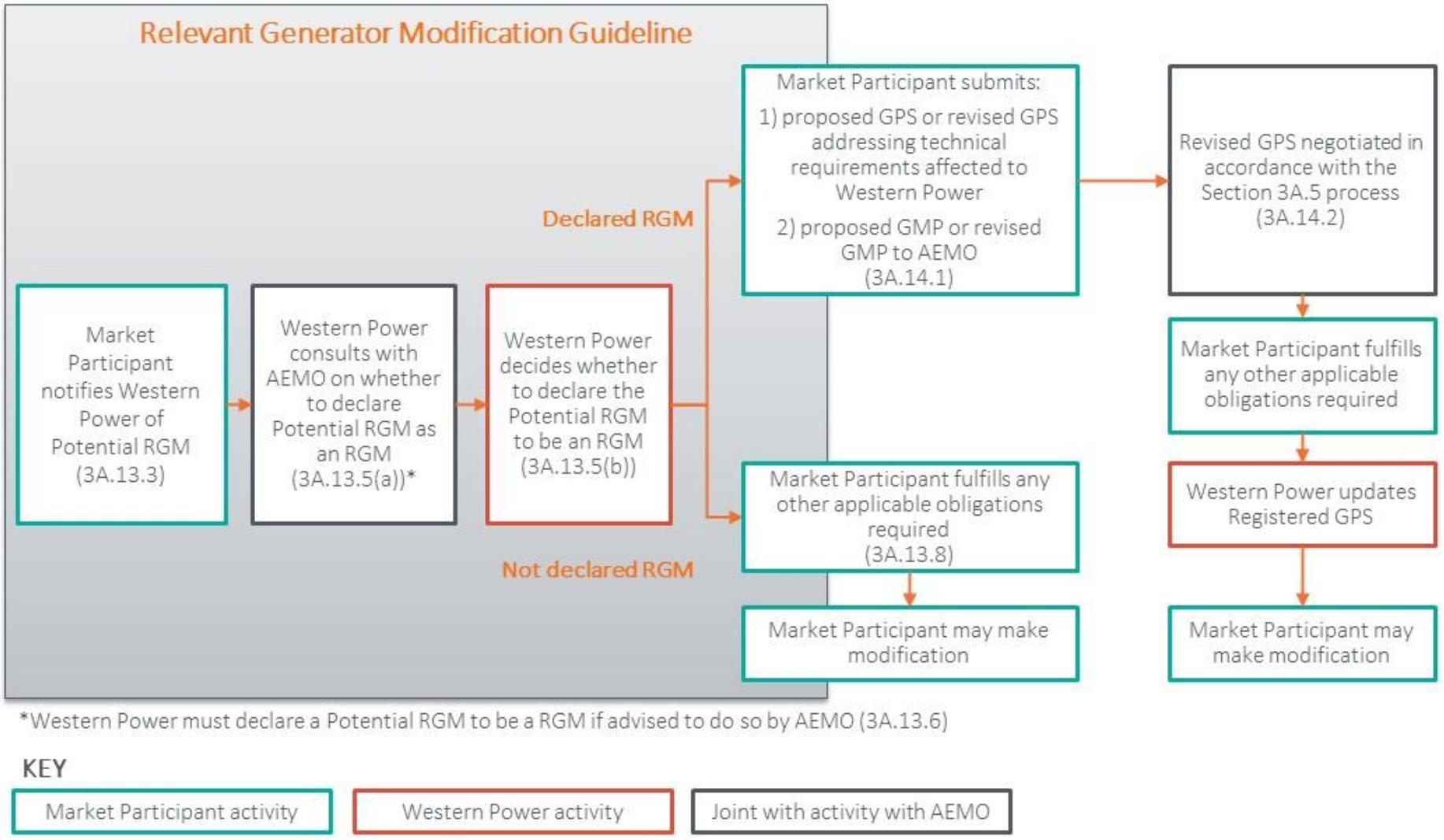
- solar tracking systems
- battery management system
- cooling tower changes
- auxiliary equipment changes.

Except for changes affecting secondary systems associated with Technical Requirements (covered in section 8 of this Guideline)[6], changes to secondary systems are typically considered indirect and will not commonly be considered Potential RGMs. However, Market Participants should consider if changes to these systems could have cumulative effects that alter the ability to meet the Registered GPS. If such changes are revealed through the monitoring of compliance under the Generator Monitoring Plan (WEM Rule 3A.6) they must be reported under the Self Reporting Regime (WEM Rule 3A.10) followed by a Rectification plan process (WEM Rule 3A.11 and 3A.12). Early identification of potential cumulative effects and notification of the Potential RGM provides a proactive alternative approach in these circumstances.

Market Participants are obligated under section 3A.13.3 of the WEM Rules to notify Western Power of a Potential RGM. Notification does not necessarily mean the change will be declared a RGM or that the Market Participant's Registered GPS will need to be re-negotiated. However, notification allows Western Power (and AEMO) together with the Market Participant to assess the potential effects of the change before it is implemented. The mechanism acts to ensure any affects are appropriately managed and recorded.

[6] Protection systems, remote monitoring and communication systems and generation system models

Figure 2-1: Overview of process for notification and assessment of Potential RGMs



2.2 Relevant Generation Modifications

A RGM is a Potential RGM that alters the expected performance of the Generating System with respect to any of the Technical Requirements set out in the WEM Rules.

Declaring a RGM enables effects of the change to be appropriately captured in updated Registered GPS. Western Power and AEMO rely on the Registered GPS information for operations and management of the power system so it is important that the Registered GPS are accurate and up to date.

This Guideline provides examples of Potential RGMs and RGMs. Notifications of Potential RGMs and subsequent declarations of RGMs may be captured in future version of this Guideline as a means of ensuring consistency in the treatment of similar RGMs and to inform Market Participants of examples.

2.3 Relationship with the compliance frameworks

Clause 3A.1.1 of the WEM Rules requires Market Participants to comply with each Registered GPS for a Transmission Connected Generating System. Non-compliances with a Registered GPS are treated under the compliance framework in Chapter 3A and are typically reactive in nature.

The RGM framework exists as part of the WEM Rules Compliance framework for Transmission Connected Generating Systems and is a proactive approach to updating a Registered GPS. It can cover updates that improve or alter the Generating System or works, and changes that seek to avoid non-compliances with the Registered GPS.

2.3.1 Replacements due to failure

Replacements of equipment due to failure (and corrections to settings, for example, due to errors) can coincide with a Generator being unable to meet its Registered GPS. Urgent replacement of equipment following a failure event that restores the ability to achieve the Registered GPS or restores the ability for Western Power or AEMO to safely and reliability operate the power system requires the Market Participant to follow the Chapter 3A compliance framework.

The Chapter 3A non-compliance framework requires a Market Participant responsible for the Transmission Connected Generating System to notify AEMO immediately of the actual or suspected non-compliance. It also typically involves the development and approval of a Rectification Plan to address the non-compliance. As part of that Rectification Plan, depending on the failure and any remedy actions taken in the short term, there may be a requirement for a Market Participant to update one or more of its Registered GPS and undertake some elements of the commissioning and testing processes.

In practice, unless spares of equipment are held on-site, Western Power anticipates there will be sufficient time prior to any replacement of failed equipment, for the Market Participant and Western Power to discuss and agree replacements that may affect the Market Participant's Registered GPS.

The RGM framework applies to replacements unless the Chapter 3A compliance framework applies.

For avoidance of doubt, identification of the need for an urgent or emergency change (including equipment replacement and other fixes) that have the potential to affect Registered GPS, or the operation of the power system must be reported to Western Power and AEMO and the options to address the urgent need discussed and agreed.

2.4 Relationship with maintenance

Consistent with Chapter 3A, all Generators have ongoing maintenance plans and processes. Where minor maintenance activities do not involve equipment that relate to any Technical Requirements, there is no overlap with the RGM framework and any changes to that equipment does not need to be put forward as a Potential RGM. Examples of ongoing maintenance that are unrelated to Technical Requirements are typically those that are not concerned with the production or delivery of electricity. For example, changes to signage at generator's site, the colour of wind turbines and updates to Windows programs used on staff computers.

Alternatively, significant maintenance is maintenance that has the potential to alter the performance of the Generating System with reference to the Technical Requirement. For example:

- Transformer refurbishments such as oil changes and re-winding of step-up transformers intended to extend the life of the transformer.
- Rotor and stator rewinding (including as part of ongoing maintenance and following a fault event).
- Stator winding overhaul (noting that typically the AVR will be changed as the same time, which is a RGM).
- Replacement of the main feeder power cables.

Following significant maintenance, Generators may be required go through commissioning processes for new (and replaced) equipment (consistent with section 3.21A of the WEM Rules and with the requirements of the WEM Procedure: Generator Monitoring Plan published by AEMO) and may be requested to conduct tests that demonstrate achievement of agreed GPS

In some cases, significant maintenance may trigger a Potential RGM (a stator inverter winding rehaul combined with an AVR change is one example given above). As such, Generators should consider whether maintenance activities need to also be reviewed through the RGM framework.

2.4.1 Reactive maintenance

Changes made as a consequence of reactive maintenance does not preclude the change being considered under the RGM framework. Similar to replacement due to failure discussed in section 2.3.1 of this Guideline, reactive maintenance needs to consider if the interim fix should be considered under RGM process or a Rectification Plan needs to be considered.

Western Power does not consider that the intention of the RGM framework is to prevent or slow a Generator from making changes where these are necessary for continued generation and transfer of power. The retrospective application of the process to reactive maintenance and changes following failure events allows for the appropriate consideration of the potential change and for updates to be captured in Registered GPS.

2.5 Replacements

Replacement of equipment, systems, software and settings necessarily occurs as part of ongoing maintenance, in response to failures and to support changes in a Generating System's performance.

The RGM framework does not intend to capture all replacement changes, but rather those that have the potential to affect the performance, characteristics, capacity and capability of the Generating System. It also seeks to record accurate, up to date information in the case of generator system models that are relied on to mimic actual performance.

Where replacements are concerned and within the RGM framework, Western Power adopts the following definitions and treatments for 'like-for-like' replacements and 'like-for-equivalent' replacements.

2.5.1 Like-for-like replacements

True 'like-for-like' changes are not Potential RGMs. Regardless of the driver (maintenance, failure), a true like-for-like change is one where the new equipment is the same as the old equipment with respect the following:

- Make, model and manufacturer are unchanged
- The same settings are adopted before and after the change.
- The same software or firmware, including the version number, is being used.
- There is no or very low risk that the characteristics, performance or capacity of the Generating System will be changed following the replacement.

True 'like-for-like' changes are different from 'like-for-equivalent' replacements discussed below.

Generators should note that after significant maintenance, even if changes are 'like-for-like' Generators will need to follow the requirements under Chapter 3A the WEM Rules, which may include commissioning testing and inspection procedures.

2.5.2 Like-for-equivalent replacements

Equivalent replacements to equipment that is involved in power generation and power transfer or that affects secondary systems that are Technical Requirements (protection, remote monitoring and control, and Generating System models) are all Potential RGMs.

The driver for a 'like-for-equivalent' replacement is not relevant to the determination that such replacements are Potential RGMs or any subsequent decision to declare the replacement a RGM. The relevant factor is whether the change could affect the way Technical Requirements outlined in the WEM Rules are achieved.

'Like-for-equivalent' replacements must be discussed as Potential RGMs with Western Power so that appropriate assessment of the change and relevant updates to the Registered GPS, if required, can be made. As with other changes discussed in this Guideline, the assessment and update process may be need not be onerous. Consistent with the principles in Chapter 3, the Technical Requirements to be considered only those affected by the replacement.

2.6 Relationship to changes to a Market Participant's Registration

A change to a Market Participant's Registration does not directly trigger a requirement to submit a Potential RGM. However, changes to the equipment, systems and settings for the Generating Systems that enable a different Registration may be Potential RGMs.

Market Participant's considering changes to their Registration should contact Western Power to discuss the changes and whether a Potential RGM must be submitted.

3. General principles for assessment

In assessing if changes are Potential RGMs and subsequently assessing if those Potential RGM should be declared RGMs, Western Power intends to apply the following general principles:

1. Focus on changes that directly affect power generation and power transfer or the secondary system Technical Requirements
2. Assess relevant Technical Requirements affected by the change.
3. Support updates that move performance towards the most current ideal standard (where technically possible)

The principles are intended to inform Market Participants of general considerations and Western Power's approach to facilitating the process. Each principle is discussed in greater detail below.

3.1 Focus on changes directly affecting Technical Requirements

As outlined in section 2.1, changes to equipment and processes directly involved in power generation and power transfer or the management of power generation or transfer are Potential RGMs. Whereas, with the exception of changes to the secondary systems for which there are Technical Requirements and changes affecting the Generating System model, changes to equipment that are only indirectly involved in power generation and power transfer are less likely to be Potential RGMs. Generators should note Western Power may request information about all changes (section 4).

3.2 Assess relevant Technical Requirements

RGMs can affect one or more Technical Requirements (as defined in Appendix 12 of the WEM Rules). In the first instance, Western Power will look to understand the Potential RGM and the extent to which the change will affect or not affect Registered GPS.

When a RGM is declared, Western Power will seek only to assess only those Technical Requirements that are impacted by the modification and re-negotiate those as appropriate.

Examples in this Guideline provide an indication of mapping between a range of changes and affected Technical Requirements. The examples and mapping are intended to provide guidance only and individual circumstances may alter the range of Technical Requirements that must be re-established following a declared RGM. The mapping is provided as guidance to Market Participants as to which Requirements Western Power will likely require information about with respect to the change. An 'unlikely' indication does not limit Western Power from considering effects of the change on the Technical Requirements.

For the Technical Requirements that are considered unlikely to be affected by the change, Western Power may seek information from the Market Participant that demonstrates this outcome as part of investigations. The nature of the information requested will depend on the Registered GPS being considered.

3.3 Support changes that move towards the Ideal GPS

Western Power supports changes which bring Generating System performance to the Ideal GPS at the time of the modification

As the power system evolves, the requirements that enable the safe, reliable and efficient operation of the power system change and the capability, characteristics and performance expected of Generators change

accordingly. All Generators have an obligation to contribute to the achievement of the power system performance standards as it allows Western Power and AEMO to run the system efficiently, reliably and securely (as stated in WEM Rules A12.3.2.2 and A12.4.2.5). Consistent with this approach, Market Participants making changes to their Generating System or generating works must take the opportunity to move towards improved performance that improves the ability to the WEM Rule objectives, wherever reasonable.

Consistent with this principle the following changes to a generating unit or generating works are **highly likely** to be declared a RGM:

- Changes where the Registered GPS for a Technical Requirement is below the current Minimum Generator Performance Standard.
- If the relevant Technical Requirement(s) affected by the RGM have changed in WEM Rules, since the GPS was last registered.

As outlined in sections 2.3 and 2.4 of this Guideline, replacements due to failure and reactive maintenance activities are not precluded from the RGM framework.

4. Information required for assessment

The information required for Western Power (and AEMO) to assess a Potential RGM will vary depending on the type of change and the extent to which Technical Requirements are affected.

In the first instance, Western Power will require information, such as:

- Description of the change and the equipment, systems or settings involved
- The reason for the change
- The expected effect (including effects outside of the Technical Requirements) of the change including if and how the change may alter the characteristics, performance or capacity of the Generating System.

Western Power and AEMO may request additional information following an initial enquiry or submission of a Potential RGM to enable them to make an assessment. Examples in this Guideline include further information that will be required to facilitate assessment where the requirement for additional information is known.

Market Participants should be aware that, regardless of any declaration of an RGM, obligations in the WEM Rules may require information to be submitted to Western Power and AEMO or for particular activities to be undertaken in relation to a change. For example:

- Commissioning related activities required for new or replaced equipment
- Testing schedules and test results demonstrating performance (or continued performance).

5. Equipment changes

In this section, changes to a selection of equipment within a Generating System are considered. The information provided is intended to give guidance only and is not conclusive or exhaustive. Every change to a Generating System needs to be considered individually.

5.1 AVR replacements

Automatic Voltage Regulator (AVR) changes are a common example of a change to a voltage control system in a synchronous generator.

Table 5.1 provides an indication of the Technical Requirements under the WEM Rules that are more likely to be affected or require reassessment following changes to an AVR.

Table 5.1: Affected Technical Requirements: Automatic voltage regulator changes

WEM Rule	Technical Requirement	AVR changes
A12.2.	Active Power Capability	Unlikely
A12.3.	Reactive Power Capability	Yes
A12.4.	Voltage and Reactive Power Control	Yes
A12.5.	Active Power Control	Unlikely
A12.6.	Inertia and Frequency Control	Unlikely
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Potentially
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Yes
A12.9.	Disturbance Ride Through for Multiple Disturbances	Yes
A12.10.	Disturbance Ride Through for Partial Load Rejection	Potentially
A12.11.	Disturbance Ride Through for Quality of Supply	Unlikely
A12.12.	Quality of Electricity Generated	Unlikely
A12.13.	Generation Protection Systems	Unlikely
A12.14.	Remote Monitoring Requirements	Potentially
A12.15.	Remote Control Requirements	Unlikely
A12.16.	Communications Equipment Requirements	Potentially
A12.17.	Generation System Model	Yes

5.2 Governor replacements

Governor replacements are a common example of a change in a synchronous generator that affects frequency control.

Table 5.2 provides an indication of the Technical Requirements under the WEM Rules that are more likely to be affected or require reassessment following changes to an AVR.

Table 5.2: Affected Technical Requirements: Governor replacements

WEM Rule	Technical Requirement	Governor replacements
A12.2.	Active Power Capability	Yes
A12.3.	Reactive Power Capability	Unlikely
A12.4.	Voltage and Reactive Power Control	Unlikely
A12.5.	Active Power Control	Yes
A12.6.	Inertia and Frequency Control	Yes
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Yes
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Potentially
A12.9.	Disturbance Ride Through for Multiple Disturbances	Potentially
A12.10.	Disturbance Ride Through for Partial Load Rejection	Yes
A12.11.	Disturbance Ride Through for Quality of Supply	Unlikely
A12.12.	Quality of Electricity Generated	Unlikely
A12.13.	Generation Protection Systems	Unlikely
A12.14.	Remote Monitoring Requirements	Potentially
A12.15.	Remote Control Requirements	Unlikely
A12.16.	Communications Equipment Requirements	Potentially
A12.17.	Generation System Model	Yes

5.3 Inverter and wind turbine replacements

All replacements of inverters and wind turbines have the potential to influence the active and reactive power outputs of a Generator. Therefore, these changes are all Potential RGMs.

The factors that will be considered when determining if individual inverter or wind turbine should be a declared RGM include:

- **The criticality of the element to the site's overall performance**. For example, replacement of a single wind turbine in a 10 MW wind farm is relatively critical to plants performance, whereas the same replacement in a 200 MW wind farm may be less critical to the plant's performance.
- **The criticality of the element to the network performance**. For example, even minor changes might be important from a network perspective depending on the location of the generator and it's expected contributions to system performance.

- **Any differences in manufacturer, style or settings for the replaced equipment.** For example, a replacement of a single inverter for an inverter that is manufactured by a different company may require an update to the GPS.
- **Relationship of the replacement to any prior replacements (and future plants updates).** For example, if this is the third replacement of a wind turbine with minorly updated technology at the same site, the cumulative effect of the changes may need to be considered.

The Technical Requirements that need to be updated following declaration of a RGM that is a change to inverters, wind turbines or solar panels depends on the unique circumstances. Further, testing provisions that relate to commissioning of new equipment may apply.

5.4 Balance of plant or ancillary equipment

Balance of plant generally refers to supporting components and auxiliary systems of a Generating System needed to deliver power other than the equipment involved in primary power generation. Balance of plant and ancillary equipment depends on the type of plant, but may include transformers, switching and control equipment, protection equipment and supporting structures.

In this section, changes to a selection of balance of plant equipment are considered. The information provided is intended to give guidance only and is not conclusive or exhaustive. Every change to a Generating System or generating works needs to be considered individually.

Market Participants should be aware that if additional equipment has been installed to enable the Generator to meet a Generator Performance Standard that any changes to that equipment is a Potential RGM.

5.4.1 Equipment that provides reactive power

Reactive compensation plant is typically associated with inverter-based systems to enhance control and increase power transfer capability. Examples of reactive compensation plant include:

- Capacitors
- Shunt reactors
- Fault limiter – series reactors
- Harmonic distortion filters
- Static Var Compensators
- STATCOMs
- In-built inverter reactive power functions

Changes to equipment that provides reactive power should only be considered a Potential RGM where the Generator is intending to alter the plants performance or there is a significant risk of that an inadvertent change will occur.

Harmonic distortion filters are an exception as this equipment can directly impact Generator System performance both for harmonic generation and reactive power capability. All changes to harmonic distortion filters, including replacements, should be considered a Potential RGM.

Table 5.3 provides an indication of the Technical Requirements under the WEM Rules that are more likely to be affected or require reassessment following changes to reactive compensation plant.

Table 5.3: Affected Technical Requirements: Equipment affecting reactive power

WEM Rule	Technical Requirement	Equipment affecting reactive power
A12.2.	Active Power Capability	Unlikely
A12.3.	Reactive Power Capability	Yes
A12.4.	Voltage and Reactive Power Control	Yes
A12.5.	Active Power Control	Unlikely
A12.6.	Inertia and Frequency Control	Unlikely
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Unlikely
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Yes
A12.9.	Disturbance Ride Through for Multiple Disturbances	Yes
A12.10.	Disturbance Ride Through for Partial Load Rejection	Unlikely
A12.11.	Disturbance Ride Through for Quality of Supply	Yes
A12.12.	Quality of Electricity Generated	Potentially
A12.13.	Generation Protection Systems	Potentially
A12.14.	Remote Monitoring Requirements	Potentially
A12.15.	Remote Control Requirements	Potentially
A12.16.	Communications Equipment Requirements	Unlikely
A12.17.	Generation System Model	Yes

5.4.2 Equipment that affects impedance

Equipment that affects impedance include:

- HV power cables
- Transformers
- Fault limiting devices

Changes to equipment that equipment affecting impedance should only be considered a Potential RGM where the Generator is intending to alter the plants performance or there is a significant risk of that an inadvertent change will occur. As discussed in section 2.4, following significant maintenance events where this equipment is changed may also trigger the need for a Potential RGM.

Table 5.4 provides an indication of the Technical Requirements under the WEM Rules that are more likely to be affected or require reassessment following changes to equipment that affects impedance.

Table 5.4: Affected Technical Requirements: Equipment that affects impedance

WEM Rule	Technical Requirement	Equipment that affects impedance
A12.2.	Active Power Capability	Potentially
A12.3.	Reactive Power Capability	Potentially
A12.4.	Voltage and Reactive Power Control	Potentially
A12.5.	Active Power Control	Unlikely
A12.6.	Inertia and Frequency Control	Unlikely
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Unlikely
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Potentially
A12.9.	Disturbance Ride Through for Multiple Disturbances	Potentially
A12.10.	Disturbance Ride Through for Partial Load Rejection	Unlikely
A12.11.	Disturbance Ride Through for Quality of Supply	Unlikely
A12.12.	Quality of Electricity Generated	Potentially
A12.13.	Generation Protection Systems	Potentially
A12.14.	Remote Monitoring Requirements	Unlikely
A12.15.	Remote Control Requirements	Unlikely
A12.16.	Communications Equipment Requirements	Unlikely
A12.17.	Generation System Model	Yes

5.5 Changes to primary power production equipment

All changes to equipment involved in primary power production are a Potential Relevant Generation Modification and are likely to be declared a RGM. The equipment involved in primary power production depends on the type of plant but may include wind blades and solar panels.

All changes to equipment involved in primary power production are Potential RGMs and all Technical Requirements may be affected. However, in assessing and declaring a RGM, Western Power and AEMO will primarily focus on how the changes affect the maximum Active Power Capability of the plant. If the Active Power Capability remains unchanged, then it is less likely other Technical Requirements will need to be updated.

6. System changes

In this section, changes to systems used in a Generating System are considered. The information provided is intended to give guidance only and is not conclusive or exhaustive. Every change to a Generating System needs to be considered individually.

Generator control systems are an integral part of the way generators operate. The types of systems incorporated in any one generator will depend on the type of generator.

The broad categories of power control systems that may be altered include:

- Governor and frequency control systems
- Power Control for Inverter systems
- Power plant controller (PPC) systems
- Voltage control systems

Each type of system is discussed in turn below with reference to the types of changes that should be considered a Potential RGM and subsequently declared a RGM.

For clarity, the changes to systems captured include changes to control logic.

6.1 Frequency control systems

The frequency control Technical Requirements from part A12.6 of the WEM Rules require Generating Systems to sustain a particular response with predetermined limits.

Frequency control may be determined by mechanical aspects of a plant (e.g., the pitch of blades on a wind turbine) as well as any overarching frequency control software and logic. Changes to either of these aspects is considered a Potential RGM.

Where the frequency control software and logic control multiple parts of a Generating System such as multiple turbines on a wind farm, Western Power is primarily concerned with changes to the way the overall control system manages frequency at the point of connection, rather than the control systems or logic that manages individual aspects of the system. However, Generators should consider how any individual unit logic may affect the overall system outcomes and may raise changes to software and related hardware as a Potential RGM.

Battery and solar systems do not typically have mechanical elements that can be used to increase or decrease generation and respond to frequency variations. Hence, the software that controls the inverters will typically be the triggers for raising a Potential RGM. However, changes to associated systems, such as solar tracking systems, should be also considered a Potential RGM, as these have systems have the ability to influence the amount of active power that may be expected from the solar farm in an area that is of concern to Western Power.

Table 6.1 provides an indication of the Technical Requirements under the WEM Rules that are more likely to be affected or require reassessment following changes to equipment involved in primary power production.

Table 6.1: Affected Technical Requirements: Frequency control systems

WEM Rule	Technical Requirement	Frequency control systems
A12.2.	Active Power Capability	Yes
A12.3.	Reactive Power Capability	Potentially
A12.4.	Voltage and Reactive Power Control	Unlikely
A12.5.	Active Power Control	Yes
A12.6.	Inertia and Frequency Control	Yes
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Yes
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Potentially
A12.9.	Disturbance Ride Through for Multiple Disturbances	Yes
A12.10.	Disturbance Ride Through for Partial Load Rejection	Yes
A12.11.	Disturbance Ride Through for Quality of Supply	Unlikely
A12.12.	Quality of Electricity Generated	Unlikely
A12.13.	Generation Protection Systems	Potentially
A12.14.	Remote Monitoring Requirements	Unlikely
A12.15.	Remote Control Requirements	Unlikely
A12.16.	Communications Equipment Requirements	Unlikely
A12.17.	Generation System Model	Yes

6.2 Power control mode changes

More than one control modes may be assessed and agreed in the Generator's GPS. AEMO or Western Power may direct a Market Participant to operate its Generating System in a way that requires a certain mode to be adopted[7]. Changes within these parameters are permitted and are not a Potential RGM.

All changes, including switches between modes, that are beyond the agreed parameters (i.e., different from the modes assessed and agreed in the Generator's GPS and not as a consequence of a direction from AEMO or Western Power) are Potential RGM.

6.3 Power Plant Control systems

Power Plant Control (PPC) system are commonly used in asynchronous Generating Systems technologies as well as hybrid Generating Systems. These systems are used to coordinate and control the various inverters within the Generating system or generally the performance at the connection point and may serve various

[7] Switches between pre-agreed modes may be managed through Control room and these changes are not part of the RGM framework or process.

purposes. They have the ability to affect the overall power output and the Generating Systems response with respect to several of the Technical Requirements.

All changes to PPCs are Potential RGMs.

The Technical Requirements that need to be assessed as part of any declaration of a RGM depend on the role of the PPC in the individual Generating System. For example, some solar farms make use of inverter level voltage control and role of the PPC is to provide communication[8]. PPCs may also have frequency control logic written in or the frequency control can be separate. PPCs may be used for voltage control, active power control, frequency control and communications.

PPCs almost always receive signals from the SCADA system and coordinate that information to control individual units to achieve set objectives. A common issue associated with power plants is communication latency. Changes to the latency of the communications has a significant effect on the performance of the power system and is a Potential RGM.

Software and firmware upgrades that related to power plant controller systems are Potential RGM. Software and firmware upgrades are discussed in section 7.1 of this Guideline.

Table 6.3 provides an indication of the Technical Requirements under the WEM Rules that are more likely to be affected or require reassessment following changes to equipment involved in primary power production.

Table 6.2: Affected Technical Requirements: PPC systems

WEM Rule	Technical Requirement	PPC systems
A12.2.	Active Power Capability	Yes
A12.3.	Reactive Power Capability	Yes
A12.4.	Voltage and Reactive Power Control	Yes
A12.5.	Active Power Control	Potentially
A12.6.	Inertia and Frequency Control	Potentially
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Unlikely
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Potentially
A12.9.	Disturbance Ride Through for Multiple Disturbances	Potentially
A12.10.	Disturbance Ride Through for Partial Load Rejection	Potentially
A12.11.	Disturbance Ride Through for Quality of Supply	Unlikely
A12.12.	Quality of Electricity Generated	Unlikely
A12.13.	Generation Protection Systems	Unlikely
A12.14.	Remote Monitoring Requirements	Unlikely
A12.15.	Remote Control Requirements	Unlikely

[8] The power plant controller sends a set point to each inverter and the inverters have separate logic and system to achieve this set point.

A12.16.	Communications Equipment Requirements	Unlikely

6.4 Voltage control systems

All changes to voltage control systems have the potential to change the performance of the Generating System and therefore are a Potential Relevant Modification. Examples of equipment that may be involved in voltage control include:

- For asynchronous Generating Systems connected systems
  - Static Var Compensators
  - STATCOMs
  - In-built inverter reactive power control functions
  - PPC voltage control functions
- For synchronous generators include:
  - Automatic Voltage Regulators (AVRs)
  - Exciter or excitation systems

Other equipment that indirectly affect voltage control, for example tap changes on transformers, are also Potential RGM.

The voltage control system for inverter connected generators may be contained within the inverter or it may form part of the power plant controller (discussed in section 6.3 of this Guideline). Examples of changes that would be declared a RGM include:

- Moving the voltage control system from being within the inverter to a system that forms part of the power plant controller is highly likely to be declared a RGM regardless of any intentions to retain existing GPS following the change.
- Changes to the design logic of the voltage control system (including on the power plant controller, where applicable)
- Changes to the type of controller, including replacements
- Software changes (discussed in section 7.1), for example power plant controller system software.

Table 6.3 provides an indication of the Technical Requirements under the WEM Rules that are more likely to be affected or require reassessment following changes to voltage control systems.

Table 6.3: Affected Technical Requirements: Voltage control systems

WEM Rule	Technical Requirement	Voltage control system
A12.2.	Active Power Capability	Unlikely
A12.3.	Reactive Power Capability	Yes
A12.4.	Voltage and Reactive Power Control	Yes
A12.5.	Active Power Control	Potentially
A12.6.	Inertia and Frequency Control	Unlikely
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Unlikely
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Yes
A12.9.	Disturbance Ride Through for Multiple Disturbances	Yes
A12.10.	Disturbance Ride Through for Partial Load Rejection	Unlikely
A12.11.	Disturbance Ride Through for Quality of Supply	Unlikely
A12.12.	Quality of Electricity Generated	Unlikely
A12.13.	Generation Protection Systems	Unlikely
A12.14.	Remote Monitoring Requirements	Unlikely
A12.15.	Remote Control Requirements	Unlikely
A12.16.	Communications Equipment Requirements	Unlikely
A12.17.	Generation System Model	Yes

7. Software and setting changes

Software and settings are used to manage a Generating System's performance and are as important as the equipment and mechanical plant in determining whether Technical Requirements are achieved.

In this section, software and setting changes are addressed. The information provided is intended to give guidance only and is not conclusive or exhaustive. Every change to a Generating System needs to be considered individually.

7.1 Firmware and software

Types of software and firmware (collectively referred to as 'software' going forward) that can affect the technical capability and performance of generators include:

- Inverter firmware
- PPC software
- SCADA system software
- Protection system firmware

All software changes, updates and upgrades (collectively referred to as 'updates' going forward) are Potential RGMs. These means that Western Power should be notified in advance of the update with information that explains the scope of the change and implications.

In deciding if a software change should be declared a RGM, Western Power expects to consider:

- Software package and version(s)
- Description of update being made including information on the change prepared by the software manufacturer
- The implications of the update in terms of the generator's technical capability and performance
- Before and after analysis that demonstrates the Registered GPS under each scenario
- The motivation for the update (e.g., normal maintenance, control algorithm upgrade, minor bug fixes, adoption of new features, fixes that prevent lack of compliance with GPS etc)
- What controls are in place to ensure there are no unknown implications for the generator's technical capability and performance
- Whether suitable testing is required to understand any implications for the generator's technical capability and performance
- Whether update complies with the relevant software version(s) outlined in the WEM Procedure: Generation System Model Submission and Maintenance.

The information provided regarding a Potential RGM that is a software change should be sufficient to enable Western Power and AEMO to consider and assess the effect of the change with respect to the points outlined above.

All Technical Requirements are potentially affected by changes to software.

7.2 Setting changes

Registered GPS and Generating System models record a range of settings, each of which dictate the expected and actual performance of the system. Examples of settings used in Generating Systems that affect performance include but are not limited to:

- inverter settings
- control system settings
- tap settings on transformers
- balance of plant settings
- protection equipment settings
- AVR settings

All changes in settings outside of those agreed in the Registered GPS are Potential RGM.

7.3 Changes in Rated Maximum Active Power

Generators may change their Rated Maximum Active Power (and request approval for this) and there are a range of options available to do this including through changes to control settings.

When a Market Participant intends to change its rated maximum active power capability, regardless of how this is achieved, the Registered GPS must be updated.

The Technical Requirements that may need to be re-negotiated following such a change depend on whether the changes result in an increase or decrease in maximum active power.

Table 5.4 provides an indication of the Technical Requirements under the WEM Rules that are more likely to be affected or require reassessment following changes to Rated Maximum Active Power.

Figure 7-1: Affected Technical Requirements: Rated Maximum Active Power

WEM Rule	Technical Requirement	Increase in Rated Maximum Active Power	Decrease in Rated Maximum Active Power
A12.2.	Active Power Capability	Yes	Yes
A12.3.	Reactive Power Capability	Yes	Yes
A12.4.	Voltage and Reactive Power Control	Yes	Potentially
A12.5.	Active Power Control	Yes	Yes
A12.6.	Inertia and Frequency Control	Yes	Yes
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Yes	Unlikely
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Yes	Unlikely
A12.9.	Disturbance Ride Through for Multiple Disturbances	Yes	Unlikely
A12.10.	Disturbance Ride Through for Partial Load Rejection	Yes	Unlikely

A12.11.	Disturbance Ride Through for Quality of Supply	Yes	Unlikely
A12.12.	Quality of Electricity Generated	Yes	Yes
A12.13.	Generation Protection Systems	Potentially	Unlikely
A12.14.	Remote Monitoring Requirements	Unlikely	Unlikely
A12.15.	Remote Control Requirements	Unlikely	Unlikely
A12.16.	Communications Equipment Requirements	Unlikely	Unlikely
A12.17.	Generation System Model	Yes	Yes

8. Secondary systems changes

Several Technical Requirements apply to the secondary systems that apply to the whole of the Generating System. Secondary systems include protection systems, remote monitoring and communication systems.

In this section, changes to secondary systems that are Technical Requirements and changes to Generating System models are addressed. The information provided is intended to give guidance only and is not conclusive or exhaustive. Every change to a Generating System needs to be considered individually.

8.1 Protection systems

Generation Protections Systems are a Technical Requirement under the WEM Rules (A12.13).

Protection systems typically consist of a range of protection schemes. Those schemes, in turn, consist of an arrangement of secondary equipment and protection apparatus. The operation of any one protection scheme depends on the cumulative effect of various individual elements. As such, replacing a single item within a scheme may not result in changed performance for the overall scheme if there are other limiting items within the scheme.

Changes, updates and replacements of any elements of a protection scheme are Potential RGMs.

Changes that involve replacement of whole protection schemes, including updates to the logic or settings used in the protection scheme are likely to be declared RGM. The need for other changes to be declared RGM depends on whether the change enables the scheme to achieve improved overall performance. However, all changes to elements or individual equivalent within a scheme should move towards achievement of improved overall performance for the scheme. For example, if a relay and a circuit in a protection scheme are limiting factors that prevent achievement of improvement in maximum fault clearance times, as each is replaced the newer equipment should be selected so as to not prevent the achievement of improved times once the other element is replaced.

To aid in the management towards Ideal GPS for protection scheme changes, Market Participants may use the trigger event mechanism applicable to a proposed Negotiated GPS. The trigger event would capture the initial change and any subsequent changes in the protection scheme that would trigger an update to the Registered Generator Performance Standard[9]. In this way, movements away from grandfathered performance can be promoted in a managed, structured way.

The WEM Rules for both Generating Systems and the Transmission System (where relevant) directs to Technical Rules for Protection requirements (A12.13). For transmission (and distribution) elements, the Technical Rules provide different maximum total fault clearance times for ‘existing equipment’ and ‘new equipment’. ‘Existing equipment’ is equipment in service at commencement of the Technical Rules (1 July 2007), and ‘new equipment’ is equipment commissioned after this time. Consistent with the principle outlined above for updating protection schemes, replacement of ‘existing equipment’ should move towards or be capable of achieving the times set out for ‘new equipment’ following replacement.

[9] The Generator Performance Standard Trigger Event Template is available on Western Power’s website here: Generator Performance Standards | Western Power

Table 8.1: Affected Technical Requirements: Protection systems

WEM Rule	Technical Requirement	Protection systems
A12.2.	Active Power Capability	Unlikely
A12.3.	Reactive Power Capability	Potentially
A12.4.	Voltage and Reactive Power Control	Unlikely
A12.5.	Active Power Control	Unlikely
A12.6.	Inertia and Frequency Control	Unlikely
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Yes
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Yes
A12.9.	Disturbance Ride Through for Multiple Disturbances	Potentially
A12.10.	Disturbance Ride Through for Partial Load Rejection	Potentially
A12.11.	Disturbance Ride Through for Quality of Supply	Unlikely
A12.12.	Quality of Electricity Generated	Unlikely
A12.13.	Generation Protection Systems	Yes
A12.14.	Remote Monitoring Requirements	Unlikely
A12.15.	Remote Control Requirements	Unlikely
A12.16.	Communications Equipment Requirements	Unlikely
A12.17.	Generation System Model	Potentially

8.2 Communications, remote control and monitoring

The communication, remote control and monitoring requirements captured as Technical Requirements under the WEM Rules (A12.14, A12.15 and A12.16) are static in nature meaning the Minimum and Ideal GPS are the same and the requirements are not negotiated.

The WEM Rule requirement set out the basic provisions including availability and upkeep of systems. Detailed requirements are included in documents such as the WEM Procedure: Communications and Control Systems (developed in accordance with WEM Rule 2.36A.1)

In general, updates and changes that are made in accordance with supporting documents, including any notification requirements in the procedure, will not be considered Potential RGM. However, matters such as change in location of measuring equipment can be Potential RGM. Therefore, it is necessary to assess all changes. For changes within the scope provided for in supporting document, the process for considering changes should involve:

1) Assessing if the change is in accordance with the relevant procedure

2) Assess if an update to the Registered GPS is required.

3) Adopt appropriate processes including tests that demonstrate functionality and ongoing compliance as applicable given the change.

Where the Generator identifies the need to update its GPS due to a change in its communications, remote control and monitoring arrangements, Western Power will consider the changes under the RGM framework to update information. This process requires the Generator to raise the change as a Potential RGM and then for the change to be declared a RGM.

For clarity, it is noted that changes driven by a Generator's own requirements (for example, a desire to collect more data points to enable better performance management) or for maintenance purposes (for example, end of life replacements) are Potential RGM. Particularly where grandfathered arrangements have applied, Western Power will seek for the updates to be compatible with the latest standards.

Generators should be aware that other changes to the Generating System or site may trigger a change to the communication, remote control and monitoring systems and the GPS for these requirements. For example, the addition of a Generating Unit or a battery system to an existing site will likely require these Technical Requirements to be re-considered, event where the addition is intended to be operated separately (but behind the same connection point).

Table 8.2: Affected Technical Requirements: Communications, remote control and monitoring

WEM Rule	Technical Requirement	Communications, remote control & monitoring
A12.2.	Active Power Capability	Unlikely
A12.3.	Reactive Power Capability	Unlikely
A12.4.	Voltage and Reactive Power Control	Potentially
A12.5.	Active Power Control	Potentially
A12.6.	Inertia and Frequency Control	Potentially
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Unlikely
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Unlikely
A12.9.	Disturbance Ride Through for Multiple Disturbances	Unlikely
A12.10.	Disturbance Ride Through for Partial Load Rejection	Unlikely
A12.11.	Disturbance Ride Through for Quality of Supply	Unlikely
A12.12.	Quality of Electricity Generated	Unlikely
A12.13.	Generation Protection Systems	Potentially
A12.14.	Remote Monitoring Requirements	Yes
A12.15.	Remote Control Requirements	Yes
A12.16.	Communications Equipment Requirements	Yes
A12.17.	Generation System Model	Unlikely

8.3 Generating system model changes

In accordance with the Technical Requirement for Generating System models (A12.17), Generators must keep their Generating System model and modelling data up to date and ensure the observed performance from their Generating System matches the predicted performance of that Generating System. These requirements reflect that Western Power and AEMO rely on the models to predict the output of the Generating System to operate the power system safely and reliably.

Any changes to the Generating System model or modelling data are Potential RGM and must be submitted to Western Power for assessment. The exception are changes that are requested by Western Power or AEMO or are provided for in supporting documents, such as the WEM Procedure: Generation Model System Submission and Maintenance, for which an alternative process for exchange of information may apply.

Almost all other changes that result in a declared RGM will require the Generating System model and information to be updated. For this reason, guidance in this document lists the Generator System Model Technical Requirement as potentially being affected for all examples.

Outside of the RGM framework, there are two main mechanisms through which a requirement to update the generator system models may be identified:

- Periodic testing of generator system models to ensure they continue to reflect actual performance is required under Generator Monitoring Plans.
- Following a power system incident, Western Power or AEMO may request a review of a Generating System model to understand the pattern of events, whether the actual performance matched the modelled outcomes, and make amendments to avoid similar situations (as appropriate).

Where the Generator, Western Power or AEMO identifies an issue with the model or that updates are needed this may be addressed through ongoing maintenance updates, compliance provisions (such as through non-compliance and the Rectification Plan process) or Western Power may request that the generator submit a Potential RGM if there is not alternative means by which the Registered GPS can be updated.

Finally, the SWIS is rapidly evolving as the generation mix and demand profiles change. Generator system models typically represent a point in time and there may be limited reasons to revisit the models if equipment is not changing. However, as the power system evolves it may be necessary for the settings and information to be updated so that the wider-system can operate efficiently. If the power system sufficiently changes around a Generating System, Western Power may request changes to the Generator's actual performance under WEMR A12.3.2.2 and A12.4.2.5 of the WEM Rules. In turn, the model for the Generating System will need to be updated and the Generator must submit a Potential RGM to initiate this process.

All Generators have an obligation to contribute to the achievement of the power system performance standards as it allows Western Power and AEMO to run the system efficiently, reliably and securely (as stated in WEMR A12.3.2.2 and A12.4.2.5). Consistent with this approach, Market Participants making changes to their Generating System or generating works must take the opportunity to move towards improved performance that improves the ability to the WEM Rule objectives, wherever reasonable

Table 8.3: Affected Technical Requirements: Generating system model

WEM Rule	Technical Requirement	Generating system model
A12.2.	Active Power Capability	Potentially
A12.3.	Reactive Power Capability	Potentially
A12.4.	Voltage and Reactive Power Control	Potentially
A12.5.	Active Power Control	Potentially
A12.6.	Inertia and Frequency Control	Potentially
A12.7.	Disturbance Ride Through for a Frequency Disturbance	Potentially
A12.8.	Disturbance Ride Through for a Voltage Disturbance	Potentially
A12.9.	Disturbance Ride Through for Multiple Disturbances	Potentially
A12.10.	Disturbance Ride Through for Partial Load Rejection	Potentially
A12.11.	Disturbance Ride Through for Quality of Supply	Potentially
A12.12.	Quality of Electricity Generated	Potentially
A12.13.	Generation Protection Systems	Potentially
A12.14.	Remote Monitoring Requirements	Potentially
A12.15.	Remote Control Requirements	Potentially
A12.16.	Communications Equipment Requirements	Potentially
A12.17.	Generation System Model	Yes

9. Additions, replacements and retirements of Generating Units within a Facility

All additions and replacements of Generating Systems (or Generating Units) that are made within a single Facility are Potential RGMs. This includes changes at an existing Facility such as:

- Addition of a new Generating System, for example the addition of a Battery Energy Storage System
- Retirement of a Generating Unit within a Generating System
- Replacement of a Generating System for another (of the same or different types)

The need for the Potential RGM to be declared a RGM and for the Registered GPS to be update depends on the nature of the changes involved, whether the capability and performance for the existing Generating System is changed and the coverage of the existing Registered GPS. For example, the separation of Generating System operations from one another and whether there are multiple sets of GPS for the single Facility will alter the need for a RGM to be declared.

In this section, additions, replacements and partial-retirements of Generating Systems within a single Facility are considered. The information provided is intended to give guidance only and is not conclusive or exhaustive. Every change to a Generating System needs to be considered individually.

9.1 Additions

The addition of a Generating System to an existing Facility is a Potential RGM.

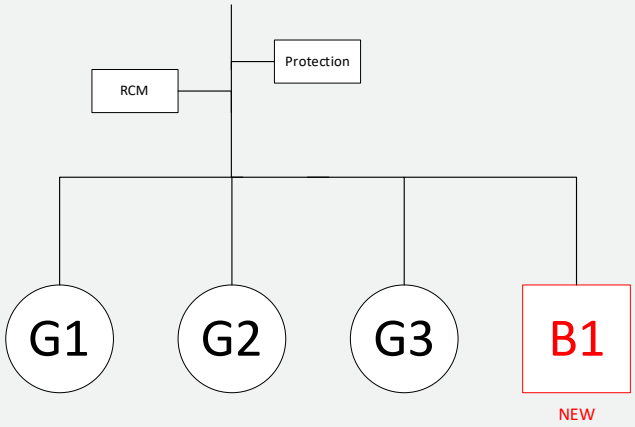
The ability to operate the existing Generation System and any new Generating System separately affects the ability for there to be unique Registered GPSs for Systems and the likelihood of an RGM needing to be declared for the existing Generating System.

Where the existing and new Generating Systems will be operated separately and have their own Registered GPS, the addition of a Generating System is less likely to result in a declared RGM for the existing Generating System. In these circumstances, it may be possible to leave the Technical Requirements related to primary power production for the existing Generating System unchanged. However, Western Power may seek to revisit Technical Requirements that apply to the whole Facility (such as protection, remote monitoring and control) and may require these aspects to be updated if the existing Registered GPS is below the Ideal GPS.

Alternatively, if there is a single GPS for the Facility or the Generating Systems are intended to be operated inseparably, the changes will require an RGM to be declared to enable an updated Registered GPS to be re-established to cater for the change.

Case study – Wind farm that introduces battery storage

A wind farm is seeking to add battery storage at its existing Facility. The wind farm and battery will be part of the same Facility and be considered a single Transmission Connected Generating System. There is a Registered GPS for the existing wind farm Generating System that include several negotiated standards.



In this case, the Generator may seek to ensure the battery can be independently operated from the wind farm in order to preserve the negotiated standards that apply to the existing wind farm. If this is the case, new (and separate) GPS can be proposed and negotiated for the battery.

Given the shared connection, Western Power will likely require the Market Participant to re-visit any Technical Requirements that apply to the existing Facility (for example, protection, remote monitoring and control). However, due to the separation of operations and the development of separate GPS for the battery, there will be a minimal need to revisit the Technical Requirements that relate to primary power production for the existing wind farm, including for the negotiated GPS.

9.2 Partial retirements and replacements

Partial retirement of a Generating System or Generating Units at the same Facility are a Potential RGM. This includes where the retired plant is being replaced with new generation of the same or a different type.

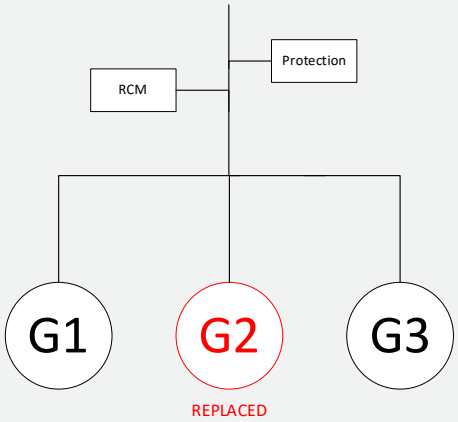
Similar to the case for additions (discussed above in section 9.1), the requirement for a partial retirement or replacement to be declared a RGM depends on the separability of operations and the existence of multiple GPS. If the Generating Systems within the Facility can be operated independently and have separate Registered GPS, then the likelihood of the partial retirement or replacement being declared a RGM reduces and the Technical Requirements that may need to be reassessed also reduces.

For partial retirements and replacements, whole of site secondary systems that are Technical Requirements, such as protection, remote monitoring and control, and communication systems, may need to be revisited and potentially upgraded to meet current standards. Generators should also consider whether there are aspects of the Generating System Model that need to be updated to reflect the new arrangements.

The case study below provides an example where an existing multiple-unit generator is able to replace one unit with minimal changes to the Registered GPS for the existing system.

Case study – Replacement of synchronous unity within the same Facility

An existing gas-fired power station consists of three Generating Units, one of which is being replaced. The Registered GPS applies for the entire Facility and includes Negotiated Standards based on inherent technology limitations.



The Market Participant may seek for the existing Registered GPS arrangements (including the Negotiated Standards) to remain in place for the two Generating Units that are not being altered. So long as these Generating Units are separably controllable and can independently meet their existing Registered GPS retention of the existing agreed Technical Requirements is possible.

As the Registered GPS currently applies to the whole Facility, the Generator would need to put forward a Potential RGM that alters the Registered GPS so that it continues to apply only to the remaining two Generating Unit. Processes for developing a new, separate GPS would apply for the new Generating Unit.

Given the shared connection, Western Power will likely require the Market Participant re-visit the existing Registered GPS for any Technical Standards that apply to the whole Facility (for example, protection, remote monitoring and control). In some circumstances, Western Power may require these secondary systems to be updated to the current Ideal GPS.

9.3 Changes to the fuel source or type of generator

Generating Systems that are being 're-purposed' or for which the fuel source is being altered are Potential RGMs and will most likely be declared RGMs. Examples include:

- A synchronous Generating System that is no longer used primarily for energy but is maintain for spinning reserve services.
- A combined cycle gas turbine (CCGT) where the gas turbine was being fuelled with natural gas and this is being replaced with a blend of natural gas and hydrogen gas.

Case study – Change of energy source for a CCGT power plant

In a CCGT, there are two main units: a gas turbine unit and a steam turbine unit. The gas turbine unit produces heat that in turn provides the fuel for the steam turbine unit.

A Market Participant is seeking to change the fuel source for the gas turbine from natural gas to a hydrogen blend. The change affects both the gas unit and the steam turbine unit because the active power that can be produced by the steam turbine unit depends on the heat output from the gas unit. The change represents a Potential RGM with respect to both units.

The declaration of the RGM and the Technical Requirements that need to be reassessed will depend how the existing Generating System's Registered GPS has been developed and the effect of any changes. In particular, Western Power will consider:

- Whether the units have already been considered separately
- Whether the alternative steam producing unit changes the active power able to be achieved from the steam turbine
- Whether there is a shared control system that need to be revisited for the whole CCGT
- Whether secondary systems on the site need to be revisited as part of the change.