

Technical Specification: Operational Data Points for Registered Facilities

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1.0	15/08/2019	Initial release
2.0	17/06/2022	Updates to prepare for WEM Reform. Retitled "Technical Specification: Operational Data Points for Registered Facilities"

Contents

1. Introduction	4
1.1. Purpose	4
1.2. Definitions	4
1.3. Interpretation	5
1.4. Related documents	6
2. Requirements by Facility and Technology Type	7
3. Aggregation of Operational Data Point Measurements	7
4. Network Protection Schemes	8
5. General SCADA point requirements	8
Appendix A. Operational Data Point Requirements for Scheduled Facilities, Semi-Scheduled Facilities, and Non-Scheduled Facilities	9
Appendix B. Operational Data Point Requirements for specific technologies	17
Appendix C. Operational Data Point Requirements For AGC Operation	22
Appendix D. Operational Data Point Requirements For Fast Start Facilities	25
Appendix E. Operational Data Point Requirements for Interruptible Loads	26
Appendix F. AGC Participation Modes	28

Tables

Table 1	Definitions	4
Table 2	Related documents.....	6
Table 3	Operational Data Point Requirements for Scheduled Facilities, Semi-Scheduled Facilities, and Non-Scheduled Facilities.....	9
Table 4	Additional Operational Data Point requirements for Scheduled Facilities.....	15
Table 5	Additional Operational Data Point Requirements for Semi-Scheduled Facilities and Non-Scheduled Facilities.....	16
Table 6	Operational Data Point Requirements for gas turbines.....	17
Table 7	Operational Data Point Requirements for steam turbines.....	18
Table 8	Operational Data Point Requirements for wind generation.....	18
Table 9	Operational Data Point Requirements for solar photovoltaic generation.....	19
Table 10	Operational Data Point Requirements for solar Electric Storage Resources.....	20
Table 11	Operational Data Point Requirements required for AGC operation.....	22
Table 12	Additional Operational Data Point Requirements required for Fast Start Facilities.....	25
Table 13	Operational Data Point Requirements for Interruptible Loads.....	26
Table 14	AGC control and participation modes.....	28

Figures

Figure 1: Diagram of communication failure alarms.....	15
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1. Introduction

1.1. Purpose

Paragraph 2.1.3 of the WEM Procedure: Communications and Control Systems requires that AEMO develop this document, which details the general SCADA points required for each type of Registered Facility and technology type.

Paragraph 2.1.2 of the WEM Procedure: Communications and Control Systems allows AEMO to specify SCADA points required for each Registered Facility and each Facility that is intended to be registered. The SCADA points specified:

- could be in addition to those required by the Network Operator under the Technical Rules and other relevant statutory instruments; and
- may vary over time or due to a modification of a Facility.

Herein, “SCADA points” are referred to as Operational Data Points.

This document does not specify Operational Data Points required by the Network Operator unless that information is also required by AEMO.

This document has been prepared to align with the WEM Rules published as at 1 June 2022, and the latest WEM Procedure: Communications and Control Systems. It is intended to provide a guide for Facilities intending to participate in the WEM after New WEM Commencement Day.

For participation in AGC in the new market arrangements, participants will need to ensure that their Scheduled Facilities and Semi-Scheduled Facilities can receive a desired MW setpoint as per Appendix C of this document. The telemetry requirements outlined in Appendix A and Appendix B of this document form the basis for new Registered Facility connections. Registered Facilities already in operation will not need to make changes to accommodate the updated telemetry requirements in this Technical Specification, unless they alter their configuration or operation significantly.

1.2. Definitions

- 1.2.1. Terms defined in the Electricity Industry Act 2004, the WEM Regulations and the WEM Rules have the same meanings in this Technical Specification unless the context requires otherwise.
- 1.2.2. The following definitions apply in this Technical Specification unless the context requires otherwise.

Table 1 Definitions

Term	Definition
Automatic Generation Control (AGC)	As defined in the Communications and Control Systems Procedure, which at the time this document was published read: "Has the meaning given in the Wholesale Electricity Market Amendment (Tranches 2 and 3 Amendments) Rules 2020."
Back-Indication Point	An Operational Data Point that returns the same value that was sent to another, related Operational Data Point. This provides indication to AEMO that the originally sent value was received by the Registered Facility.
Calculated Point	An Operational Data Point that is not directly measured, but is calculated from one or more Measured Points and/or constant values. These are also referred to as “soft points” in industry.
Contingency Reserve	One of or both Contingency Reserve Raise and/or Contingency Reserve Lower

Term	Definition
End of Interval (EOI)	The end time of the relevant Dispatch Interval.
Gross (measurement)	In relation to a physical quantity (e.g. MW, MVar, kV) “Gross” measurements are taken at, or close to the output of the relevant individual Energy Producing System. For a synchronous generator, this would typically be a measurement at the output of the generator. For an inverter connected equipment, this would typically be the output of the inverter.
Inter-Control Centre Communications Protocol (ICCP)	As defined in the Communications and Control Systems Procedure, which at the time this document was published read: “The ICCP, also known as the Telecontrol Application Service Element (TASE.2) protocol, is an international standard for communications between control centres in the electrical power sector. This ICCP protocol is formally referred to as the IEC60870-6 TASE.2 and its extensions secure ICCP.”
Measured Point	An Operational Data Point that is a directly measured, physical value, such as MW, Amps, Volts etc. These are also referred to as “hard points” in industry.
Net (measurement)	In relation to a physical quantity (e.g. MW, MVar, kV) “Net” measurements are taken at, or close to the Connection Point(s) of the Registered Facility. The points for these measurements should closely correlate to the location of revenue metering, if present.
Operational Data Point	A data object referring to a single input or output value, monitored by a SCADA system or other appropriate communication mechanism, encompassing the “SCADA data points” referred to in the WEM Procedure: Communications and Control Systems (see related documents in section 1.4).
Regulation	One of or both Regulation Raise and/or Regulation Lower
Supervisory Control and Data Acquisition (SCADA)	As defined in the Communications and Control Systems Procedure, which at the time this document was published read: “Supervisory Control and Data Acquisition (SCADA) is a system that is used to monitor and control field device(s) at remote locations.”

1.3. Interpretation

- 1.3.1. The following principles of interpretation apply in this Technical Specification unless the context requires otherwise.
- (a) Clauses 1.3 to 1.5 of the WEM Rules apply in this Technical Specification.
 - (b) References to time are references to Australian Western Standard Time.
 - (c) Terms that are capitalised, but not defined in this Technical Specification, have the meaning given in the WEM Rules.
 - (d) A reference to the WEM Rules or WEM Procedures includes any associated forms required or contemplated by the WEM Rules or WEM Procedures.
 - (e) Words expressed in the singular include the plural and vice versa.
 - (f) A reference to a paragraph refers to a paragraph of this Technical Specification.
 - (g) A reference to a clause refers to a clause or section of the WEM Rules.
 - (h) The body of this Technical Specification prevails to the extent of any inconsistency with the figures, diagrams, appendices, schedules, annexures or attachments contained within this document.

1.4. Related documents

1.4.1. The documents in Table 2 are associated with this Technical Specification.

Table 2 Related documents

Reference	Title	Location
Technical Specification	AGC, Scada Dispatch Instructions, And Fast Start Facility Operational Behaviour	TBA
WEM Procedure	Communications and Control Systems	WEM Website

2. Requirements by Facility and Technology Type

Appendices A through D of this document contain various Operational Data Point requirements depending on certain characteristics of a Registered Facility:

- Appendix A specifies the general Operational Data Point requirements for Scheduled Facilities, Semi-Scheduled Facilities, and Non-Scheduled Facilities;
- Appendix B specifies the Operational Data Point requirements for Registered Facilities that incorporate certain technologies;
- Appendix C specifies requirements for Facilities seeking to operate under using AGC; and
- Appendix D specifies requirements for Registered Facilities seeking to participate as Fast Start Facilities.
- Appendix E specifies the general Operational Data Point requirements for Interruptible Loads.
- Appendix F provides additional details of AGC participation modes, and their relevant codes.

Registered Facilities may require Operational Data Points that combine requirements from these various appendices.

AEMO may require additional points to those specified in these appendices where required for Power System Security or Power System Reliability. At the time of publication of this document, AEMO has not specified Operational Data Point requirements for Demand Side Programmes.

AEMO may still require Operational Data Points for Registered Facilities in these Facility Classes if it deems this necessary to meet Power System Security or Power System Reliability requirements.

3. Aggregation of Operational Data Point Measurements

AEMO will identify the level of aggregation of Operational Data Points that is acceptable for a Registered Facility, to ensure that AEMO has suitable visibility for the purposes of Power System Security and Reliability. The acceptable level of aggregation may vary for factors including:

- performance characteristics of the Registered Facility;
- geographic dispersion of the components of the Registered Facility;
- types of technology comprising the Registered Facility;
- AEMO's forecasting requirements; and
- AEMO's modelling requirements.

As an example, AEMO may not require telemetry from each individual wind turbine in a wind farm. However, if the wind farm is geographical diverse, such that wind speed indication for one collector group is not a reasonable reflection of wind speed at another collector group, AEMO may require separate Operational Data Points to measure wind speed at each location.

4. Network Protection Schemes

Where the Network Operator requires a Registered Facility to have a special protection requirement, AEMO will require visibility of the status of that protection scheme.

5. General SCADA point requirements

Where an Operational Data Point that feeds an alarm is required by AEMO for a piece of equipment at a Registered Facility, these Operational Data Points may be provided as:

- a single Operational Data Point, where the Operational Data Points from individual devices are paralleled within the Registered Facility; or
- individual Operational Data Points from the individual devices and paralleled within the Network Operator's equipment.

To ensure adequate redundancy for the security dispatch functions in the SCADA System, all analogue points should be provided from a direct measurement of the quantities unless otherwise specified by AEMO.

Unless otherwise specified or agreed by AEMO, all digital controls should have back indications and all analogue setpoints should have check-back signals confirming the receipt of the setpoint.

Appendix A. Operational Data Point Requirements for Scheduled Facilities, Semi-Scheduled Facilities, and Non-Scheduled Facilities

In the column “Naming Convention”, **F** means the Registered Facility’s short name, and an **X** indicates a number. For example, for the net MW value for the first generator of the Facility “SWAN_G1”, the recommended name for the net MW telemetry would be “SWAN_G1_NET_MW”.

Table 3 Operational Data Point Requirements for Scheduled Facilities, Semi-Scheduled Facilities, and Non-Scheduled Facilities

Point Description	Scheduled Facility or Semi-Scheduled Facility	Non-Scheduled Facility	Naming Convention	Notes
Status				
All Facility switching devices opened/closed (e.g. isolators, earth switches, circuit breakers – two complementary contacts i.e. NO/NC pair)	Yes	Yes	F CB X	
Governor mode (e.g. droop/isochronous)	Yes	Optional	F GOVERNOR MODE	Where applicable
Fuel type (e.g. liquid/gas/coal)	Yes	Yes	F FUEL IN USE	Only required where a Registered Facility can operate on more than one fuel type.
Associated reactive plant switching devices opened/closed (e.g. isolators, circuit breakers – two complementary contacts i.e. NC/NO pair)	Yes	Optional	F PLANT NAME CB X	Where PLANT_NAME is the relevant piece of equipment (e.g. synchronous condenser).
Status of anti-islanding protection	Yes	Yes	F ANTI ISLANDING STATUS	If an anti-islanding scheme is present at the Registered Facility.
Generator step-up transformer(s) tap position	Yes	Optional	F GSUTX TAP POSITION	Where applicable
Generator step-up transformer(s) tap changer control mode (remote/local)	See notes	No	F GSUTX TAP CHANGER CONTROL MODE	If the tap changer has remote tap changing capability, this indication identifies whether the tap changer is under local or remote control.

Point Description	Scheduled Facility or Semi-Scheduled Facility	Non-Scheduled Facility	Naming Convention	Notes
Generator step-up transformer AVR status	Yes	Optional	F GSUTX AVR	Where applicable.
Alarms				
Protective load shed operated	Yes	Optional	F PROTECTIVE LOAD SHED OPERATED	
Remote Terminal Unit (RTU) to Distributed Control System (DCS) Comms Watchdog	Yes	Yes	<i>Internal point</i>	This internal point periodically sends a control signal to the Facilities control system. A response is expected from the control system to indicate that communications are still alive. If a response is not received within a specific time period, an alarm is generated (see Figure 1 below).
Communications link(s) fail	Yes	Yes	F DCS COMMS LINK FAIL	Alarm raised when the communications fail between the RTU and the Facility control system
Master station communications fail	Optional	Optional	<i>Internal point</i>	Internal indication that the communications between the Network Operator's SCADA Remote Terminal Unit and the Network Operator's SCADA master station has failed.
Generator / main switch protection operated	Yes	Yes	F X PROTECTION OPERATED	
Step up transformer protection operated	Yes	Yes	F SUTX PROTECTION OPERATED	
Associated reactive plant protection operated	Yes	Optional	F PLANT_NAME PROTECTION OPERATED	Only required where additional reactive power devices have been installed. Where PLANT_NAME is the relevant piece of equipment (e.g. a synchronous condenser)
Measured and Calculated Telemetry				
Gross active power measurement of each generating unit	Yes	Optional	F X GROSS MW	Where one or more of the Energy Producing Systems within the Registered Facility are inverter connected, these values should measure the AC side of the inverter, or collection of inverters as appropriate. Where a collector group has a gross capacity of more than 10 MW, it should generally be measured separately, and not grouped with other collectors for telemetry purposes.
Gross reactive power measurement of each generating unit	Yes	Optional	F X GROSS MVAR	Where the Energy Producing System is inverter connected, these values should measure the AC side of the inverter, or collection of inverters as appropriate.
Net active power measurement of each generating unit	Yes	Optional	F X NET MW	Where the Facility is inverter connected, these values should measure the AC side of the inverter. If this value measures a collection of inverters, a measurement at the high voltage side of the group's step up transformer is acceptable.

Point Description	Scheduled Facility or Semi-Scheduled Facility	Non-Scheduled Facility	Naming Convention	Notes
Net reactive power measurement of each generating unit	Yes	Optional	F X NET MVAR	Where the Facility is inverter connected, these values should measure the AC side of the inverter, or collection of inverters as appropriate.
Generating unit stator voltage	Yes	Yes	F X KV	If the relevant Energy Producing System has a stator.
Generating unit target stator voltage	Yes	Optional	F X TARGET KV	If applicable, current generator terminal target voltage
Total gross active power for the Facility	Yes	Yes	F GROSS MW	Where a Facility comprises of more than one Energy Producing System. This can be a Calculated Point.
Total gross reactive power for the Facility	Yes	Yes	F GROSS MVAR	Where a Facility comprises of more than one Energy Producing System. This can be a Calculated Point.
Total net active power for the Facility	Yes	Yes	F NET MW	Where a Facility comprises multiple Connection Points, this point can be a Calculated Point which is sum of Connection Point measurements.
Total net reactive power for the Registered Facility	Yes	Yes	F NET MVAR	Where a Facility comprises multiple Connection Points, this point can be a Calculated Point which is sum of Connection Point measurements.
Registered Facility maximum active power capacity	Yes	Yes	F MAX OPERATING LIMIT	The real-time maximum sent-out capability of the Facility in MW
Registered Facility minimum active power capacity	Yes	Yes	F MIN OPERATING LIMIT	The real-time minimum sent-out capability of the Facility in MW. This value can be negative to represent maximum Withdrawal capability of load or bi-directional Registered Facilities.
Registered Facility maximum ramp up capability	Yes	Yes	F MAX RAMP RATE UP	MW/min.
Registered Facility maximum ramp down capability	Yes	Yes	F MAX RAMP RATE DOWN	MW/min.
Registered Facility current active ramp rate in use	Yes	Yes	F RAMP RATE IN USE	MW/min.
Active power for each primary transmission device in the Registered Facility	Yes	Yes	F X MW	E.g. step-up transformer, feeder/collector, transmission line
Reactive power for each primary transmission device in the Registered Facility	Yes	Yes	F X MVAR	E.g. step-up transformer, feeder/collector, transmission line.
Aggregate active power for auxiliary loads associated with	Yes	Optional	F X AUX TX MW	This can be a Calculated Point.

Point Description	Scheduled Facility or Semi-Scheduled Facility	Non-Scheduled Facility	Naming Convention	Notes
each generating unit in the Registered Facility				
Aggregate reactive power for auxiliary loads associated with each generating unit in the Registered Facility	Yes	Optional	F X AUX TX MVAR	This can be a Calculated Point.
Overexcitation limit for each relevant device within the Registered Facility	Yes	Optional	F X OVEREXCITATION LIMIT	Not applicable to inverter connected devices.
Underexcitation limit for each relevant device within the Registered Facility	Yes	Optional	F X UNDEREXCITATION LIMIT	Not applicable to inverter connected devices.
Generation feeder MW	Yes	Optional	F GX FEEDER MW	For each feeder containing a generating unit or energy producing device.
Generation feeder MVAR	Yes	Optional	F GX FEEDER MVAR	For each feeder containing a generating unit or energy producing device.
Generation feeder current	Yes	Optional	F GX FEEDER AMPS	For each feeder containing a generating unit or energy producing device.
Reactive feeder MVAR	Yes	Optional	F RX FEEDER MVAR	For each feeder containing a reactive device.
Reactive feeder current	Yes	Optional	F RX FEEDER AMPS	For each feeder containing a reactive device.
Generator step-up transformer(s) HV voltage	Yes	Optional	F GSUTX KV	
Generator step-up transformer(s) HV MW	Yes	Optional	F GSUTX MW	
Generator step-up transformer(s) HV MVAR	Yes	Optional	F GSUTX MVAR	
Generator step-up transformer(s) HV voltage	Yes	Optional	F GSUTX KV	
Generator step-up transformer(s) LV voltage	See notes	Optional	F GSUTX LV KV	Depending on site configuration and synchronization/islanding arrangements.
Generator step-up transformer(s) protection status (normal/abnormal)	Yes	Optional	F GSUTX PROTECTION STATUS	
Generator step-up transformer(s) protection operated	Yes	Optional	F GSUTX PROTECTION OPERATED	

Point Description	Scheduled Facility or Semi-Scheduled Facility	Non-Scheduled Facility	Naming Convention	Notes
Voltage measurement at the connection point	Yes	Yes	F X KV	Typically a transmission line voltage measurement. If this value is already provided to AEMO by the Network Operator, it is not required to be provided by the Facility.
Reactive device available reactive MVAR	Yes	Yes	F PLANT_NAME AVAILABLE REACTIVE MVAR	Current available reactive MVAR available from the device (e.g. STATCOM/SVC). Only relevant for Registered Facilities with additional reactive power devices installed. Where PLANT_NAME is the relevant piece of equipment (e.g. a synchronous condenser).
Reactive device available capacitive MVAR	Yes	Yes	F PLANT_NAME AVAILABLE CAPACITIVE MVAR	Current available capacitive MVAR available from the device (e.g. STATCOM/SVC). Only relevant for Registered Facilities with additional reactive power devices installed. Where PLANT_NAME is the relevant piece of equipment (e.g. a synchronous condenser).
Current measurement at the connection point	Yes	Optional	F X AMP	This can typically be a transmission line current measurement.
Facility HV busbar voltage measurement	Yes	Yes	F BUS X KV	Where applicable.
Facility LV busbar voltage measurement	Yes	Yes	F BUS X KV	Where applicable.
Reactive power flow for each associated reactive power device	Yes	Optional	F PLANT_NAME MVAR	Only required where additional reactive power devices have been installed. Where PLANT_NAME is the relevant piece of equipment (e.g. synchronous condenser).
Facility target MVAR/PF/KV	Yes	Yes	F TARGET MVAR/PF/KV	Current target setpoint for voltage control purposes (if applicable), fed back from the Registered Facility's control system to AEMO.
Ambient temperature (°C)	Yes	Optional	F AMBIENT TEMPERATURE	
Control				
Net MW Facility setpoint	See notes	Optional	F DESIRED MW	This is the setpoint which is actively sent setpoint instructions by AEMO's AGC system when the Registered Facility is participating in AGC dispatch. This point is compulsory for Registered Facilities providing Regulation or Contingency Reserve, and encouraged but optional for Registered Facilities only seeking to participate in Energy. This does not include Registered

Point Description	Scheduled Facility or Semi-Scheduled Facility	Non-Scheduled Facility	Naming Convention	Notes
				Facilities that provide these Essential System Services via a block or switched response. This setpoint requires a Back-Indication Point.
Generator terminal voltage control	See notes	See notes	F X DESIRED KV	If required by the Network Operator. This setpoint requires a Back-Indication Point.
Facility voltage control mode	See notes	See notes	F CONTROL_MODE	Where CONTROL_MODE is one of the individual type of voltage control mode available (e.g. MVAR, PF, KV), if applicable.
Generator step-up transformer tap control	Yes	Optional	F GSUTX TAP CONTROL	Raise/Lower voltage controls. If required by the Network Operator.
Dispatch Target ramp rate	Optional	Optional	F DISPATCH TARGET RAMP RATE	Facilities are required to ramp linearly between Dispatch Targets unless directed otherwise. Optionally, AEMO can issue an EOI Dispatch Target and a desired Ramp Rate if this point is available. If present, it is recommended that this setpoint has a Back-Indication Point.
Dispatch Target MW	Optional	Optional	F DISPATCH TARGET MW	This is the EOI Dispatch Target for current Dispatch Interval, or next Dispatch Interval where there is a step change just prior to the commencement of that Dispatch Interval. If present, it is recommended that this setpoint has a Back-Indication Point.
Target Net load setpoint	Yes	Optional	F TARGET NET SETPOINT	Facility internal control system setpoint for the Facility net output. It is an indication to AEMO to show their current control system setpoint to their facility output.

Figure 1: Diagram of communication failure alarms

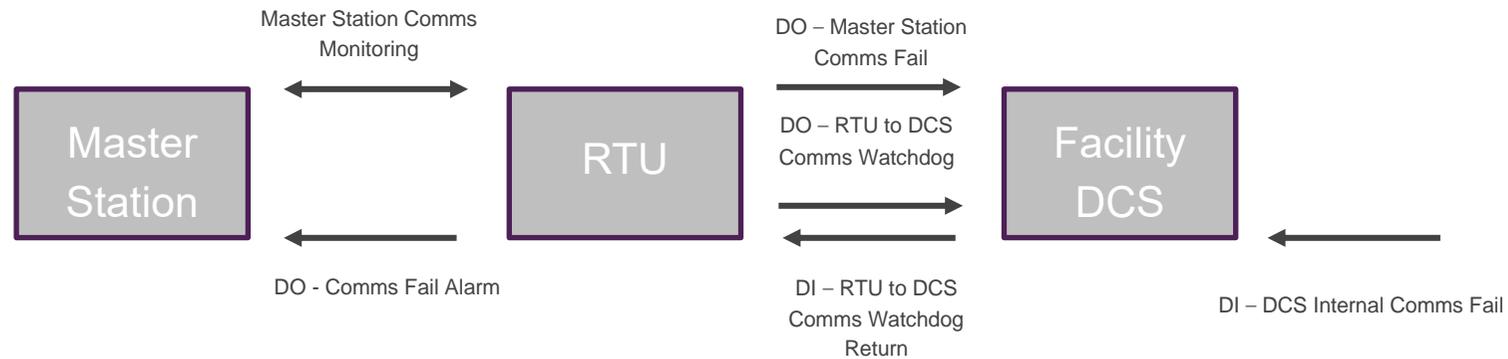


Table 4 Additional Operational Data Point requirements for Scheduled Facilities

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
Status				
Generating Facility synchronising	Yes	Yes	F SYNC IN PROGRESS	
Alarms				
No additional points				
Measured and Calculated Telemetry				
Generating unit turbine speed	Yes	Yes	F Gx TURBINE SPEED	Indication of the turbine speed associated with each generating unit in the Facility, measured as a %, where applicable to the relevant technology.
Control				
No additional points				

Table 5 Additional Operational Data Point Requirements for Semi-Scheduled Facilities and Non-Scheduled Facilities

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
Status				
No additional points				
Alarms				
Control system failure	Yes	Yes	F CONTROL SYSTEM FAIL	
Measured and Calculated Telemetry				
Facility available Net MW	Yes	Yes	F NET AVAILABLE MW	MW available to export from the Facility if there were no active MW setpoint limiting the output
Facility local limit MW	Yes	Yes	F LOCAL LIMIT MW	Indicates the maximum output the facility can achieve accounting for any local limitations (e.g. temperature limitations, protection limitations, etc.)
Control				
Dispatch Cap/Target MW (Injection)	Yes (as applicable)	Optional	F DISPATCH INJECTION CAP MW	This is the Dispatch Cap MW setpoint for Injection (as applicable) for current Dispatch Interval, or next Dispatch Interval where there is a step change just prior to the commencement of that interval.
Dispatch Cap/Target MW (Withdrawal)	Yes (as applicable)	Optional	F DISPATCH WITHDRAWAL CAP MW	This is the Dispatch Cap MW setpoint for Withdrawal (as applicable) for current Dispatch Interval, or next Dispatch Interval where there is a step change just prior to the commencement of that interval.

Appendix B. Operational Data Point Requirements for specific technologies

Note that the technologies in the tables below apply to all Facility Classes. The requirements listed here are in addition to any requirements in Appendix A of this document. Where a Facility comprises of multiple different technologies (a “hybrid” facility), each of the below tables applies for the relevant technologies within the Registered Facility. Additionally, there may be extra Operational Data Points required to capture any potential complexities that arise from the interaction between the technologies of a hybrid Facility. Where an Operational Data Point in this appendix is already required in Appendix A, the requirements in Appendix A take precedence, but do not require the duplication of Operational Data Points that fulfil the same function.

In the column “Naming Convention”, **F** means the Registered Facility’s short name, and an **X** indicates a number. For example, for the first circuit breaker for Facility “SWAN_G1”, the recommended name for the net MW telemetry would be “SWAN_G1_CB_1”.

At the time of publication, the final registration and participation construct for DER had not been fully established. Once this occurs, this document will be updated to reflect any requirements that will need to apply to Registered Facilities that incorporate DER.

Table 6 Operational Data Point Requirements for gas turbines

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
Status				
Base/peak mode	Yes	Optional	F X OPERATING MODE	Or other operating modes as appropriate for the turbine
Droop enabled/blocked	Yes	Optional	F X DROOP MODE	Indicates whether “standard” droop is active on the generator
Ready to start	Yes	Optional	F X READY TO START	Indicates that the generator is in a ready to start state
Starting in progress	Yes	Optional	F X STARTING IN PROGRESS	Indicates when the generator is in the process of starting up
Rundown in progress	Yes	Optional	F X RUNDOWN IN PROGRESS	Indicates when the generator is in the process of shutting down
At temperature limit indication	Yes	Optional	F X TEMPERATURE LIMIT	Indicates where a turbine has reached a temperature limit and can no longer increase output

Table 7 Operational Data Point Requirements for steam turbines

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
Status				
Turbine mode	Yes	Optional	F X TURBINE MODE	Boiler follower/turbine follower
Drop enabled/blocked	Yes	Optional	F X DROOP MODE	Indicates whether “standard” droop is active on the generator
Excitation mode	Yes	Optional	F X EXCITATION MODE	Auto/manual
Starting in progress	Yes	Optional	F X STARTING IN PROGRESS	Indicates when the generator is in the process of starting up
Rundown in progress	Yes	Optional	F X RUNDOWN IN PROGRESS	Indicates when the generator is in the process of shutting down

Table 8 Operational Data Point Requirements for wind generation

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
Measured Values				
Number of individual generation units available for service	Yes	Optional	F X AVAILABLE GENERATION UNITS	
High wind alarm	Yes	Yes	F HIGH WIND ALARM	Indicates where one or more wind turbines are running back due to high wind conditions
Turbines stopped for high wind	Yes	Optional	F TURBINES STOPPED FOR HIGH WIND	Number of turbines out of service for high wind
Wind speed at nacelle height (km/h)	Yes	Optional	F WIND SPEED KMH	Where a wind farm has significant geographic diversity, multiple wind speed measurements may be required to account for distinct groups of turbines with differing characteristics within the wind farm. This value should be an average of every nacelle or group of nacelles. If measurement at the nacelle height is unavailable, then at a nominated height no less than 60% of the nacelle height is acceptable.
Wind direction at nacelle height (°)	Yes	Optional	F WIND DIRECTION DEG	Where a wind farm has significant geographic diversity, multiple wind direction measurements may be required to account for distinct groups of turbines with differing characteristics within the wind farm.

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
				If measurement at the nacelle height is unavailable, then at a nominated height no less than 60% of the nacelle height.
Ambient dry bulb temperature (°C)	Yes	Optional	F AMBIENT DRY BULB TEMP DEG C	These data points are only required from one measurement site at each facility. If the Facility is a hybrid Facility, one set of these data points for the entire Facility is sufficient. All values should be taken at ground level or within 3m of such.
Air pressure (hPa)	Yes	Optional	F AIR PRESSURE HPA	
Relative humidity (%) or dew point (°C)	Yes	Optional	F RELATIVE HUMIDITY	
Temperature at nacelle height (°C)	Yes	Optional	F TEMPERATURE DEG C	Average across the Facility
Maximum of temperatures at nacelle height (°C)	Yes	Optional	F MAX TEMPERATURE DEG C	The maximum value from the sensors that comprise readings that contribute to the average value.
Maximum of wind speeds at nacelle height (km/h)	Yes	Optional	F MAX WIND SPEED KMH	The maximum value from the sensors that comprise readings within the average value.

Table 9 Operational Data Point Requirements for solar photovoltaic generation

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
Measured Values				
Number of individual units available for service	Yes	Optional	F SOLAR INVERTERS AVAILABLE	Depending on the arrangement of the Facility, this may be by inverter or collector.
Solar irradiance (W/m ²) - horizontal	Yes	Optional	F HORIZONTAL IRRADIANCE	This value must be the average of all the sensors on the site such that no individual sensor is weighted to represent more than 10MWp of capacity installed. E.g. a 40MW site will require at least 4 sensors.
Solar irradiance (W/m ²) – inclined plane	Yes	Optional	F INCLINED IRRADIANCE	This value must be the average of all the sensors on the site such that no one sensor is weighted to represent more than 10MWp of capacity installed. E.g. a 40MW site will require at least 4 sensors. This value should represent the irradiance on the tracking surface.
Tracking angle(s) (° from horizontal)	Yes	Optional	F TRACKERS AVG ANGLE	This is the angle between the current position and horizontal. Only required for facilities that include single-axis or dual-axis tracking.
Tracking orientation (° East of North)	Yes	Optional	F TRACKERS AVG ORIENT	Orientation for single axis and fixed or semi-fixed arrays can be provided in standing data instead if it is constant. Dual Axis tracking systems must provide this.

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
Air temperature (°C, dry bulb)	Yes	Optional	F AMBIENT TEMPERATURE	Multiple Operational Data Points may be required where the Registered Facility is geographically dispersed, and significant variations in temperature across the site are possible.
Module surface temperature (°C)	Yes	Optional	F MODULE TEMPERATURE	Average for modules. Multiple Operational Data Points may be required where the Registered Facility is geographically dispersed, and significant variations in temperature across the site are possible.

Table 10 Operational Data Point Requirements for solar Electric Storage Resources¹

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
Measured Values				
Number of individual units available for service	Yes	Optional	F INVERTERS AVAILABLE	Where the Registered Facility consists of multiple, distinct inverters or Electrical Storage Resources. May also be “F UNITS AVAILABLE” for non-inverter based technologies.
Charging/discharging mode	See notes	Optional	F CHARGING MODE	This Operational Data Point is only required if the Registered Facility has distinct charging/discharging modes that significantly alter the operational capabilities of the Registered Facility, and where the process for changing modes takes longer than 10 seconds.
Charging efficiency (%)	Yes	Optional	F CHARGING EFFICIENCY	These may be a single Operational Data Point where these values typically differ by less than 2%.
Discharging efficiency (%)	Yes	Optional	F DISCHARGING EFFICIENCY	
Grid following / grid forming mode	Optional	Optional	F INVERTER MODE	May be required for the provision of certain Essential System Services by the Registered Facility.
Available discharge capability (MWh)	Yes	See notes	F AVAILABLE DISCHARGE	The usable energy (in MWh) stored in the Facility and capable of being Injected to the Network under prevailing conditions, but at maximum discharge rates. That is, accounting for any minimum state of charge requirements for the Facility. For a Registered Facility with a System Size < 10 MW, this point is optional, but is required if the Registered Facility wishes to opt into storage constraints

¹ Table 10 is written in anticipation of battery storage systems. However, the general principles and requirements are extensible to all forms of Electric Storage Resources. Please contact AEMO if you are seeking to construct other forms of Electric Storage Resources for WEM participation to confirm that these requirements are appropriate .

Point Description	System Size ≥ 10 MW	System Size < 10 MW	Naming Convention	Notes
				under clause 7.5.9 of the WEM Rules, or if the Registered Facility is a Scheduled Facility or Semi-Scheduled Facility.
Available charge capability (MWh)	Yes	See notes	F AVAILABLE CHARGE	The remaining capability for the Energy Storage Resource to Withdraw energy from the network and store it in (MWh) under prevailing conditions, but at maximum charge rates. That is, accounting for any maximum state of charge requirements for the Facility. For a Registered Facility with a System Size < 10 MW, this point is optional, but is required if the Registered Facility wishes to opt into storage constraints under clause 7.5.9 of the WEM Rules, or if the Registered Facility is a Scheduled Facility or Semi-Scheduled Facility.
Ambient dry bulb temperature (°C)	Yes	Optional	F AMBIENT TEMPERATURE	These data points are only required once for the Facility. If the Facility is a hybrid Facility, one set of these weather data points for the entire Facility may be sufficient. Measured within 4 m of ground level.
Relative humidity (%) or dew point (°C)	Yes	Optional	F RELATIVE HUMIDITY F DEW POINT	
Module temperature (°C)	Yes	Optional	F MODULE TEMPERATURE	
Derated Available tag (10minutes, MW)	Optional	Optional	F 10 MIN AVAILABLE CAPACITY	The maximum amount the storage Facility could send out at a constant MW output in the next 10 minutes.
Derated Available tag (30minutes, MW)	Optional	Optional	F 30 MIN AVAILABLE CAPACITY	The maximum amount the storage Facility could send out at a constant MW output in the next 30 minutes.
Measured frequency	Optional	Optional	F CP FREQUENCY	The frequency as measured at the connection point, or as seen by the park controller. Alternatively, if park controller reading isn't available, inverter level is acceptable.

Appendix C. Operational Data Point Requirements For AGC Operation

In addition to the requirements listed above, Table 11 lists the SCADA point requirements for Facilities that are being dispatched via AEMO’s AGC system.

Note that “output” and “input” are from AEMO’s perspective. As such, an output is a signal that is sent from AEMO to the Registered Facility, and an input is a signal that is sent from the Registered Facility to AEMO.

Registered Facilities are required to operate on AGC to provide Regulation Raise and/or Regulation Lower, and may also be required to operate on AGC to provide other ESS in certain scenarios. Please refer to the WEM Procedure: Frequency Co-optimised Essential System Services Accreditation for more information.

More details about AGC operation can be found in the Technical Specification: AGC, Scada Dispatch Instructions, and Fast Start Facility Operational Behaviour.

Table 11 Operational Data Point Requirements required for AGC operation

Point Description	Point Type	Units	Update rate	Requirement	Naming Convention	Notes
Signals sent from AEMO to the Facility						
Facility desired Net MW setpoint	Analogue output	MW	4 seconds in AGC 30 seconds in MANUAL	Yes	F DESIRED MW	The MW set point which the Registered Facility must follow. This is sent (up to) every four seconds if the Facility is operating under AGC.
Facility desired ramp rate setpoint	Analogue output	MW/min	60 seconds	See notes	F DESIRED RAMP RATE	This is the Dispatch required ramp rate, issued on-change regardless of whether the unit is in AGC control or local control. If the Registered Facility is participating in AEMO-managed linear ramping, this value is not required as the Registered Facility will be ramped via AGC (see AGC/ABC Technical Specification). If the Registered Facility is not under AGC control, AEMO can optionally set the ramp rate of the Facility per Dispatch Interval using this control to match the Dispatch Target ramp rate (e.g. for a Semi-Scheduled Facility). If the Registered Facility is participating in Regulation the Facility should ignore this and use the maximum ramp rate achievable to move to its desired net MW setpoint.

Point Description	Point Type	Units	Update rate	Requirement	Naming Convention	Notes
AGC participation/control mode indication	Analogue output	-	30 seconds	Yes	F AGC CONTROL MODE	The current AGC mode that AEMO is dispatching the Registered Facility under. See Appendix E for the values used by this point. This setpoint is issued on-change.
Facility AGC low operation limit	Analogue output	MW	60 seconds	Optional	F LOW AGC LIMIT	The lower limit used by AGC. The Registered Facility will not be sent a target below this value. Provided only for informational purposes.
Facility AGC high operation limit	Analogue output	MW	60 seconds	Optional	F HIGH AGC LIMIT	The upper limit used by AGC. The Registered Facility will not be sent a target above this value. Provided only for informational purposes.
Facility actual MW setpoint	Analogue output	MW	30 seconds	Optional	F ACTUAL MW	The current Registered Facility's loading as seen from the master station. This setpoint is issued periodically at a configurable time interval.
Facility basepoint MW setpoint	Analogue output	MW	30 seconds	Optional	F BASEPOINT MW	The current basepoint used by AGC, which is the value to which a Registered Facility would be dispatched when participating in energy only. This setpoint is issued on-change.
Look-ahead dispatch Target MW setpoint	Analogue output	MW	60 seconds	Optional	F LOOKAHEAD MW X	<p>One or more look-ahead points can be configured, which communicate the most recent forecast of Dispatch Targets for a Dispatch Interval or Pre-Dispatch Interval in a set ahead period (e.g. 15 minutes from the latest dispatch).</p> <p>Up to a maximum of 4 lookahead setpoints per Facility. The times for each lookahead are configurable, however restricted to times corresponding to 5-minute dispatch intervals within the Pre-Dispatch horizon. These setpoints are issued on-change.</p> <p>The five-minute ahead look-ahead is recommended to be included, as it is the point to which the effective Dispatch Target or Dispatch Cap will be sent. Other look-ahead points are optional.</p>
Signals sent from the Facility to AEMO						
Facility local/remote MW control	Digital input	-	On change	Yes	F REMOTE CONTROL	Determines if the Registered Facility is capable of receiving instructions from AEMO's AGC system. If this point is set to 'local', AEMO's AGC system will remove the Registered Facility from AGC dispatch.
AGC control availability status	Digital input	-	30 seconds	Yes	F AGC CONTROL SELECTION	An indication from the Registered Facility that it is available for AGC control. When true, the Registered Facility will receive signals as per the participation modes outlined in Appendix E. If a Registered Facility is no longer available for AGC dispatch, it must update this point within 30 seconds to reflect this.

For any Registered Facilities that currently operate using an “intermediate MW target setpoint”, AEMO will work with individual Registered Facilities to minimise required changes to Registered Facility’s control systems.

Appendix D. Operational Data Point Requirements For Fast Start Facilities

Note that “output” and “input” are from AEMO’s perspective. As such, an output is a signal that is sent from AEMO to the Facility, and an input is a signal that is sent from the Facility to AEMO.

Table 12 Additional Operational Data Point Requirements required for Fast Start Facilities

Point Description	Point Type	Units	Update rate	Requirement	Notes
Outputs					
FSIP mode (enabled/disabled)	Digital output	-	On change	Optional	Indicates whether the Registered Facility has been specified as fast start in the real-time submission for the current Dispatch Interval.
Facility fast start signal (Option 1)	Digital output	-	4 seconds	Yes	A digital setpoint to which AEMO issues a signal upon a Fast Start Facility being dispatched as per the Central Dispatch process.
Facility fast start signal (Option 2)	Analogue output	-	4 seconds	Yes ²	As an alternative to a digital setpoint, AEMO can issue a specific value to an analogue setpoint to signal a Fast Start Facility dispatch. This can be an existing analogue setpoint used for another purpose (e.g. the Desired MW Setpoint), provided the Registered Facility control system can treat the different signals appropriately.
Inputs					
Facility fast start signal feedback (Option 1)	Digital input	-	4 seconds	Yes	Feedback for the “Facility fast start signal”, providing AEMO indication that the Registered Facility has received an instruction to start.
Facility fast start signal feedback (Option 2)	Analogue input	-	4 seconds	Yes ³	As above, but in analogue form.

AEMO has not yet defined the implementation to be used for any analogue fast start signals, and will update this document once it has done so, if this implementation is desired by Market Participants.

² Only one of the Facility Fast Start Signals should be implemented, either the digital or analogue option.

³ As per footnote 2.

Appendix E. Operational Data Point Requirements for Interruptible Loads

Note that “output” and “input” are from AEMO’s perspective. As such, an output is a signal that is sent from AEMO to the Facility, and an input is a signal that is sent from the Facility to AEMO.

For an Interruptible Load, AEMO requires telemetry and alarming on individual relays with the potential to shed more than 10 MW upon operation. Where the Interruptible Load is made up of multiple relays, AEMO requires summary information for the aggregate operation of these relays.

Table 13 Operational Data Point Requirements for Interruptible Loads

Point Description	Requirement	Naming Convention	Notes
Status			
Relay/scheme activation status	Yes	F CB X	Where AEMO requires monitoring of multiple relays or schemes, there should be one point for each of these.
Relay/scheme operated	Yes	F X RELAY OPERATED	Where AEMO requires monitoring of multiple relays or schemes, there should be one point for each of these.
Alarms			
Communications link(s) fail	Yes	F DCS COMMS LINK FAIL	
Measured and Calculated Telemetry			
Gross active power measurement of each relay/scheme	See notes	F X GROSS MW	This point should measure the total, gross active power consumed by the connections that form part of the Interruptible Load, where this is meaningful measurement. It is not intended to represent the currently available load for interruption, which should instead be communicated to AEMO via an appropriate Real-Time Market Submission.
Gross reactive power measurement of each relay/scheme	See notes	F X GROSS MVAR	This point should measure the total, gross reactive power consumed by the connections that form part of the Interruptible Load, where this is meaningful measurement.
Net active power measurement of each relay/scheme	See notes	F X NET MW	This point should measure the total, net active power consumed by the connections that form part of the Interruptible Load, where this is meaningful measurement. It is not intended to represent the currently available load for interruption, which should instead be communicated to AEMO via an appropriate Real-Time Market Submission.
Net reactive power measurement of each relay/scheme	See notes	F X NET MVAR	This point should measure the total, Gross reactive power consumed by the connections that form part of the Interruptible Load, where this is meaningful measurement.
Relay voltage	See notes	F X KV	Only where the relay or scheme is transmission-connected
Controls			

Point Description	Requirement	Naming Convention	Notes
Scheme/Relay frequency trip threshold	See notes	F DESIRED TRIP HZ	This point is intended for AEMO to communicate the desired frequency threshold below which a scheme/relay should operate (e.g. 49.5 Hz). Where AEMO has determined multiple desired frequency thresholds, there should be an individual point for each threshold.

Appendix F. AGC Participation Modes

Table 14 shows the various possible AGC participation modes for a Facility, as well as the analogue values that are sent to the Facility using the “AGC control mode indication” point. The list below highlights the key values for energy and Regulation participation:

- A Facility receiving Dispatch Targets via AGC, but not participating in Regulation will be in “base none” (value 90).
- A Facility participating in Regulation will be in “base full” (value 120).
- A Facility participating in Contingency Reserve (but not in Regulation) will be in “base assist” (value 110) if it is actively participating in AGC.
- A Facility no longer participating in AGC will be in “manual” (value 80).

Other values are not actively used for the communication of Dispatch Targets or Regulation provision but are included for completeness. More details about AGC operation can be found in the Technical Specification: AGC, Scada Dispatch Instructions, And Fast Start Facility Operational Behaviour.

Table 14 AGC control and participation modes

Control mode / Participation mode	Full	Regulation	Assist	None
Econ	200	180	190	170
Ramp	160	140	150	130
Base	120	100	110	90
Manual	80	N.A	N.A	N.A
Available	40	N.A	N.A	N.A
Unavailable	20	N.A	N.A	N.A