

VPP DEMONSTRATIONS DATA SPECIFICATION

PREPARED BY: AEMO Emerging Markets and Services
VERSION: 1.0
EFFECTIVE DATE: 22 August 2019
STATUS: FINAL

VERSION RELEASE HISTORY

Version	Effective date	Summary of changes
1.0	22 August 2019	First issue of the VPP Demonstrations Data Specification

CONTENTS

1.	INTRODUCTION	4
1.1.	Data specification objectives	4
1.2.	Transferring data to AEMO	4
2.	ENROLMENT DATA	5
3.	FCAS ASSESSMENT DATA	5
4.	OPERATIONAL DATA SPECIFICATION	5
4.1.	Scope of operational data specification	6
4.2.	Opportunity for further feedback	7
4.3.	Aggregated data	8
4.4.	Device level telemetry data	11
5.	DATA PROVIDED FROM AEMO	11
APPENDIX A.	ADDITIONAL INFORMATION RELATING TO THE OPERATIONAL DATA SPECIFICATION	12
APPENDIX B.	EXAMPLE DATA FEEDS FOR THE OPERATIONAL DATA SPECIFICATION	14

TABLES

Table 1	Aggregated data classifications	8
Table 2	Aggregated forecast data specification.....	9
Table 3	Actual performance data and standing data specification.....	10
Table 4	Actual performance data and standing data specification.....	10
Table 5	Device level telemetry data specification	11

FIGURES

Figure 1	Examples of pre-dispatch runs, 40-hour and 16-hour horizons.....	13
Figure 2	Example of data feeds.....	15

1. INTRODUCTION

AEMO has launched the VPP Demonstrations, with funding support from ARENA through its Advancing Renewables Program, to learn how VPPs should be integrated into the National Electricity Market. To inform AEMO's learning and facilitate the VPP Demonstrations, participants are required to submit a range of data to AEMO.

This *VPP Demonstrations Data Specification* outlines three categories of data that VPP Demonstrations participants will submit to AEMO:

- Enrolment Data.
- Frequency Control Ancillary Services (FCAS) Data.
- Operational Data.

1.1. Data specification objectives

The VPP Demonstrations objectives are outlined in the *VPP Demonstrations Final Design Document*¹.

The VPP Demonstrations Data Specification has been designed such that it meets the objectives of the VPP Demonstrations and is intended to:

- Facilitate AEMO's operational visibility of VPPs to understand their impact on power system security, local power quality and how they interact with the market.
- Enable AEMO to assess current regulatory arrangements affecting participation of VPPs in energy and FCAS markets and inform new or amended arrangements where appropriate.

1.2. Transferring data to AEMO

The VPP Demonstrations participants must provide to AEMO (either directly or through a third party nominated by the Applicant) the data as set out in this *VPP Demonstrations Data Specification* in place from time to time.

Data should be transferred to AEMO by integrating with AEMO's VPP Demonstrations Application Programming Interfaces (APIs). Further information on this can be found in the *Guide to VPP Demonstrations APIs*².

These APIs are not available at the time of the VPP Demonstrations launch.

Until the APIs are available, Applicants should submit Enrolment Data and FCAS Data to AEMO by email (Enrolment Data to VPPEnrolment@aemo.com.au and FCAS data to Freq_Event.Data@aemo.com.au), using the *VPP Demonstrations Data Template*³. Once the APIs are available, Applicants must integrate with the AEMO APIs to facilitate data transfers. AEMO will allow reasonable time for Applicants to integrate with the AEMO APIs once they are made available.

As it is not practical to submit the Operational Data via email, the obligation to transfer Operational Data to AEMO will only commence once the VPP Demonstrations APIs are available.

¹ At http://aemo.com.au/-/media/Files/Electricity/NEM/DER/2019/VPP-Demonstrations/NEM-VPP-Demonstrations_Final-Design.

² At <http://aemo.com.au/-/media/Files/Electricity/NEM/DER/2019/VPP-Demonstrations/DRAFT-Guide-to-VPP-Demonstrations-APIs>.

³ At <http://aemo.com.au/-/media/Files/Electricity/NEM/DER/2019/VPP-Demonstrations/VPP-Demonstrations-Data-Template>.

2. ENROLMENT DATA

To classify loads as ancillary services loads and aggregate two or more loads so they are treated as one ancillary services load, Applicants are required to submit data to AEMO during the enrolment process in relation to:

- A list of NMI and Device Data.
- Frequency Injection Test Data (FITD)⁴.

Applicants can use the *VPP Demonstrations Data Template*⁵ to submit this data via email (to VPPEnrolment@aemo.com.au) until AEMO's VPP Demonstrations APIs are available.

More information on the Frequency Injection Test requirements can be found in Appendix B of the *VPP Demonstrations FCAS Specification*⁶, which outlines the standard test procedures that AEMO will use when requiring a VPP Demonstrations Applicant to demonstrate the relevant plant's capability to provide the market ancillary service to the satisfaction of AEMO under clause 3.11.2(i) of the Rules.

3. FCAS ASSESSMENT DATA

Upon successful completion of the enrolment process VPP Demonstrations Applicants will be approved to participate in the contingency FCAS markets.

FCAS Assessment Data refers to the data that must be submitted by VPP Demonstrations participants to verify the delivery of FCAS in response to a contingency FCAS event.

The *VPP Demonstrations FCAS Specification* provides the monitoring and recording requirements which a VPP Demonstrations Participant must install and maintain, and the standards which apply to the equipment, to monitor and record the response of the ancillary service load to changes in the frequency of the power system under clauses 3.11.2(f) and (g) of the Rules.

Participants can use the *VPP Demonstrations Data Template* to submit FCAS assessment data for each VPP portfolio, or Dispatchable Unit Identifier (DUID), via email (to Freq.Event.Data@aemo.com.au) until AEMO's VPP Demonstrations APIs are available.

4. OPERATIONAL DATA SPECIFICATION

AEMO anticipates that operating a more decentralised power system with two-way power flows in many areas will require a much greater level of operational awareness of electricity networks, supported by larger and more frequent exchanges of operational and network data between stakeholders.

The data requirements described in this section will be collected and used for the VPP Demonstrations to meet the specified learning objectives and to define what ongoing data specifications should be required to enable AEMO to meet its obligations to securely operate the power system.

This Operational Data Specification is not necessarily indicative of the ongoing data specifications for VPPs, although the 5-minute settlement implementation indicates the importance of the 5-minute timeframe in future.

AEMO is sensitive to the need for longer-term data requirements to be devised carefully in consultation with consumers, equipment manufacturers, and electricity market participants, and

⁴ See the Data Submission for Ancillary Service Loads section of the VPP Demonstrations Enrolment Form for more information, at <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program/Virtual-Power-Plant-Demonstrations>.

⁵ At <http://aemo.com.au/-/media/Files/Electricity/NEM/DER/2019/VPP-Demonstrations/VPP-Demonstrations-Data-Template>.

⁶ At <http://aemo.com.au/-/media/Files/Electricity/NEM/DER/2019/VPP-Demonstrations/VPP-Demonstrations-FCAS-Specification>.

for those requirements to strike the right balance between operational requirements and compliance costs.

AEMO also recognises that VPPs are currently developing their capabilities to collect and communicate operational data. To the extent that a VPP Participant is unable to provide data in accordance with the Data Specification, the VPP Participant should inform AEMO of the issues together with a rectification plan outlining how the VPP Participant intends to address the deficiencies to ensure compliance with the Data Specification. AEMO may agree to alternative data arrangements for a limited period of time as set out in the rectification plan.

The Operational Data Specification is split into the following sections:

- Aggregated Data – an aggregated forecast of anticipated active power flows, and aggregated actual performance data, from each VPP portfolio.
 - Function: to be used by AEMO’s Operational Forecasting team to monitor the regional balance of supply and demand. Because VPPs participating in these Demonstrations will be operating as non-scheduled price takers when injecting energy (as distinct from FCAS) into their local network, AEMO will not have visibility of these power flows unless a forecast is provided. Awareness of VPP operation could be critical to managing the power system in high demand periods where reserves (spare capacity) have dropped to historic lows in recent years.
- Device Level Telemetry Data – a set of key DER system variables sampled at 5-minute resolution. This dataset is similar to the Schedule D data specification produced by the ACT Government as part of their NextGen Energy Program.
 - Function: the primary purpose of this dataset is to provide a clear technical record of how DER aggregated into VPPs operate in the NEM under the current NER. This dataset will be carefully analysed by AEMO to assess whether the breadth of current rules and procedures applicable to VPPs adequately incentivise consumer and power system benefits.

4.1. Scope of operational data specification

For the purposes of this specification the following terms will be limited to the scope defined below:

VPP	Sum of controllable loads/generation that constitute a VPP portfolio. Data in this specification is intended to be delivered by DUID, for each VPP. Each of the generation or load devices explicitly under control, enrolled to the VPP for each DUID is to be included in the operational dataset. <u>This dataset is intended only for devices under active control, e.g. a battery, or switched pump. Rooftop-PV is not included.</u> The VPP will not extend beyond the borders of a NEM Region.
-----	--

Consideration

AEMO considered two options for the scope of operational data requirements. Option 1 is presented in this specification and in the example in Appendix B. AEMO welcomes feedback on the feasibility of each of the options presented below.

- Option 1 [Device Level Data Only]: Only data relating to the devices explicitly under active control is submitted. This would exclude devices that are passive such as rooftop-PV or household load in some cases.
- Option 2 [Site Level Data]: All data on the site under control is submitted. This would include some site-based information on devices that are not under active control such as rooftop-PV

and household loads. AEMO considers challenges with this option, as some forecast double-counting may occur (such as overlap with AEMO's rooftop-PV forecasts).

4.2. Opportunity for further feedback

As the obligation to transfer Operational Data to AEMO will only commence once the VPP Demonstrations APIs are available, there is an opportunity to incorporate any final stakeholder feedback by 6 September 2019, prior to the publication of the final the Operational Data API specification (which would incorporate the final operational data specification).

Please contact DERProgram@aemo.com.au if you have any further feedback on the Operational Data Specification.

4.3. Aggregated data

4.3.1. Aggregated data classifications

Table 1 Aggregated data classifications

Data Feed Type	Timestep	Description
Operational forecast	5-minute resolution covering the pre-dispatch timeframe, instantaneous period ending	Forecast of aggregated generation or load under control in each VPP portfolio (exclusive of any generation or load being held available for FCAS enablement). Re-forecast every 5 minutes.
Availability forecast	5-minute resolution covering pre-dispatch timeframe and 30-minute resolution covering the ST PASA timeframe, instantaneous period ending	Available capacity of generation or load in each VPP portfolio. Re-forecast every 5 minutes in pre-dispatch and every 30 minutes in ST PASA. The availability forecast is exclusive of charge and discharge expectations of the storage systems, this only reflects the total online capability.
Actual performance data	5-minute resolution, instantaneous period ending	Actual delivered aggregated generation or load under control in each VPP portfolio. Received no later than 5 minutes after the fact, every 5 minutes.
Standing Data	30-minute resolution	Updated as required, only when there is a forecast change or has been a change in the data. This can be both forecast data and actual data.

4.3.2. Aggregated Forecast Data Specification

VPPs may respond to signals outside the wholesale electricity market, or outside AEMO’s visibility on the power system. In order to forecast effectively to maintain power system security, AEMO anticipates use of information in regards to load and generation of the VPP as specified in Table 2 below.

Further, AEMO’s real time operations and forecasting functions anticipates the need to have visibility of VPP capacity in order to forecast capability of all VPPs to ensure optimal operational decision-making to maintain power system reliability.

A simplified, worked example of the data specifications outlined in Table 2 is provided in Appendix B for visualisation.

Note: All demonstration participants are obliged to submit forecasts that represent their best reasonable expectation of plant operation. Participants should provide these forecasts on a *best endeavours* basis and ensure they are not false or misleading.

Table 2 Aggregated forecast data specification

	Data Feed Type	Data Feeds Required	Units	Description	Justification	Example (see Appendix B)
1	Operational forecast	Forecast Controlled Generation	MW	The sum of the best estimate of VPP generation activity at each individually controlled generation device. (Note rooftop-PV is not considered as explicitly controlled here and so not intended to be included).	AEMO is investigating how forecasts of VPP activity can be factored into operational planning activities and dispatch.	Solid purple line
2	Operational forecast	Forecast Controlled Load	MW	The sum of the best estimate of VPP load activity at each individually controlled load device. (Note this is not intended to include uncontrolled loads such as household appliance loads unless explicitly under control).	As above.	Solid red line
3	Operational forecast	Forecast Energy Storage (MWh)	MWh	The energy that the VPP operator has stored that could be discharged if required.	AEMO requires visibility of VPPs for real time operations to maintain power system security, including forecasting of state of charge.	Shaded grey area
4	Availability forecast	Forecast Generation Capacity	MW	The level of total generation that could be created (MW) if the VPP discharged at the maximum rate.	Generation capability can change with time if systems are offline or undergoing maintenance. AEMO's real time operations and forecast modelling needs to have visibility of installed capacity in order to forecast capability of all VPPs and in order to maintain power system security.	Dashed purple line
5	Availability forecast	Forecast Load Capacity	MW	The level of load that could be created (MW) if the VPP operator charges storage at the maximum rate.	The load capability of the VPP (not necessarily equal to the generation capability). Load capability can change with time if systems are offline or undergoing maintenance. There may also be times of day that load is able to be controlled.	Dashed red line
6	Availability forecast	Forecast Energy Storage Capacity	MWh	Forecast energy storage capacity of the VPP.	The installed storage capacity of a VPP can change as new systems are installed, or as systems degrade with time or are un-installed.	Dashed grey line

4.3.3. Actual performance data and standing data

Table 3 Actual performance data and standing data specification

	Data feed type	Data feeds required	Units	Description
1	Actual performance data	Controlled Generation	MW	The sum of actual VPP discharge/generation activity. (Note this is not intended to include un-controlled generation such as rooftop-PV)
2	Actual performance data	Controlled Load	MW	The sum of actual VPP charge/load activity. (Note this is not intended to include un-controlled loads such as household appliance loads unless explicitly under control).
3	Actual performance data	Energy Stored	MWh	The Energy that the VPP operator had stored that could have been discharged if required (Actual)
4	Standing Data	Generation Capacity	MW	The actual level of total generation that could have been created within the VPP (MW) if the VPP discharged at the maximum rate.
5	Standing Data	Load Capacity	MW	The actual level of load that could have been created (MW) had the VPP operator elected to charge storage at the maximum rate
6	Standing Data	Total Energy Storage Capacity	MWh	The Energy that could have been stored if all batteries were fully charged (Actual)

4.3.4. Aggregated data specification summary

Table 4 specifies a summary of data streams that are to be provided as part of the VPP Demonstrations. Not all VPPs will be required to provide all data feed types, for example, if no load is under control items 2 and 4 below will not be required.

Table 4 Actual performance data and standing data specification

	Data feed	Units	Operational forecast	Availability forecast	Actual performance data	Standing data
1	Controlled Generation	MW	Y	N	Y	N
2	Controlled load	MW	Y	N	Y	N
3	Energy Stored	MWh	Y	N	Y	N
4	Generation Capacity	MW	N	Y	N	Y
5	Load Capacity	MW	N	Y	N	Y
6	Total Energy Storage Capacity	MWh	N	Y	N	Y

4.4. Device level telemetry data

The device level dataset in the table below should be provided at a 5-minute resolution for each DER device within a VPP portfolio, refreshed/uploaded to AEMO on a daily or weekly basis.

Table 5 Device level telemetry data specification

Installation type	Parameter	Units	Basis
All	Timestamp	Timestamp	Instantaneous
All	Customer gross load	kW, kVAr	Max, min, mean
All	Voltage	V	Max, min, mean, instantaneous
All	Frequency	Hz	Max, min, mean, instantaneous
All	Export power	kW, kVAr	Max, min, mean
DC battery	Inverter power output	kW, kVAr	Max, min, mean
DC battery	Battery DC power output	kW	Max, min, mean
AC battery	PV inverter power output	kW, kVAr	Max, min, mean
AC battery	Battery inverter power output	kW, kVAr	Max, min, mean
Any battery	Battery state of charge (usable)	Wh	Mean, instantaneous
No battery	Device net power output. Power consumption is negative	kW, kVAr	Max, min, mean

5. DATA PROVIDED FROM AEMO

Two-way communication control signals may be considered, similar to Reliability and Emergency Reserve Trader (RERT) or dispatch instructions, but are not currently in scope for the VPP Demonstrations

APPENDIX A. ADDITIONAL INFORMATION RELATING TO THE OPERATIONAL DATA SPECIFICATION

Relevant information is available on AEMO's website:

- Pre-dispatch (PD) System Operating Procedure (SO_OP_3704): https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3704---Predispatch.pdf.
- Short-term projected assessment of system adequacy (ST PASA): <https://www.aemo.com.au/-/media/Files/PDF/0431-0004-pdf.pdf>.
- Spot market operations timetable: https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Dispatch/Spot-Market-Operations-Timetable.pdf.

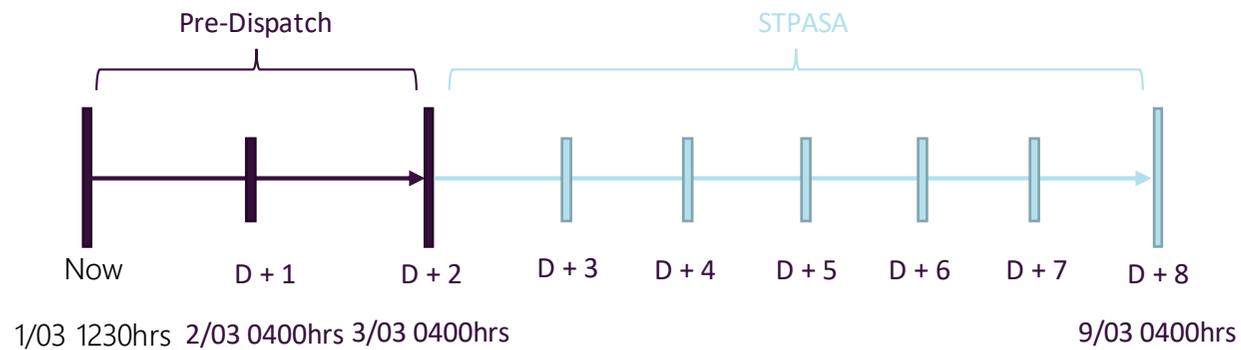
The pre-dispatch forecast horizon begins at 1230 hrs (Market Time/EST) on each trading day, extending to the end of the next trading day.

The ST PASA forecast horizon begins at the end of the next trading day, extending to the end of trading day + 7 days.

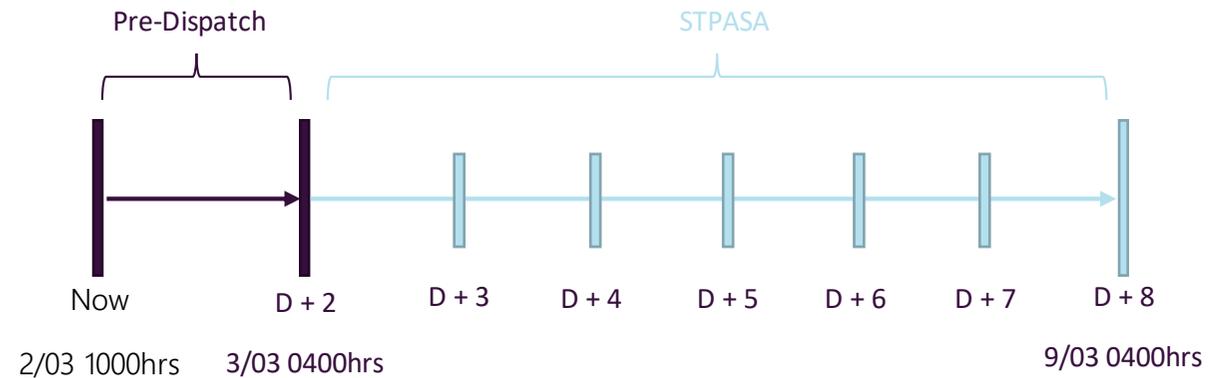
The following diagrams demonstrate two examples.

Figure 1 Examples of pre-dispatch runs, 40-hour and 16-hour horizons

Example 1: As at 1230 hrs pre-dispatch run on calendar day 1 March. Pre-dispatch is a 40-hour horizon.



Example 2: As at 1000 hrs pre-dispatch run on calendar day 2 March. Pre-dispatch is now a 16-hour horizon.



APPENDIX B. EXAMPLE DATA FEEDS FOR THE OPERATIONAL DATA SPECIFICATION

The following diagram is an example representation of each of the data feeds specified above. These values could represent either forecasts or actual.

- Chart shows only to Day + 3, however the ST PASA window extends to 0400 hrs on Day + 8 as in Appendix A.
- This example assumes a VPP comprising 15 MW load (10 MW battery + 5 MW controllable load), 10 MW generation (battery only) and 20 MWh battery storage.
- An additional 2 MW of both load and generation, and 2 MWh of storage, is made available from 0400hrs on Day + 3.

Figure 2 Example of data feeds

