WIND AND SOLAR ENERGY CONVERSION MODEL GUIDELINES CONSULTATION

SECOND DRAFT REPORT AND DETERMINATION

Published: October 2016

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

NOTICE OF THIRD STAGE CONSULTATION – **AMENDMENTS TO THE WIND ENERGY CONVERSION MODEL (ECM) GUIDELINES AND THE SOLAR ENERGY CONVERSION MODEL (ECM) GUIDELINES**

NATIONAL ELECTRICITY RULES – RULE 8.9

Date of Notice: 14 October 2016

This notice informs Semi-Scheduled Generators and any party having an interest in the Wind and Solar ECM Guidelines (**Consulted Persons**) of the publication of AEMO's second draft report and determination, and commencement of the third stage of consultation on the Wind Energy Conversion Model Guidelines and the Solar Energy Conversion Model Guidelines.

This consultation is being conducted under clause 2.2.7(d) of the National Electricity Rules (**NER**), in accordance with the Rules consultation requirements detailed in rule 8.9 of the NER.

Invitation to make Submissions

AEMO invites written submissions on this Second Draft Report and Determination (Second Draft Report).

Please identify any parts of your submission that you wish to remain confidential, and explain why. AEMO may still publish that information if it does not consider it to be confidential, but will consult with you before doing so.

Consulted Persons should note that material identified as confidential may be given less weight in the decision-making process than material that is published.

Closing Date and Time

Submissions in response to this Notice of Third Stage of Rules Consultation should be sent by email to Op.forecasting@aemo.com.au with **Subject: ECM Consultation** to reach AEMO by 5.00pm (Australian Eastern Standard Time) on 4 November 2016.

All submissions must be forwarded in electronic format (both pdf and Word). Please send any queries about this consultation to the same email address.

Submissions received after the closing date and time will not be valid, and AEMO is not obliged to consider them. Any late submissions should explain the reason for lateness and the detriment to you if AEMO does not consider your submission.

Publication

All submissions will be published on AEMO's website, other than confidential content.

EXECUTIVE SUMMARY

The publication of this Second Draft Report and Determination (Second Draft Report) commences the third stage of the Rules consultation process conducted by AEMO to **consider proposed amendments to the Wind and Solar Energy Conversion Model (ECM) Guidelines** under the National Electricity Rules (NER).

In late 2015, AEMO identified an issue with the accuracy of the Australian Wind Energy Forecasting System (AWEFS) dispatch forecasts in the NEM. This issue had potential to affect NEM Semi-Scheduled Generators at times when output is constrained by a local limit not reflected in the AWEFS forecast. The *Issues Paper* for this consultation proposed a new Supervisory Control and Data Acquisition (SCADA) signal "Local Limit" to address this, along with an optional "Possible Power" SCADA signal, and amendments to the definition of the "Wind Speed" SCADA signal, and other minor amendments.[1] This consultation process is on current issues in the NEM and does not consider WA.

During the course of the consultation, a number of material issues were raised. Due to strong participant feedback in the second stage of consultation on the "Possible Power" SCADA signal, AEMO is conducting, with the agreement of stakeholders, a third stage of consultation.

The material issues addressed in this Second Draft Report and Determination include:

- Minor issues with the SCADA Local Limit definition.
- Concern that the proposed SCADA Extreme Wind Cut-out signal is difficult to implement for some farms, and of limited benefit especially if a SCADA Possible Power signal was available.
- Strong concern about the omission of the SCADA Possible Power signal.

After considering the submissions received, AEMO's response (as further detailed in this paper) is:

- To make minor amendments to the SCADA Local Limit definition.
- To provide additional explanation on the purpose and value of the SCADA Extreme Wind Cut-out signal, to acknowledge it is of limited value to many farms, and to note that AEMO will not pursue its implementation while work on assessing the viability of a SCADA Estimated Power signal is ongoing.
- To propose a minor amendment to the existing definition of SCADA Turbines Available to more correctly handle high-temperature cut-out.
- To note further work following this consultation on a review of the precise definition of the SCADA Turbines Available signal, and associated signals that may be of value in future.
- To propose a definition for an "Estimated Power" SCADA signal that is the wind or solar farm's forecast of its generation at the end of the next dispatch interval, based on technical factors behind the connection point.
- To commence work, concurrent with this consultation, with *Semi-scheduled Generators* on assessing the accuracy of candidate "Estimated Power" signals, and on scoping of implementation pathways.

After completion of this consultation, AEMO will be conducting a detailed AWEFS review across all forecast timeframes . AEMO will engage regularly with stakeholders during this process.

AEMO's second draft determination is the Wind Energy Conversion Model Guidelines and Solar Energy Conversion Model Guidelines in the form published with this Second Draft Report and Determination.

[1] Refer to http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms for the *Issues Paper*.

Contents

1 Stakeholder Consultation Process

AEMO is consulting on **amending and publishing the ECM Guidelines** in accordance with the National Electricity Rules (the Rules) consultation process in rule 8.9.

This Second Draft Report is published in accordance with clause 8.9(g).

There is a link to all submissions received during the second stage of consultation in Appendix B. Issues raised in submissions are summarised in Table 1, and discussed in more detail in Section 4.

The Second Draft of the ECM Guidelines is published on AEMO's website at:

http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms.

Note that there is a glossary of terms used in this Draft Report in Appendix A. Terms in italics are defined in Chapter 10 of the Rules.

2 Background

2.1 National Electricity Rules requirements

The matter under consultation is identified in clause 2.2.7(d) of the Rules. This clause provides:

> "AEMO must develop and publish guidelines in consultation with Semi-Scheduled Generators and such other person that AEMO, acting reasonably, considers appropriate setting out the information to be contained in energy conversion models. Any amendments to the guidelines are also to be made in consultation with Semi-Scheduled Generators and such other person that AEMO, acting reasonably, considers appropriate."

Energy conversion model is defined in Chapter 10 of the Rules as:

> "The model that defines how the intermittent input energy source (such as wind) is converted by the semi-scheduled generating unit into electrical output. That model must contain the information set out in the guidelines published by AEMO in accordance with clause 2.2.7(d)*."*

2.2 Context for this consultation

In late 2015, AEMO identified an issue with the accuracy of the Australian Wind Energy Forecasting System (AWEFS) dispatch forecasts. This issue had the potential to affect NEM *Semi-Scheduled Generators* at times when output is constrained by a local limit currently not reflected in the AWEFS forecast.

During discussions on other matters, AEMO raised this issue with several NEM *Semi-Scheduled Generators* and identified a potential solution, which would require NEM *Semi-Scheduled Generators* to provide a new SCADA signal to AEMO with information that identifies limits to the export of the plant. During these discussions and internal review, further improvements to the dispatch forecast were also proposed. These included investigating the capture of a "Possible Power" SCADA feed provided by *Semi-Scheduled Generators* in real time, and allowing the "Wind Speed" SCADA feed to be an average of several representative wind speeds located across a farm.

AEMO held a Pre-Consultation Forum on 23 February 2016 which was attended by the majority of NEM Semi-Scheduled Generators.

2.3 First stage consultation

AEMO issued a Notice of First Stage Consultation on **18 March 2016**. Refer to http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms for the *Issues Paper*.

AEMO received seven written submissions in the first stage of consultation, from:

- AGL Energy (AGL)
- CWP Renewables – Boco Rock (Boco Rock)
- CWP Renewables – Taralga (Taralga)
- Infigen Energy (Infigen)
- Pacific Hydro
- Musselroe
- Vestas.

AEMO also held a meeting with AGL on **21 June 2016**. Consistent with the National Electricity Rules (NER 8.9(e)), AEMO extended the current consultation timeline by 25 days, to accommodate meetings requested by Consulted Persons between the submissions close date and publication of the Draft Report.

Copies of all written submissions and minutes of the meeting held with AGL have been published on AEMO's website at http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms.

2.4 Second Stage Consultation

On **2 August 2016**, AEMO issued a Notice of Second Stage Consultation along with the Draft Report and Determination and draft ECM Guidelines. This information is also available on AEMO's website at: http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms.

The Draft ECM Guidelines proposed:

- A new SCADA Local Limit signal, with updated definition and implementation in response to the first submission stage .
- Updated definition of the existing SCADA Wind Speed, in response to the first submission stage.
- Addition of a new SCADA signal Extreme-Wind Cut-out, proposed only in the second round.
- The omission of the proposed optional Possible Power signal to allow more comprehensive consultation to occur.
- Adoption of other minor changes proposed in the *Issues Paper*[2].

In the second stage of consultation, AEMO received seven written submissions, from:

- AGL Energy (AGL)
- CWP Renewables (CWPR (Boco Rock)) – this submission was received late.
- Infigen Energy (Infigen)
- Pacific Hydro
- Clean Energy Council (CEC)
- Australian Energy Regulator (AER)
- Musselroe – part of this submission was confidential.

[2] Refer to http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms for the *Issues Paper*.

AEMO held the following meetings with stakeholders:

- Face-to-face meeting with AGL, Pacific Hydro, and Infigen Energy on 8 September 2016 to clarify details in their submission.
- One confidential meeting.
- Face-to-face and teleconference meeting on 26 September 2016, attended by the majority of *Semi-Scheduled Generators*.

Copies of all written submissions (excluding any confidential information) have been published on AEMO's website at: http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms, along with minutes from the two non-confidential meetings.

3 Summary of material issues

The key material issues raised by Consulted Persons in response to the proposed changes to the ECM Guidelines in the Draft Report and Determination are summarised in the following table, covering the second stage of consultation.

Table 1 Summary of material issues raised in the second stage of consultation

NO.	ISSUE	RAISED BY
1.	New ECM Item: Proposed SCADA Local Limit	AGL, Musselroe, Infigen, AER
2.	New ECM Item: Dispatch Forecast With Extreme Wind Speed and Direction Cut-out	Musselroe, Infigen, Pacific Hydro, CWPR (Boco Rock)
3.	Existing ECM Item: Changes to definition of SCADA Wind Speed	Pacific Hydro
4.	New ECM Item: Optional Possible Power SCADA item	AGL, CWPR (Boco Rock), Musselroe, Pacific Hydro, Infigen, CEC
5.	New ECM Item: Maximum Capacity Static Parameter	AGL
6.	New ECM Item: Slope Tracking Direction	AGL
7.	Provision of signals for FCAS	Pacific Hydro, AGL, Infigen, CEC
8.	Transparency and Bidding of Availability	Infigen, AER, Musselroe, AGL

A detailed summary of issues raised by Consulted Persons in submissions to the second stage of consultation, together with AEMO's response, is contained in Appendix B.

4 Discussion of material issues

This section details the material issues AEMO identified following receipt of second stage submissions. It also provides AEMO's assessment of the issues and how AEMO proposes to address them.

4.1 New ECM item: Proposed SCADA Local Limit

4.1.1 Issue summary and submissions

In the *Issues Paper*[3], AEMO proposed to add a new SCADA item, "Local Limit", to the Wind and Solar ECM Guidelines. All new and existing *Semi-Scheduled Generators* will be required to provide this in respect of their *semi-scheduled generating units*.

Infigen Energy's first stage submission requested the exclusion of short-term manual limits that do not reflect availability for the next dispatch interval, and in response AEMO amended the definition of SCADA Local Limit to exclude manually-applied transient limits of less than 5 minutes. **Infigen**'s second stage submission, and clarification by phone, proposed that the definition of the transient limits be widened to 10 minutes from 5 minutes as a safety margin where the manual limit was not removed in time.

The **AER**'s submission to the second stage notes that the **AER** supports the SCADA Local Limit on the basis that it has the potential to improve the accuracy of the dispatch targets issued by AEMO, and considers that it is a technical parameter and should not be used for commercial purposes. The **AER**'s submission notes that utilising price bands in their bid to reflect their commercial availability is the most appropriate means by which a *Semi-Scheduled Generator* communicates their intentions to market.

Musselroe's second stage submission stated that dispatch intervals affected by the SCADA Local Limit should not be used for model tuning. AEMO's response is that AWEFS/ASEFS already does model tuning based on the existing SCADA MW Setpoint signal, thereby excluding from tuning all intervals where the wind/solar farm has some limitation, local or otherwise, and hence the SCADA Local Limit information is not required for correct model tuning.

Musselroe's submission and further discussions raised concern with the definition of the SCADA Local Limit, particularly that "The SCADA Local Limit excludes limits on a transmission network and distribution network, and other limits managed by AEMO through the central dispatch process", because this would mean limits within the connection point that were managed within NEMDE would then need to be specifically excluded from the SCADA Local Limit, which was difficult as the precise coverage of these would need to be determined.

Several first stage submissions noted that handling of distribution network limits, excluded from the SCADA Local Limit definition, was of value. The **AER**'s second stage submission noted agreement with AEMO's statement in the Draft Report and Determination that information on network limits imposed on Semi-Scheduled Generators by Distribution Network Service Providers would be best collected from the Distribution Network Service Providers. **Musselroe**'s second stage submission noted that "the fullness of the local limit information will not be realised if distribution level information is excluded". Further conversation with **Musselroe** identified that there may be transmission limits that are not modelled in NEMDE, which would not be covered by the SCADA Local Limit.

First stage submissions addressed matters of how the SCADA Local Limit signal would be validated. In response, AEMO proposed an updated definition in the Draft Report and Determination. There were no comments on this in the second stage submissions.

Two first stage submissions commented on the bidding of availability and on market transparency. There were further comments on this in the second stage submissions, addressed separately in Section 4.8.

4.1.2 AEMO's assessment

On the transient limits, AEMO's assessment is that the definition will be redefined to "Manually-applied transient limits not intended to affect the end of the next dispatch interval may be excluded from the SCADA Local Limit", to better capture AEMO's purpose, which is to accurately forecast available capacity for the next dispatch interval.

AEMO's assessment in response to the AER's submission that the SCADA Local Limit should be a technical parameter, is to add the word "technical" to the first sentence of the definition, along with rewording for clarity, to make it: "In MW, the SCADA Local Limit for a wind/solar farm is the lower of its *plant availability* and all **technical** limits on the capacity of its connection assets to export energy."

[3] Published for the first round of this consultation on the webpage for this consultation, at http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms.

On the "other limits managed by AEMO through the central dispatch process", AEMO's assessment is that there is no issue with NEMDE managing limits inside the connection point alongside the wind/solar farm adjusting its availability based on its own implementation of these limits. In response, AEMO has added the word "may" to this definition to allow the wind/solar farm to choose the most efficient implementation, noting that any uncertainty should be resolved with AEMO.

Under the *Rules*, the SCADA Local Limit, used to limit the dispatch UIGF, must exclude *transmission* and *distribution network constraints*. The accuracy of dispatch may be improved if all *network constraints* relevant to *Semi-Scheduled Generators* are considered by NEMDE. AEMO notes the support from the AER for the proposed approach of modelling *distribution network constraints* through NEMDE using information from the DNSPs. AEMO acknowledges that currently some *Semi-Scheduled Generators* may have transmission limits that are not fully modelled in NEMDE. AEMO wishes to rectify this situation, and will work with each of the *Semi-Scheduled Generators* to ensure as far as possible that all relevant *network constraints* are adequately managed by NEMDE.

4.1.3 AEMO's conclusion

AEMO concludes that the SCADA Local Limit should be defined as below, as a mandatory provision unless otherwise agreed with AEMO.

Revised definition of SCADA Local Limit – to be provided by all new and existing NEM *Semi-Scheduled Generators* in respect of their *semi-scheduled generating units*

SCADA Local Limit – Mandatory, unless otherwise agreed by AEMO

In MW, the SCADA Local Limit for a wind/solar farm is the lower of its *plant availability* and all technical limits on the capacity of its connection assets to export energy.

When implemented in AWEFS/ASEFS1, the SCADA Local Limit is used to cap the UIGF for the wind/solar farm in the dispatch timeframe.

The SCADA Local Limit excludes limits on a *transmission network* and *distribution network* (to ensure AEMO's compliance with clause 3.7B(c)(6) of the *Rules*), and may exclude other limits managed by AEMO through the central dispatch process.

Limits already communicated in the SCADA Turbines Available signal may be excluded from the SCADA Local Limit.

Manually-applied transient limits not intended to apply at the end of the next dispatch interval may be excluded from the SCADA Local Limit.

The SCADA Local Limit should not exceed the higher of the *nameplate rating* and the Maximum Capacity of the wind/solar farm.

Revised explanatory text

SCADA Local Limit should give regard to:

- Technical limits or outages on connection assets and network connection plant.
- Limits or outages on generating plant (*plant availability*), unless already communicated in the SCADA Turbines Available signal.

SCADA Local Limit should not give regard to:

- Limits on the *transmission network*.
- Limits on the *distribution network*.
- Limits due to the available wind/solar energy.
- Limits due to turbine cut-out from extreme wind speed or direction change.
- The current *dispatch* level during a *semi-dispatch interval*.

- Manually-applied transient limits not intended to apply at the end of the next *dispatch interval*, including manual ramping limits after a semi-dispatch period.
- Limits due to ramp rate limitations as modelled by central dispatch

Further, AEMO concludes that:

- AEMO will investigate implementing additional constraint equations to represent *distribution network constraints* impacting on the dispatch of *Semi-Scheduled Generators*, seeking information from Distribution Network Service Providers.
- AEMO will work with *Semi-Scheduled Generators* to ensure as far as possible that all relevant *transmission* and *distribution network* constraints are managed adequately by AEMO.

4.2 New ECM item: Dispatch Forecast with Extreme Wind Speed and Direction Cut-out

4.2.1 Issue summary and submissions

Musselroe's first stage submission raised that the proposed SCADA Local Limit solution would not address issues with incorrect dispatch during extreme (high) wind speed or extreme wind direction changes. In the Draft Report and Determination, AEMO proposed a new SCADA signal "Turbines Extreme Wind Cut-Out" in response to this submission, and in response to AEMO's experience of sustained high-wind conditions in May and July 2016, which showed situations where AWEFS would have more accurately modelled the impact of extreme wind cut-out in the dispatch timeframe with more information on high-speed cut-out.

Submissions from **Infigen**, **Pacific Hydro**, and **CWPR (Boco Rock)** agreed that the proposed signal solved the specific identified issue of improving the dispatch forecast after the high-wind cut-out had occurred.

Infigen noted that this signal would not inform pre-dispatch forecasting, nor predict the cut-out in dispatch before it occurs, and that more work should be done on these aspects in AWEFS. **Infigen**'s submission also noted that cut-out parameters are provided in power curves.

Submissions from **Musselroe**, **Pacific Hydro** and **CWPR (Boco Rock)** noted that a SCADA Possible Power signal would be more valuable as it could capture all effects that reduce production such as ambient temperature, wind-sector management and wind direction. In their submission and in discussion with AEMO, **Musselroe** expressed concern that a new SCADA Turbines Extreme Wind Cut-Out signal would be the start of a series of additional mandatory SCADA signals covering different factors, where a suitable SCADA Possible Power could cover all.

In their submission, **CWPR (Boco Rock)** noted that it was uncertain on the benefit, as high-wind cut-out is an infrequent issue in its experience, and resources would be better spent on developing a SCADA Possible Power signal, making the high-wind cut-out signal redundant.

Infigen and **CWPR (Boco Rock)**'s submissions agreed that this signal could be implemented, with **CWPR (Boco Rock)** noting it would be less expensive if extreme wind direction was not included. **Pacific Hydro**'s submission indicated that "significant" engineering work would be required. **Pacific Hydro** later clarified by phone that it was not certain of the costs as it had not had time to fully investigate them, but effort would be required as the parameter is not typically available via SCADA.

4.2.2 AEMO's assessment

AEMO appreciates that it is difficult and/or expensive for some wind farms to provide this high-wind cut-out signal. AEMO agrees that it does not address all reasons for reduced production, and it is only of benefit to the dispatch forecast once high-wind cut-out has occurred. Elsewhere in this report, AEMO proposes a definition for an "Estimated Power" signal which would capture all reasons for reduced production. However, AEMO considers that while work on "Estimated Power" is ongoing, and in the case that this work does not progress successfully, that there may be benefit in obtaining information from wind farms to improve the dispatch forecast during high-wind cut-out events.

In this second draft report, the Extreme-Wind Cut-out signal is retained, but AEMO notes that it will not pursue implementation of this by wind farms until further progress is made on the "Estimated Power" signal. Concurrently,

AEMO is proposing a small change to the current definition of the Turbines Available signal to improve the forecasting of high-temperature cut-out events, and has identified potential benefit in a review of the definition of the Turbines Available signal, and of the potential addition of a "Future Turbines Available" or similar signal, for further discussion following this consultation process.

AEMO agrees that the proposed Extreme-Wind Cut-out signal addresses only the specific issue of dispatch accuracy following an event, and intends in the upcoming detailed review of AWEFS to investigate options for improving pre-dispatch forecasting of high-wind cut-out. In response to **Infigen**'s comment that cut-out parameters are already provided in power curves, AEMO agrees. However, high-speed cut-out is a complex process where individual turbines enter a cut-out state and may remain there for some time, minutes or hours after the wind has fallen below the cut-off threshold modelled in the power curve. The state of the turbines – which ones are paused due to high-speed cut-out, and so are unlikely to run in the following dispatch interval – is the key piece of information AWEFS needs from this SCADA signal to improve the dispatch accuracy during semi-dispatch intervals.

The benefit of the Extreme Wind Cut-out signal varies between wind farms. When an AWEFS dispatch forecast during high-speed cut-out is anticipated to negatively affect system security, AEMO may revert the AWEFS forecast to a persistence forecast[4], which can result in less accurate forecasts for some dispatch intervals. Provision of this extra high-speed cut-out information to AWEFS would allow the cost to wind farms of this less accurate dispatch forecast to be reduced. For many wind farms, high-speed cut-out occurs less than 100 hours a year, across up to 20 days. There are a number of wind farms that have a higher incidence of high-speed cut-out and/or which experienced several hours or more where high-speed cut-out coincided with a semi-dispatch cap, which is where the AWEFS forecast accuracy would be improved with more information. AEMO considers that this new SCADA signal may be of value for some wind farms while work on an "Estimated Power" signal is ongoing. The cost to AEMO to implement the use of the Turbines Extreme Wind Cut-out SCADA signal in AWEFS is low.

AEMO again proposes that this will be mandatory for all new and existing generators except by agreement with AEMO, where exception would be made for generators where implementation is impractical or cost is found to outweigh market and system operation benefits. AEMO appreciates that many wind farms will participate in work on an "Estimated Power" signal which would potentially provide improvements to dispatch forecast accuracy during high-speed cut-out, and does not expect to pursue wind farm implementation of the Extreme Wind Cut-out signal while this work is ongoing, except on wind farm request. AEMO will prepare and publish a procedure for the evaluation of the costs and benefits of the Extreme Wind Cut-out signal.

In acknowledgement of **CWPR (Boco Rock)**'s comment on extreme wind-direction cut-out adding extra cost, and noting that for some wind farms this may be a very rare event, the definition includes the potential for extreme wind-direction change cut-out to be excluded by agreement with AEMO.

At the meeting with a majority of *Semi-Scheduled Generators* on 26 September 2016 there was agreement that the Turbines Available signal definition would benefit from review, given the complexity around the conditions that make a turbine genuinely able to run, as opposed to just "available". AEMO also raised the idea of a "Future Turbines Available" or similar signal to indicate which turbines would likely be able to run in the next dispatch interval, or a "Share of farm available" signal. AEMO intends to investigate following this consultation, in discussion with stakeholders and the vendor of AWEFS, the options and implications across all AWEFS forecasting timeframes of such an approach. AEMO considers that this approach may be valuable to wind farms that do not see value in a full "Estimated Power" signal. Such signals could also improve the accuracy of the AWEFS-calculated forecast for all farms, which would improve AEMO's ability to validate an "Estimated Power" signal.

In the interim, to better manage high-temperature cut-out, AEMO proposes (on the advice of the vendor of AWEFS) a small change to the definition of "Turbines Available", to note that turbines paused due to ambient temperature should not be counted as available. AEMO does not anticipate that this would be retro-fitted, but considers it valuable to make this small change for future wind farms if it can be easily implemented.

The box below shows the updated definition. The term "ambient conditions" is changed to "ambient wind conditions", "ambient temperature" removed from the brackets, and "extreme direction change" added to the brackets as this is also an ambient wind condition. Unlike ambient wind conditions, AWEFS currently does not model ambient temperature cut-out in the other forecast horizons, so the other forecast horizons will not be impacted by this change.

[4] As described in Appendix C.3 of AEMO, *Australian Wind Energy Forecasting System (AWEFS)*, May 2016, available at: http://aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/-/media/4B1DC3682FC04A6E9B9D2DCED75CED55.ashx.

SCADA Turbines Available – Provided by Cluster – Wind only

Number of turbines available for generation. This definition is the summation of:

- Turbines operating
- Turbines available to operate, but not operating due to ambient wind conditions (very low / high wind speeds, extreme direction change)
- Turbines available to operate, but paused due to down regulation.

This definition excludes all the following cases:

- Turbines under maintenance or repair
- Turbines with a fault or damage
- Turbines not yet built
- Transmission/distribution network not available

If agreed with AEMO, turbines paused due to ambient temperature may be counted as available in this signal.

4.2.3 AEMO's conclusion

AEMO concludes that there is value in implementing a new SCADA Turbines Extreme Wind Cut-out signal in the Wind ECM Guidelines, as defined below. AEMO will consider exemptions on a case-by-case basis, acknowledging the cost of implementation and limited benefit for some farms, and acknowledging the ongoing work on an "Estimated Power" signal which may reduce the benefit from the Turbines Extreme Wind Cut-out signal.

To be provided by all new and existing Semi-Scheduled Generators in respect of their semi-scheduled generating units – Wind only

SCADA Turbines Extreme Wind Cut-out – Provided by Cluster – Wind only – Mandatory, except by agreement with AEMO

This is the number of turbines counted in the Turbines Available signal that are currently in cut-out mode due to extreme high wind speed or extreme wind direction change.

If agreed with AEMO, this signal may be provided at a farm level. If agreed with AEMO, extreme wind direction change may be excluded.

Further, AEMO proposes a small change to the definition of the SCADA Turbines Available signal to that shown in Section 4.2.2, and to further investigate following this consultation process a potential redefinition of the SCADA Turbines Available signal and/or the addition of a "Future Turbines Available" or other signal to improve the dispatch forecast accuracy of AWEFS.

In addition, AEMO intends to investigate improvements to the forecasting before it occurs of high-wind cut-out for the dispatch and longer forecast timeframes.

4.3 Existing ECM item: Changes to Definition of SCADA Wind Speed

4.3.1 Issue summary and submissions

In the *Issues Paper*, AEMO proposed changes to the definition in the Wind ECM Guidelines of the farm-level SCADA Wind Speed signal, to clarify that:

- Instantaneous measurements are required, with a definition of "instantaneous".
- Wind speed may be an average of several representative locations in the wind farm or cluster.

In response to the first stage submissions, AEMO added “unless otherwise approved by AEMO” to the new definition of “instantaneous” and added a definition of “representative”.

In the second stage of submissions, **Pacific Hydro** commented that instantaneous sampling faster than 4 seconds should be allowed.

4.3.2 AEMO’s assessment

AEMO agrees that sampling faster than 4 seconds is acceptable, but notes that AEMO’s SCADA systems typically sample from the NSP at no faster than 4 seconds, and at 10 seconds for some less-critical SCADA signals. On recent advice from the vendor of AWEFS, the definition is revised to recommend that while 4–10 second instantaneous sampling is acceptable, 4 seconds or faster is preferred.

The first sentence in the Wind Farm SCADA to AEMO has been revised for clarity, with “unless otherwise stated” removed, as there are no longer any SCADA items in the ECM Guidelines that state a different sampling rate.

4.3.3 AEMO’s conclusion

AEMO determines that the Wind Farm SCADA to AEMO and SCADA Wind Speed components of the Wind ECM Guidelines be amended as below.

Revised Implementation of Wind Farm SCADA to AEMO and SCADA Wind Speed

Wind Farm SCADA to AEMO

Instantaneous measurements are required, unless otherwise agreed by AEMO.

Instantaneous means values updated at least every 4–10 seconds, with 4 seconds or faster preferred. If averages only are available, a maximum 15 second update to the average is required.

SCADA Wind Speed – Farm level

Measurements from turbine nacelle anemometers are much preferred over measurements from meteorological mast(s).

SCADA Wind Speed – Farm level is a single wind speed measurement, which must be representative of wind conditions across the site for calculation of dispatch UIGF. For large wind farms, an average of several turbine nacelle wind speed measurements may be used to achieve this. Ideally this average is of all turbine nacelles, or of several geographically-distributed meteorological masts.

The measurement is considered representative if, on the advice of the AWEFS vendor, the wind speed measurement is sufficiently stable and there is adequate correlation between the wind speed measurement and the farm’s active power output when not downregulated.

As noted in the Draft Report and Determination, AEMO will work with all wind farms to assess the quality and representativeness of their SCADA Wind Speed signal, noting that it directly affects the accuracy of each wind farm’s dispatch level during semi-dispatch intervals, and indirectly, outside of semi-dispatch intervals through its impact on the power curve and other model tuning.

4.4 New ECM item: Optional Estimated Power SCADA Signal

4.4.1 Issue summary and submissions

In the *Issues Paper*, AEMO proposed adding to the ECM Guidelines an **optional** SCADA item “Possible Power” that provides an estimate of the active power that each wind farm can deliver to the network, based only on wind conditions

at the site and available wind turbines. AEMO proposed to begin a program to investigate its use in calculating the AWEFS dispatch forecast.

In considering the detailed submissions in the first stage of submissions, AEMO considered that while there was strong support to provide such a signal, the details of the factors this signal should consider, its validation and use were not sufficiently well-defined for it to be added to the ECM Guidelines at the current time. Many farms were not able to meet the existing specification and AEMO did not see the value in defining a signal, even if optional, in the ECM Guidelines that would be revised later to tighten its specification and accuracy requirements once its use was precisely known.

Several submissions (**Infigen, Musselroe, Pacific Hydro, AGL, CEC**, and **CWPR (Boco Rock)**) to the second stage of consultation expressed strong concern at the omission of the optional Possible Power signal from the ECM Guidelines, particularly as they consider a more accurate dispatch forecast crucial for wind farms to participate in FCAS provision. The submissions from the **CEC, Pacific Hydro**, and **AGL** stated that participants have the right to override the AWEFS forecast, and **CWPR (Boco Rock)** and **AGL** stated that a Possible Power signal should be used in preference to the AWEFS UIGF. Several submissions strongly urged the definition be resolved in the current round of consultation, while **Musselroe** urged it be included now as an optional signal for investigation and refinement. The **CEC** submission requested expeditious changes to enable SCADA signals to support FCAS.

The **CEC**'s submission noted that dynamic efficiency under the National Electricity Objective (NEO) is consistent with participants providing more certain data, to allow them to better manage their risk with regards to FCAS causer-pays factors, reduce dispatch error, and assist in optimising market outcomes. **AGL**'s submission noted that Possible Power would materially reduce the risk of misalignment between forecast, dispatch and operating capabilities and responses of the plants. **Pacific Hydro**'s submission noted that it is consistent with the NEO for wind farms to determine the level of cost to incur in implementing a sufficiently accurate signal, and that the motiviation for providing the Possible Power signal is to improve the dispatch outcomes of both the wind farm and the NEM as a whole, and that it has the potential to reduce FCAS costs across the market.

Several submissions commented that it would be better to introduce a single Possible Power signal that captured all effects on generation, not only high-speed cut-out, as the wind farm had more information than AWEFS could, and should, have.

The second stage submissions provided detailed descriptions of potential Possible Power signal(s). These definitions were more complex than those provided in response to the first stage of submissions.

- The first stage submissions described a Possible Power signal calculated from the wind speed at all available turbines passed through a fixed power curve.
- The second stage submissions detailed Possible Power signals able to reflect all effects internal to the wind farm, and in some submissions, an extra signal indicating a dynamic ramp rate and/or an "Achievable Power", to allow full consideration of the plant's capability.

AEMO met with **AGL**, **Infigen** and **Pacific Hydro** for further clarification of the definition and use of these signals. A copy of the minutes of this meeting is available at http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms. **AGL**, **Infigen**, **Pacific Hydro**, and **Musselroe** provided further feedback following this meeting, suggesting a single-signal solution, leading AEMO to call a meeting for all NEM *Semi-Scheduled Generators* as discussed below.

Submissions suggested consultation with industry and OEMs to set a clear definition for the industry to follow, which would allow turbine manufacturers to develop improved forecasting for future and existing wind farms.

AGL and **Pacific Hydro**'s submissions stated that it may not be possible for all plants to provide such a signal, but it should not be precluded from plants which can. **Pacific Hydro**'s submission noted that a forward forecast signal(s) could account for wind speed predictions if the technology was present.

Following this feedback, AEMO held a meeting with the majority of *Semi-Scheduled Generators* on **26 September 2016** to discuss proposing a definition for "Estimated Power" to put into the ECM Guidelines in this consultation, in advance of work to assess the accuracy and potential implementation of this signal. At the meeting there was strong support for a precise simple definition to be made for wind and solar farms and for the consultation to be extended to a third stage of consultation to agree on a definition. Solar farm owners expressed support for a similar signal for solar farms.

At this meeting, AEMO asked stakeholders present to evaluate the benefits of ending the consultation with this report and commencing implementation of the SCADA Local Limit, against the benefits of extending the consultation to agree

on a definition for “Estimated Power”. Everyone at the meeting agreed on extending the consultation or were indifferent between the two options.

4.4.2 AEMO’s assessment

For ease of reading, throughout this section, “wind farm” and “AWEFS” are used, but these comments apply equally to solar farms and ASEFS. The name “Estimated Power” is proposed instead of “Possible Power” to avoid confusion with existing “Possible Power” signals in many wind farm control systems, which may have a different meaning.

AEMO acknowledges the view of several submissions that the SCADA Estimated Power should be defined now, if only as an optional signal, and acknowledges the work done by several participants to attempt to refine the definition of this signal. In the second stage of submissions there was strong support for the wind farm’s forecast to replace the AWEFS dispatch forecast, considered by submissions to be key to participation in FCAS. AEMO agrees that overriding the AWEFS forecast in timeframes other than dispatch is currently possible, but not currently possible in dispatch.

AEMO agrees that the wind farm has better information than AWEFS on complex factors affecting wind farm production. AEMO agrees that better dispatch forecasts should increase dispatch accuracy including the benefits to risk management and market outcomes as noted in the submissions.

AEMO is proposing to define an optional signal “Estimated Power” in the ECM Guidelines, and is holding a third stage of consultation for this purpose. In parallel with this consultation process, and continuing afterwards, AEMO will work with participants on assessing the accuracy of candidate signals, via SCADA or spreadsheet. Should AEMO determine that this signal will be used to determine the dispatch UIGF, ongoing validation and accuracy assessment will be required to ensure the signal meets AEMO’s needs for efficient market and secure power system operation. AEMO would develop these procedures and implementation details in consultation with stakeholders.

The proposed “Estimated Power” signal, defined as the forecast of active power at the end of the next dispatch interval, may incorporate information on the achievable rate of change. AEMO notes that *Semi-Scheduled Generators* currently bid a ramp rate limit which is applied by NEMDE. *Semi-Scheduled Generators* would need to consider any interaction between “Estimated Power” and the ramp rate limit in NEMDE.

In response to the **CEC**’s submission which stated that “Semi-scheduled generators should also be provided with the opportunity to provide a ramp rate along with possible power so that their potential capability can be fully considered in NEMDE and in providing FCAS services.”, AEMO requests confirmation on whether the proposed definition of “Estimated Power” adequately conveys the *Generator*’s potential capability, or if two separate signals are required.

As discussed in Section 4.4.2, AEMO will also, following this consultation process, review the definition of SCADA Turbines Available and investigate related signals that may provide improved AWEFS dispatch forecast accuracy for wind farms that do not intend to provide the optional Estimated Power signal. Such improvements would also improve the ability of AWEFS to validate an Estimated Power signal.

AEMO agrees that it is not AEMO’s place to set an industry standard for implementation. AEMO agrees the signal should be defined in such a way to ensure AEMO can obtain the accuracy needed for efficient market and system operation, while allowing flexibility in implementation and refinement as technology advances, as required for dynamic efficiency consistent with the NEO. Further implementation details such as the timing of the signal may need to be refined as this work progresses.

AEMO proposes the following definition of an optional “Estimated Power” SCADA signal. It includes limits on connection assets, also covered by the “Local Limit” SCADA signal, to allow the “Estimated Power” to best represent an equivalent to the dispatch UIGF.

Optional provision by new and existing Semi-Scheduled Generators in respect of their semi-scheduled generating units – Wind and Solar

SCADA Estimated Power

SCADA Estimated Power is the Generator's forecast in MW of active power at the end of the next dispatch interval, subject only to technical factors affecting operation of its generation and connection assets.

SCADA Estimated Power should be calculated assuming that no distribution or transmission network constraints apply to the next dispatch interval, and may assume that other limits managed by AEMO through the central dispatch process do not apply to the next dispatch interval.

The SCADA Estimated Power should not exceed the higher of the *nameplate rating* and the Maximum Capacity of the wind/solar farm.

Implementation of this parameter is dependent on AEMO being satisfied that its accuracy and implementation concerns are addressed. AEMO will then issue a market notice to this effect and post it on its website.

After implementation, AEMO will retain discretion to reject data that does not pass its initial and ongoing validation and accuracy assessment.

AEMO seeks feedback on the following questions, and any other issues you wish to raise:

1) **Do you agree with the name "Estimated Power"?**
2) **Should limits on connection assets be included or excluded from this definition?**
3) **Is one signal enough? Is there a need for a second signal such as a dynamic rate of change?**
4) **Do you have concerns about interaction between the "Estimated Power" value and the existing bid of ramp rate?**
5) **Do you agree with the level of detail in the definition?**
6) **Any other comments on the definition?**

4.4.3 AEMO's conclusion

AEMO concludes that "SCADA Estimated Power" will be proposed as defined in Section 4.4.2 above.

AEMO will, concurrent to this consultation process, work with wind and solar farms to assess the accuracy of candidate signals. AEMO will also investigate potential implementation pathways for the use of this signal. This parameter will only be implemented, as noted in the definition, if and when AEMO is satisfied that its accuracy and implementation concerns are addressed.

4.5 Maximum Capacity static parameter

4.5.1 Issue summary and submissions

The *Issues Paper* proposed an additional static parameter for Maximum Capacity so AWEFS is able to cap its forecasts (dispatch and otherwise) to Maximum Capacity.

In the first stage of submissions, one comment from **AGL** was received, noting that the AWEFS forecast should be limited only by Maximum Capacity not by *nameplate rating* as it is currently. In the second stage, **AGL** noted agreement with AEMO's conclusion.

4.5.2 AEMO's assessment

The one submission received from **AGL** was in support of this proposal. AEMO agrees that AWEFS should limit the AWEFS forecasts only by Maximum Capacity, not *nameplate rating* as done currently, as this better implements clause 3.7B(c)(1) of the *Rules*.

4.5.3 AEMO's conclusion

The Maximum Capacity static parameter will be added to the ECM Guidelines. AEMO will investigate limiting the AWEFS forecasts only by Maximum Capacity, not by *nameplate rating* as done currently.

4.6 New ECM item: Slope Tracking Direction – Solar ECM

4.6.1 Issue summary and submissions

In the *Issues Paper*, AEMO proposes to add a new item, "Slope Tracking Direction", to the Solar ECM Static Data as a mandatory provision for solar farms using active solar tracking. It is required as the existing Solar ECM Static Data does not capture adequate detail to allow modelling of tracking array equipped solar farms.

AGL's first stage submission commented that their farms do not currently use tracking, and the second commented that details of tracking should be provided if applicable.

4.6.2 AEMO's assessment

Given no submissions against this proposal, AEMO's assessment is to implement it as proposed in the *Issues Paper*. AEMO considers that the Solar ECM Guidelines spreadsheet adequately captures "if applicable" through the "Required" column which states "Required for tracking systems only".

4.6.3 AEMO's conclusion

To add the new item "Slope Tracking Direction" to the Solar ECM Static Data as proposed in the *Issues Paper*.

4.7 Provision of signals for FCAS

4.7.1 Issue summary and submissions

Several submissions in the first stage commented on their interest in providing FCAS in future, and that a more accurate dispatch forecast was a key component. In the second stage, submissions from **Infigen**, **Pacific Hydro**, **AGL**, the **CEC**, and **CWPR (Boco Rock)** supported this view.

4.7.2 AEMO's assessment

AEMO has included this section to correspond to the matching section in the Draft Report and Determination, and has in this document responded to these submissions in the section on Possible/Estimated Power above.

On the topic of the participation of *Semi-Scheduled Generators* in FCAS markets, AEMO provides the following comment:

Review of Causer Pays and Market Ancillary Services Specification

AEMO is constantly reviewing its processes and procedures to ensure they remain current in today's energy landscape.

AEMO will be recommencing a review into the causer pays process in 2016. As part of this review participants will be invited to make submissions on the causer pays process. One or more NER change proposals may also be developed as a consequence of this review.

The Market Ancillary Services Specification (MASS) outlines the technical requirements of participants in the FCAS market. AEMO is assessing whether the current MASS present technical barriers to participation from technologies not typically associated with the delivery of FCAS.

4.7.3 AEMO's conclusion

AEMO refers participants to Section 4.4 on Possible/Estimated Power above, and to the reviews of Causer Pays and the Market Ancillary Services Specification as discussed above.

4.8 Transparency and bidding of availability

4.8.1 Issue summary and submissions

In the first stage of consultation, two submissions noted support for increased transparency of *Semi-Scheduled Generator* operations and for the addition of the ability for *Semi-Scheduled Generators* to bid their availability directly.

In the second stage of submissions, **Infigen**, the **AER**, **Musselroe**, and **AGL** strongly supported investigation into these issues. **Musselroe** stated AEMO should prosecute the availability bidding with haste to give *Semi-Scheduled Generators* a means to limit dispatch in case of forecast error.

At the meeting with *Semi-scheduled Generators* on 26 September 2016, participants commented that being able to bid limits on their availability in Pre-dispatch in a convenient manner would also be beneficial, and would allow better alignment between Dispatch and Pre-dispatch forecasts. Participants can currently advise of such limits for Predispatch, through the Intermittent Generation part of the EMMS Portal, but requested that the useability of this tool, and the ability to automate submissions, be reviewed.

4.8.2 AEMO's sssessment

AEMO notes the support for these investigations.

4.8.3 AEMO's conclusion

While outside the scope of this determination, AEMO intends to investigate measures to increase the transparency of *Semi-Scheduled Generator* operations, specifically the possibility of *Semi-Scheduled Generators* bidding their availability for Dispatch and Predipatch through NEMDE as well as potential improvements to the useability of the EMMS Portal for Intermittent Generation for PASA.

5 Other matters

Appendix A of the *Issues Paper* listed a number of minor changes to the ECM Guidelines. One comment was received on these minor matters in the first stage of consultation. **Musselroe** commented that the units from wind direction had been amended from Decimal Degrees Latitude Longitude to degrees true, which is what their wind farm already provides. No other comments were received.

AEMO will adopt the minor changes as proposed in the *Issues Paper*.

In addition, AEMO will make a non-material change to the definition of "Cluster ID" in the Solar ECM Guidelines, to amend the current Data Type of "Scalar with Valid Range > 1" to "String", as a cluster ID string is expected here. This error was identified in the final review of the ECM spreadsheets.

Appendix A – Glossary

TERM OR ACRONYM	MEANING
AWEFS	Australian Wind Energy Forecasting System
ASEFS1	Australian Solar Energy Forecasting System Phase 1
FCAS	Frequency Control Ancillary Services
OEM	Original Equipment Manufacturer
SDC	Semi-dispatch Cap
SCADA	Supervisory Control and Data Acquisition
UIGF	Unconstrained Intermittent Generation Forecast

In this document, *italicised* phrases refer to defined terms in chapter 10 of the National Electricity Rules. A list of commonly used terms and acronyms from the gas and electricity industry can be found on AEMO's website at http://www.aemo.com.au/About-AEMO/Glossary-of-terms.

Appendix B – Summary of submissions and AEMO responses

NO.	CONSULTED PERSON	ISSUE	AEMO RESPONSE
1.	AER	"We support the work AEMO and market participants have undertaken to identify improvements to the accuracy of Australian Wind Energy Forecasting System (AWEFS) forecasts, outputs of which are used in the calculation to determine dispatch targets. We support the suggested short term measures proposed by AEMO to improve dispatch outcomes, which is also expected to reduce the flow on effects to the calculation of and payments associated with frequency control ancillary services causer pays factors. We encourage continued work on options to further improve forecast accuracy as identified in AEMO's Discussion Paper, and any others which may be identified, following the completion of this round of consultation."	Support and encouragement noted. Future works addressed in S4.8.
2.	AER	"In attempting to address the AWEFS inaccuracies AEMO has proposed the inclusion of a 'SCADA Local Limit' parameter in identifying limits on wind farms achieving the unconstrained intermittent generation forecast (UIGF) produced by AWEFS. We support the inclusion of the SCADA Local Limit parameter on the basis that it has the potential to improve the accuracy of the dispatch targets issued by AEMO."	Noted in S4.1.1
3.	AER	"We consider the 'SCADA Local Limit' parameter to be a technical parameter and, as such, should not be used for commercial purposes."	Addressed in S4.1.2
4.	AER	"We consider that Semi-Scheduled Generators can currently utilise price bands in their bid to reflect their commercial availability and that this is the most appropriate means by which to communicate their intentions to the market."	Addressed in S4.1.2
5.	AER	"We support AEMO's intention, as set out at 4.1.3, to investigate applying the bid Availability for Semi-Scheduled Generators in NEMDE and PASA."	Addressed in S4.8.3.
6.	AER	"We also support the collection of information on the network limits imposed on Semi-Scheduled Generators by Distribution Network Service Providers. This would assist further improvements in the accuracy of the AWEFS forecast to be realised. We consider that Distribution Network Service Providers are best placed to provide this information, such that transparent and accurate information is provided to the market."	Addressed in S4.1.3

7.	AER	"More broadly, we support AEMO's intention to undertake further work to identify ways of increasing market transparency for forecast and actual dispatch targets for Semi-Scheduled Generators, as set out on pp.13, 19, 20 of the Draft Report."	Addressed in S4.8.3
8.	AGL	"AGL appreciates and supports AEMO's effort in improving the forecasting of wind and solar generation which will greatly enhance the participation of intermittent generators in the National Electricity Market (NEM). In particular, the provision of local plant and connection limits, and improved wind speed data that will ensure AWEFS and ASEFS can quantify the most probable plant output at any given time that reflect these site conditions. AGL is pleased that AEMO will explore further other possible improvements identified through this consultation, which AGL fully supports."	AEMO notes support.
9.	AGL	"AGL is concerned that the proposed amendments to the Energy Conversion Model Guidelines (ECM) will not include the provision of SCADA Possible Power. AGL expects that at the very least, the ECM should be amended to provide an option for plant operator to provide this data. AGL considers a Possible Power signal would provide an accurate and timely estimate of the output from the wind farm at the point of connection excluding any limitations of connection asset. It would be the best possible estimates taking into account conditions internal to the wind farm (eg. wind sector management, wind direction, wind speed cut-out etc)."	Addressed in S4.4.2
10.	AGL	"AGL considers that the scope of the Possible Power can be reasonably defined to ensure that it is a robust estimate of the most probable plant output for any given timeframe."	Addressed in S4.4.2
11.	AGL	"AGL acknowledges that it may not be possible for all plants to provide such a value, but it should not be precluded from plants which has such a capability."	Addressed in S4.4.2
12.	AGL	Proposed SCADA Local Limit "AGL has no issues with the proposed changes and implementation and agrees with AEMO's conclusions. AGL supports AEMO's recommendations to investigate the use of constraint equation for network constraints, bid Availability in NEMDE and PASA and improvement in the transparency of operation."	Support noted Bid availability and transparency addressed in S4.8.3
13.	AGL	Change of Definition of SCADA Wind Speed "AGL has no issues with the proposed changes and agrees with AEMO's conclusions."	Support noted
14.	AGL	"AGL disagrees with AEMO that SCADA Possible Power could not be included in the amendments of the ECM Guidelines."	Addressed in S4.4.2

15.	AGL	"AGL considers that at the very least, the operator should be given the option of providing the Possible Power signal to provide the best possible estimate of the forecast output for a given plant and operating condition. The plant operator has a deep understanding, knowledge and the control set up of the plant operation and environmental conditions, which could vary from plant to plant, and subject to complex changes."	Addressed in S4.4.2
16.	AGL	"AGL notes the option to provide an alternative forecast by the operator was foreshadowed in AEMO's guidelines which was intended for participants to override the AWEFS forecast. AGL considers that the provision of optional Possible Power is consistent with objectives of the guidelines."	Noted in S4.4.1
17.	AGL	"AGL agrees with AEMO that it is important to have an acceptable definition and identify the appropriate way to incorporate the use of Possible Power in AEMO's forecast. AGL and other participants have provided their initial views on the definition and application of Possible Power in previous submissions, and will outline them further in the current submission. AGL strongly supports a follow up technical session with the participants working with AEMO in finalising these details. In AGL's view, there is strong commitment from the industry including AGL, other participants and OEMs to work with AEMO to achieve an acceptable outcome."	Addressed in S4.4.2 AEMO met with AGL, Infigen and Pacific Hydro for follow-up technical session.
18.	AGL	"As suggested in AGL's previous submission, the Possible Power would need to recognise it is firstly influenced by wind resource and the state of the turbines, and secondly the rate at which different plants can deliver the estimated outputs. Following discussions with other participants, AGL agrees that the optional Possible Power SCADA data may be best provided by the participants through two separate signals to AEMO."	Noted in S4.4.1 and addressed in S4.4.2
19.	AGL	"The two SCADA Possible Power signals would include the UIFG value and the achievable power that reflects the rate at which the possible power can be delivered from the plant for each five minute interval. This will ensure that the forward 5 minute interval forecast can adequately take into account availability of turbines to generate, any complex changes of wind conditions and varying control capability of the turbine at any given time. AGL considers that this approach will materially reduce the risk of any misalignment between the AEMO's forecast, dispatch and operating capabilities and responses of the plants."	Noted in S4.4.1 and addressed in S4.4.2
20.	AGL	"Hence, for those plants that provide the optional Possible Power signals, AGL proposes that the values are accepted as the forecast value unless there is a well-defined criteria for AEMO to override the operator's Possible Power values."	Addressed in S4.4.2
21.	AGL	Maximum Capacity Static Parameter. "AGL agrees with AEMO's conclusion."	Addressed in S4.5.2
22.	AGL	Slope Tracking Direction. "AGL considers that the details of tracking should be provided to AEMO if applicable."	Addressed in S4.6.2

23.	AGL	Provision of Signals for FCAS. "AGL agrees with AEMO's view that wind farms can be providers of FCAS in the NEM. This is important as wind farms are escalating its share of generation portfolio in the NEM at a time when there are increasing concern on their impact on power system security and frequency control incidents."	Addressed in S4.7.2
24.	AGL	"This further reinforces the need for AEMO to allow for wind farms to provide an optional Possible Power as a key enabler for the market system to develop FCAS capability. AGL considers this an important step in ensuring that the NEM does not discriminate wind farms from participating in the FCAS market."`	Addressed in S4.4.2
25.	CEC	"The CEC's members have raised significant concerns about the draft decision not to proceed with incorporating the "Possible Power" setting as originally proposed."	Addressed in S4.4.2
26.	CEC	"They also see the need to expeditiously make changes to permit the use of local SCADA signals for semi-scheduled generation to support Frequency Control Ancillary Services (FCAS)."	Addressed in S4.7.2
27.	CEC	"There appears to be inconsistencies exist between the draft decision in Possible Power and AEMO's clear expectation[1] that semi-scheduled generators should participate in FCAS in the near future. There are two major issues of concern." "[1] As made evident through discussions with AEMO and the creation of a scarce market for regulation FCAS in South Australia when Heywood is operating on a single contingency basis."	Addressed in S4.7.2 and S4.4.2
28.	CEC	"Firstly, the AWEFS 'measure-model' system is currently the only mechanism through which semi-scheduled generators appear in the NEM dispatch engine (NEMDE). The proposed avoidance of 'possible power' data removes the ability for semi-scheduled generators to provide more certain data to the market based on dynamic plant operation and on-site information. Including this information would enable these market participants to better manage their risk with regards to FCAS causer-pays factors, reduce dispatch error and assist in optimising market outcomes, consistently with the dynamic efficiency principles of the National Electricity Objective (NEO)."	Addressed in S4.4.2
29.	CEC	"Semi-scheduled generators should also be provided with the opportunity to provide a ramp rate along with possible power so that their potential capability can be fully considered in NEMDE and in providing FCAS services."	Addressed in S4.4.2
30.	CEC	"In addition, AEMO should be aware that the right for participants to override modelled generation was built into the design of AWEFS from the initial stages of its implementation[2]. CEC members assume this was created because generator operators can prepare more accurate dynamic information about their plant than AWEFS can produce." "[2] AEMO, Wind Forecast Override Participant Guide, 2009, Version 1.0"	Addressed in S4.4.2

31.	CEC	"Secondly, for some time AEMO has undertaken a practice of managing dispatch of semi- scheduled generators through the Market Management Systems (MMS), rather than the SCADA system. The MMS system interfaces with operator control centres via public telecommunications infrastructure. This system was not designed for the real time operation, or even operate with confidence in the five minute dispatch timeframe (a likely reason for overrides being limited to 30 minute periods), which is expected for participation in the FCAS market. Allowing semi-scheduled generators to access the SCADA system for dispatch would again allow these participants to participate in the ancillary services market, manage their risk and assist in optimising dispatch as expected by the NEO."	The override functionality in the EMMS portal only applies to pre-dispatch, STPASA and MTPASA. Addressed in S4.4.2
32.	CEC	"The CEC reiterates our concern on omitting Possible Power as this is likely to lead to sub- optimal market design in the near and long term. In addition, the deferred consideration of SCADA for dispatch will delay the potential participation of semi-scheduled generation in FCAS. These measures appear to be counterproductive to the NEO."	Addressed in S4.4.2
33.	CWPR Boco Rock	1. Do you agree with the definition and proposed use of this signal? "CWPR agrees with the definition, however CWPR is uncertain as to the overall benefit of this signal. Although this signal would likely resolve the issue stated by AEMO in the ECM stage 2 consultation, it's a targeted/specific signal which, from CWPR's experience in NSW, would come into practice for less than 3% of the time in any given year (CWPR understands extreme wind speed cut out is location dependent and other farms are subject to varying degrees of extreme wind speed events, however it is still believed extreme wind cut out is seldom)."	Addressed in S4.2.2
34.	CWPR Boco Rock	"Regardless, CWPR believe the possible power signal would be more beneficial in addressing both this issue and the accuracy of UIGFs on a day to day basis, thus making the 'extreme wind speed cut out' signal redundant."	Addressed in S4.2.2
35.	CWPR Boco Rock	2. Is your wind farm able to provide this signal? "BRWF (Boco Rock Wind Farm) is currently able to provide WTG's cut out due to excessive winds, however further work and investigation would be required for extreme wind direction shifts."	Addressed in S4.2.2
36.	CWPR Boco Rock	3. What upfront and ongoing costs do you estimate your farm(s) will face to provide this signal? "CWPR does not believe this signal would be significantly expensive for BRWF, however CWPR does recognise other wind farms may be unable to provide this signal without considerable costs and upgrades. CWPR believes the cost of implementation of this signal for other wind farms would be better utilised for establishing a possible power signal instead. Once established the ongoing costs are likely to be negligible for both the extreme wind cut out and possible power."	Addressed in S4.2.2

37.	CWPR Boco Rock	4. Do you consider other options more suitable for managing extreme wind cut-out? "CWPR is of the opinion that the possible power signal discussed in the initial consultation paper would be adequate in managing the issue of extreme wind speed cut-out. The cost of implementing the possible power signal, to BRWF alone, would be less in contrast to the proposed extreme wind speed signal, as the signal is currently available within the BRWF SCADA system, with little modifications required (the extreme wind speed signal does require further investigation with respect to the wind direction cut out). "	Acknowledged in S4.2.2.
38.	CWPR Boco Rock	"Furthermore, the possible power signal has the added benefit of increasing the accuracy/reliability of virtually all UIGFs on a daily basis, as opposed to a targeted signal for extreme wind speed cut out events only."	Addressed in S4.2.2
39.	CWPR Boco Rock	CWPR provided example of high wind speed cut-out event that occurred during May 2006. "CWPR have provided a snap shot in Appendix A of a high wind speed event which occurred during May 2016. Unfortunately, current circumstances have not allowed a data resolution beyond 10 minute intervals for possible power, nevertheless the tabulated data demonstrates a strong correlation between the actual output of the wind farm with the possible power, which is greater than that of the UIGF issued by NEMDE. This is considered a more accurate representation of the wind farms target and CWPR believe it should be utilised for determining an intermittent generators UIGF."	Comment on utilisation of possible power addressed in S4.4.2
40.	CWPR Boco Rock	"It is CWPR's understanding AEMO receives a snap shot of the wind farm, for the purposes of the UIGF, 3 minutes into a 5 minute dispatch interval. CWPR believe that a higher resolution of the possible power signal (1 minute intervals), would further demonstrate the accuracy and reliability of the possible power signal during both extreme wind events and UIGFs for all dispatch intervals when compared to current NEMDE issued UIGFs."	AWEFS currently samples 1 minute averages for every minute, with the 3rd minute most heavily weighted in the UIGF calculation.
41.	CWPR Boco Rock	4.4– Optional Possible Power SCADA Signal. "CWPR maintains its support for the inclusion of the possible power signal and, although there are concerns surrounding the definitions for the possible power signal, CWPR does not believe it should be excluded from this ECM consultation."	Addressed in S4.4.2
42.	CWPR Boco Rock	"CWPR believes the best opportunity to achieve mutual agreement of the defining parameters for possible power is via the current ECM consultation. With a clear definition of the possible power signal, manufacturers will be able to account for the signal in future projects, and current wind farms will be able to determine the viability of upgrading systems to accommodate such a signal."	Addressed in S4.4.2
43.	CWPR Boco Rock	"As previously stated, CWPR believes the inclusion of the possible power signal will increase accuracy of UIGFs in addition to resolving large discrepancies during periods of extreme wind speed cut out. The inclusion of the possible power signal for this ECM consultation would eliminate the need to introduce other signals, such as the extreme wind speed cut out, which would be addressed via the possible power signal therefore reducing implementation costs to existing wind farms."	Addressed in S4.2.2

44.	CWPR Boco Rock	4.7– Provision of Signals for FCAS. "AEMO's consideration and investigation of wind farm generators ability to participate within the FCAS market is welcomed by CWPR. CWPR also look forward to working with AEMO and other participants in the development of this objective."	Addressed in S4.7.2
45.	Musselroe	"The fullness of the local limit information will not be realised if distribution level information is excluded."	Addressed in S4.1.2
46.	Musselroe	"The AWEFS tuning process must include due consideration of the local limit to avoid tuning processes at times when local limits are binding."	Addressed in S4.1.1
47.	Musselroe	"As part of this current ECM consultation, it is our strong desire for AEMO to further explore the use of possible power in future AWEFS processes."	Addressed in S4.4.2
48.	Musselroe	"The intended developments AEMO has taken on board around bidding maximum availability are welcome, although we urge you to prosecute these issues with haste."	
49.	Musselroe	"Unlike scheduled generators at present, if dispatch anomalies are occurring, semi-scheduled generators have no way to limit the dispatch inaccuracy, leading to increased FCAS regulation requirements across the region – in a small and sometime disconnected system such as Tasmania this can be problematic."	Noted in S4.8.1 Addressed in S4.8.3
50.	Musselroe	"MRWF is not convinced the 'High speed wind cut-out' SCADA value, as proposed by AEMO, will sufficiently improve the forecast accuracy of AWEFS. Whilst appreciating AEMO's acknowledgment of the issue, this type of limitation is one of a number of environmental factors (some of which occur more often) that can limit actual wind turbine performance at any particular time."	Addressed in S4.2.2
51.	Musselroe	"For instance; • Many wind farms operate under wind sector management (WSM) profiles to manage wake effects that are currently not taken into consideration in AWEFS (despite wind direction being sent from some wind farms); • Rapid wind-direction change factors experienced at individual wind turbines; • Maximum turbine operating temperatures exist for all wind turbine types, yet these de-rates are not considered."	Addressed in S4.2.2
52.	Musselroe	"A far better use of any data, in the dispatch timeframe, would be to include the Possible Power value which will take into consideration ALL of the above mentioned points as well as the impacts of high-speed wind cut-out and rate of change."	Addressed in S4.2.2
53.	Musselroe	"MRWF could envisage a situation where WSM alarms, high-speed direction change or cut-out alarms are all being requested by AEMO in the future, when the Possible Power would have been sufficient. Whether a single turbine is out of service for high speed wind, extreme change of direction or high operating temperature, will be of little significance to the AEMO control room."	Noted in S4.2.1

54.	Musselroe	"Therefore, AEMO should as a minimum, request provisions for possible power to be sent and logged as a recommended signal (unless the vendor control system does not have it), to assist refining this for future use (as suggested by AEMO in the Issues Paper and Determination)."	Addressed in S4.4.2
55.	Musselroe	"We would recommend AEMO rely on the industry, in consultation with OEM's to assess any inconsistencies with the aim of determining a common definition."	
56.	Musselroe	"We note that the AWEFS daily tuning process should NOT include intervals when the local limits are active, as it will unnecessarily create reduced power duration curves for given wind conditions based on local limits that may subsequently be applied in dispatch once the local limits are removed. In the event that a sustained period of local limit operation is occurring, AWEFS should be using the default power curves as supplied in the ECM."	Addressed in S4.1.1
57.	Pac Hydro	"Pacific Hydro wishes to draw AEMO's attention to the right a market participant has always had to overwrite the AWEFS forecast. This was negotiated as part of the development package for the AWEFS system. The method for doing this is documented in AEMO's "Wind Forecast Override Participant Guide"[1]. At the time that this was developed the right was enabled for all timeframes except for the 5 minute dispatch. This is most likely because MMS management did not see a way to get the data into the system within the dispatch time boundaries, due to the file transferral systems being the primary method for data transfer."	Noted in S4.4.1
58.	Pac Hydro	"As wind farms currently send data via SCADA to AWEFS, we see no reason why it should not be possible to incorporate forward 5 minute forecast data from the wind farms. We think this is critical to improving the accuracy of the dispatch."	Addressed in S4.4.2
59.	Pac Hydro	"It is not within AWEFS' capability to take into account the more complex control systems that are used within a wind farm for sector management of noise or turbulence. Nor is it AWEFS role to work out whether a wind turbine is returning from a full or partial shutdown, as turbines utilise different brake programs. Under certain circumstances each brake program may have a different period of time in which the turbine will be able to recover its power output. For all of these reasons we believe that the wind farm is in the best possible position to predict the forward five minute forecast."	Addressed in S4.4.2
60.	Pac Hydro	"Without a real time five minute forward forecast taking into account the internal control system, the likelihood of errors remaining within the dispatch is high. These errors adversely contribute to the wind farm's causer pays factor and dispatch inaccuracies. Furthermore, the ability of wind farms to participate more fully in the market will be delayed if forward forecast figures remain inaccurate."	Addressed in S4.4.2
61.	Pac Hydro	"Lastly, having participants provide the forward forecast data is in line with providing the pathway for the cost efficient outcomes expected under the NEO."	Addressed in S4.4.2
62.	Pac Hydro	"For this purpose Pacific Hydro recommends that AEMO adopt an option for wind farms to participate in providing the SCADA data signals associated with the forward forecast. That way those farms wishing to implement systems and software to provide it will do so at their own cost, and it would be part of their individual program to achieve better forecast outcomes for the reasons outlined above."	Addressed in S4.4.2

63.	Pac Hydro	"We cover our recommendations in Section 4.4 regarding the discussion on possible power and suggest that two signals are required in order to fully realise the potential benefits."	Later 1-signal definition noted in S4.4.1 and addressed in S4.4.2
64.	Pac Hydro	4.2 - Dispatch Forecast with Extreme Wind Speed and Direction Cut-out. 1. Do you agree with the definition and proposed use of this signal? "Pacific Hydro believes that the proposed signal solves the issues that have been identified."	Addressed in S4.2.2
65.	Pac Hydro	2. Is your wind farm able to provide this signal? "For the majority of Pacific Hydro's wind farms it would require significant engineering effort to produce the required SCADA values."	Addressed in S4.2.2
66.	Pac Hydro	3. What upfront and ongoing costs do you estimate your farm(s) will face to provide this signal? "The largest cost would be capital expenditure to deliver the required value. In some cases it is possible to retrieve on a turbine basis whether wind speed cut-out has occurred, and other cases require a software upgrade to achieve AEMO's desired outcomes.	Addressed in S4.2.2
67.	Pac Hydro	4. Do you consider other options more suitable for managing extreme wind cut-out? "Pacific Hydro believes that the proposed possible power signal and forward forecast signals is a more suitable method to capture the impacts of extreme wind affecting the semi-scheduled generating system. The proposed solution appears complex and relies on AEMO predicting the internal controls of the farm; we reiterate that the wind farm control system is best suited to calculate the forward power taking into account the wind speed. AEMO's focus should be lifted to the output of a wind farm; that is what it is expected to export to the grid in the next 5 minutes. Whilst a specific signal to directly address a single factor affecting wind farm generation may be useful, it is proposed that possible power would provide a better outcome in dispatch."	Addressed in S4.2.2 and S4.4.2
68.	Pac Hydro	4.3 – Wind Farm Wind Speed Definition "Pacific Hydro notes that the definition of wind speed has changed from Stage 1 to Stage 2 of the consultation. It is believed that the provision of data at a rate higher than 4 seconds provides the best compromise of largest flexibility and insight for AEMO."	Addressed in S4.3.2
69.	Pac Hydro	4.4 – Possible Power SCADA Signal "Pacific Hydro strongly reiterates its support for an optional possible power signal. Whilst it is acknowledged that manufacturer implementations vary, it is for this reason that AEMO should consider allowing participants the option to provide possible power forecast data suitable for the five minute forward market."	Addressed in S4.4.2

70.	Pac Hydro	"Pacific Hydro proposes the use of two signals to implement possible power. The first signal, a "possible power" signal would identify what the wind farm is capable of due to wind resource and available turbines, and the second signal would identify what it is capable of achieving in a dispatch interval."	Later 1-signal definition noted in S4.4.1 and addressed in S4.4.2
71.	Pac Hydro	Pacific Hydro provided a chart in their submission as an example.	Noted as example of 2 signal approach to possible power.
72.	Pac Hydro	"Pacific Hydro discussed in its first stage ECM submission the benefit of using a possible power calculation supplemented by a forward forecast of generation capability. A possible power signal would identify the possible unconstrained output of the wind farm at the point of connection excluding connection asset and DNSP/AEMO constraints, suitable for use within a UIGF context. All effects internal to the wind farm (wind sector management, wind direction, wind speed cut-out etc) would be included in the definition; properly defining the scope of a possible power value should alleviate AEMO's concerns."	Addressed in S4.4.2
73.	Pac Hydro	"A forward forecast signal(s) would include the possible power figure AND the time dependencies such as ramp rate limitations, allowing for a true estimate of the achievable power within a dispatch interval. Such a signal could also account for wind speed predictions if the technology was present." Refers to chart provided as example.	Addressed in S4.4.2
74.	Pac Hydro	"Whilst Pacific Hydro acknowledges that such a signal may not be implemented or difficult to achieve on older wind farms, providing the option with broad definitions for turbine manufacturers and wind farm owners enables local controls to be taken into account. This means it could be developed with shorter lead times and less cost."	Addressed in S4.4.2
75.	Pac Hydro	"Defining the signal as optional allows wind farms with complicated terrain, wind sector management, and other miscellaneous factors the flexibility to implement an appropriate calculation suitable to their farm control arrangements; they can assess whether it is technically and commercially viable"	Addressed in S4.4.2
76.	Pac Hydro	"The definition that should be adopted would be high level allowing the participant to work with their turbine manufacturer to develop an appropriate set of algorithms to generate the figure for that wind farm. As all farms differ with respect to internal management, such as noise sector or turbulence, the algorithm would be bespoke to the wind farm."	Addressed in S4.4.2
77.	Pac Hydro	"The wind farm is in the best possible position to provide a possible power signal, as it has the most detailed information to provide an accurate estimate."	Addressed in S4.4.2
78.	Pac Hydro	"A "dynamically tuned" power curve has been shown to have many limitations and factors that affect the accuracy of its forecast. This has been demonstrated within the ECM process as identified in Section 4.2 "Dispatch Forecast with Extreme Wind Speed and Direction Cut-out"[2]." [2] Wind and Solar Energy Conversion Model Guidelines Consultation Draft Report and Determination, AEMO, August 2016	AEMO agrees that a dynamically tuned power curve does not capture factors such as high-wind cut-out.

79.	Pac Hydro	"Ultimately, the motivation behind providing a possible power signal is to improve the dispatch outcomes of both the wind farm and the NEM as a whole."	Addressed in S4.4.2
80.	Pac Hydro	"This has the potential to reduce the dispatch error and the magnitude and cost of frequency control ancillary services within the market. Without a possible power signal the errors introduced to the dispatch engine remain high, causing increased costs across the market."	Addressed in S4.4.2
81.	Pac Hydro	"Pacific Hydro would propose that a correctly implemented possible power signal would allow AEMO to remove the use of a "hysteresis limit" that incorporates both dispatch and predispatch values. It is noted that many limitations are shown to exist for pre-dispatch values, and that this has both a negative impact to the wind farm and NEM dispatch outcomes[3]." [3] Factors Contributing to Differences Between Dispatch and Pre-Dispatch Outcomes, AEMO, February 2012	AEMO will investigate the blending in AWEFS of the dispatch and pre-dispatch forecasts in the upcoming detailed review of the system.
82.	Pac Hydro	"By setting a standard in the ECM on possible power requirements for the industry to follow, it would allow turbine manufacturers to develop improved forecasting for both future and existing wind farms in line with proposed standards."	Addressed in S4.4.2
83.	Pac Hydro	4.7 – Provision of Signals for FCAS "Pacific Hydro welcomes AEMO's acceptance of wind farms as a future provider of ancillary services in the NEM."	Addressed in S4.7.2
84.	Pac Hydro	"In order to provide an accurate estimate of the amount of FCAS available for dispatch, it is necessary to have a representative prediction of active power achievable throughout the dispatch interval. This is even more important if an "FCAS trapezium" is to be used."	Addressed in S4.4.2
85.	Pac Hydro	"It should be recognised that a generator must provide the FCAS services if they are enabled, and as such all endeavours should be made to ensure that the wind farm is not dispatched outside of its plant capabilities. As a generator with an intermittent fuel source, it is envisaged that a more accurate representation of possible power as discussed above is an important mechanism to provide more accurate dispatch targets and ensure the future provision of FCAS in the NEM."	Addressed in S4.4.2
86.	Infigen	"As stated within the first round of consultations, Infigen Energy supports the proposed ECM changes as they identify areas of improvement of the forecasting and dispatch of intermittent generation in the NEM. AEMO have identified several areas for further investigation and Infigen Energy are eager to be involved in this process going forward. "	Support noted.
87.	Infigen	"The SCADA Local Limit is a setpoint that would help address the correct determination of the wind farm's capacity in certain circumnstances and improve the forward 5 minute dispatch instruction."	Support noted.

88.	Infigen	“Infigen Energy agrees with the definition of the SCADA Local Limit in large part but would request the definition be updated to “Transient limits of less than 10-minute duration” rather than 5-minute as this would more accurately exclude transient limits potentially applied on the park.”	Addressed in S4.1.2
89.	Infigen	“Infigen Energy strongly agrees further investigation is needed of semi-scheduled generators availability bidding and PASA be included into NEMDE as well as increasing transparency of semi-scheduled generation operation going forward.”	Addressed in S4.8.3
90.	Infigen	“Infigen Energy supports that SCADA Possible Power should be included in the ECM guidelines and believes it would be the most accurate source of possible power that would improve overall system forecasting.”	Addressed in S4.4.2
91.	Infigen	“There should be no obstacle in incorporating the SCADA’s Possible Power setpoint to AWEFS in the same way all other data points are being sent and used.”	Addressed in S4.4.2
92.	Infigen	“The data would be the closest to the true reflection of the wind farms capability in real time taking into accounts individual turbines operational status and ambient conditions, something which AWEFS is not capable of doing nor should it be.”	Addressed in S4.4.2
93.	Infigen	“If wind farms wish to improve performance and progress in the space of providing frequency control ancillary services to the market it is crucial that forward 5 minute forecasting is as accurate as possible.”	Addressed in S4.4.2
94.	Infigen	“If this information comes from SCADA then many of these issues can be resolved.”	Addressed in S4.4.2
95.	Infigen	“Infigen agrees that there is a need to improve how high wind speed and extreme wind direction change cut outs are incorporated into the dispatch timeframe. These stops are part of the normal operation limitations of the wind farm and are able to significantly reduce the output of the wind farm in a short time for an unspecified period of time.”	Addressed in S4.2.2
96.	Infigen	“High wind speed cut out parameters are already provided to AEMO and AWEFS through the turbine power curves.”	Addressed in S4.2.2
97.	Infigen	“The proposed signal would retrospectively provide information regarding which turbines were offline due to high wind speed cut outs. By the time that the signal has gone through, the turbines are already offline and the wind farms generation levels will have already dropped off.”	Addressed in S4.2.2
98.	Infigen	“For the next dispatch interval, this information will be able to inform a more accurate UIGF determination however this will not help with visibility and predispatch forecasting of the wind farms resource.”	Addressed in S4.2.2
99.	Infigen	“Infigen believes that the additional information provided in this signal should also be used by the AWEFS vendor to further tune the wind farms power curves through these high wind periods.”	AEMO notes this suggestion.
100.	Infigen	“This benefit to visibility and generation forecasting is something that should be further investigated.”	Addressed in S4.2.2

101.	Infigen	"Further Infigen Energy would request clarification on how this signal would be incorporated into the UIGF calculation process."	AEMO provided explanation directly to Infigen.
102.	Infigen	"Infigen agrees that the SCADA Turbines Extreme Wind Cut-out signal could improve the dispatch of semi-scheduled wind farms but does not believe that this would fully address the issue associated with ambient condition stops, in particular visibility in the predispatch time frame. Infigen believes that further investigation and research should be done to address this issue."	Addressed in S4.2.2
103.	Infigen	"Yes Infigen's wind farms would be able to provide this signal [extreme wind cut-out] with some additional engineering work."	Noted in S4.2.1
104.	Infigen	"The upfront cost of implementing the SCADA Turbine Extreme Wind Cut-out will vary across Infigen's wind farms however the ongoing costs are not expected to be high."	Noted in S4.2.1
105.	Infigen	"The proposed SCADA Turbine Extreme Wind Cut-out signal would help improve the dispatch outcomes once the turbines have stopped due to high winds or extreme direction changes, however the current proposal does not help improve the overall forecasting and predispatch of these extreme wind scenarios."	Addressed in S4.2.2
106.	Infigen	"Infigen Energy think further investigation should be done to further advance the predispatch forecasting of these events, rather than incorporating this information once turbines have cut out. This would enhance both the dispatch of semi-scheduled wind farms and overall power system security."	Addressed in S4.2.2
107.	Infigen	"Infigen Energy believes that while the Local Limit and Extreme Wind Change Cut-out signals will help improve dispatch outcomes for semi-scheduled wind farms there is still a requirement for further investigation into the forecasting of wind farms in the NEM and the overall transparency and visibility of the operation of semi-scheduled wind farms. Infigen Energy hopes there will be further discussion of the new amendments and further opportunity for collaboration on the points flagged by AEMO for further investigation."	Addressed in S4.8.3 Addressed in S4.4.2

Attachment 1 – Wind Energy Conversion Model Guidelines and Solar Energy Conversion Model Guidelines

See spreadsheets:

Energy_Conversion_Model_Guidelines_Wind_20161014.xlsx and
Energy_Conversion_Model_Guidelines_Solar_20161014.xlsx

as published on the consultation website at http://www.aemo.com.au/Stakeholder-Consultation/Consultations/Energy-Conversion-Model-Guidelines-Consultation---Wind-and-Solar-Farms.