SCHEDULING ERROR REPORT

INCORRECT UNCONSTRAINED INTERMITTENT GENERATION FORECASTS FOR SEMI-SCHEDULED GENERATORS

PREPARED BY: Electricity Market Performance

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FINAL

Disclaimer

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Abbreviations and Symbols

ABBREVIATION	TERM
AWEFS	Australian Wind Energy Forecasting System
DI	Dispatch Interval
NER	National Electricity Rules
SCADA	Supervisory Control and Data Acquisition
TNSP	Transmission Network Service Provider
UIGF	Unconstrained intermittent generation forecast

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1 Summary

In some circumstances, the Australian Wind Energy Forecasting System (AWEFS) has produced unconstrained intermittent generation forecasts (UIGFs) that are significantly less than that suggested by prevailing wind conditions[1] for some wind farms in some circumstances. This issue has resulted in the overly restrictive capping of the output from these semi-scheduled generating units by the central dispatch process, typically during periods of network congestion.

In December 2011, a participant approached AEMO in relation to this issue and the dispatch of its wind farm in Victoria. Following investigations, the issue was traced to the absence of certain real-time SCADA[2] information required by AWEFS to produce the correct UIGF[3].

AEMO has consequently determined that under these circumstances it has failed to follow the central dispatch process set out in rule 3.8 of the National Electricity Rules (NER) and declares that a scheduling error has occurred. Specifically, the scheduling error occurred for a wind farm during semi-dispatch intervals where:

- the wind farm's dispatch level was capped by its UIGF and was less than its available capacity, and
- the interval followed a semi-dispatch interval where the wind farm was involved in a binding or violated network constraint.

The affected period for each wind farm is from its classification as a semi-scheduled generating unit until the necessary real-time information was provided and used by AWEFS to produce the correct UIGF.

Under NER clause 3.16.2 (a), Market Participants affected by a scheduling error may apply to the dispute resolution panel established under NER clause 8.2.6A for a determination as to compensation.

2 Purpose of the UIGF

As part of the semi-dispatch arrangements introduced on 31 March 2009, AEMO must prepare and make available at all times a UIGF for each semi-scheduled generating unit [4] that takes into account, among other things, the real-time information provided to AEMO in accordance with its energy conversion model and the assumption that there are no network constraints otherwise affecting its generation.

These forecasts are then applied in the central dispatch process as an upper limit on the unit's calculated dispatch level, as required by NER clause 3.8.1 (b)(2)(ii). Under NER clause 3.8.23 (b), the relevant generator must cap its output at or below this level by the end of the relevant dispatch interval if its semi-dispatch cap flag is also set for that interval (a semi-dispatch interval). Otherwise the generator is free to operate at any level.

3 Design of the UIGF

In the 5-minute dispatch time frame the UIGF is, absent any network constraint, based on the measured SCADA output from the wind farm, which is more reliable than a weather model-based forecast. That is, the forecast for the next five minutes will be close to the actual output for the previous five minutes.

[1] This issue relates only to the 5-minute dispatch process, noting AWEFS also produces forecasts for the 5-minute Pre-dispatch, Pre-dispatch and PASA time frames
[2] Supervisory Control and Data Acquisition – a computer-based system for the real-time capture and storage of power system measurements and the monitoring and control of the power system
[3] AEMO has since requested, and largely been provided with, this information
[4] In accordance with NER clauses 3.7B (c) and (d)

However, if there is a network constraint operating to reduce the output of a wind farm, a weather model-based forecast is to be used instead.

The AWEFS uses the SCADA control set-point of the wind farm provided in real-time to AEMO to determine whether a wind farm's actual output has been reduced by a network constraint. Otherwise, AWEFS assumes the output reduction is due to a reduction in the level of wind in the area of the wind farm.

4 Incorrect Implementation of UIGF Design

Prior to the implementing the semi-dispatch arrangements, AEMO established guidelines and information provision requirements for the wind farm energy conversion model. During the consultation to develop these guidelines, AEMO changed the real-time provision of wind farm control set-point information from mandatory to optional.

However, without this real-time information, AWEFS could not distinguish between a reduction in wind farm output due to a network constraint or due to a genuine reduction in wind energy.

5 Impact of the UIGF Error

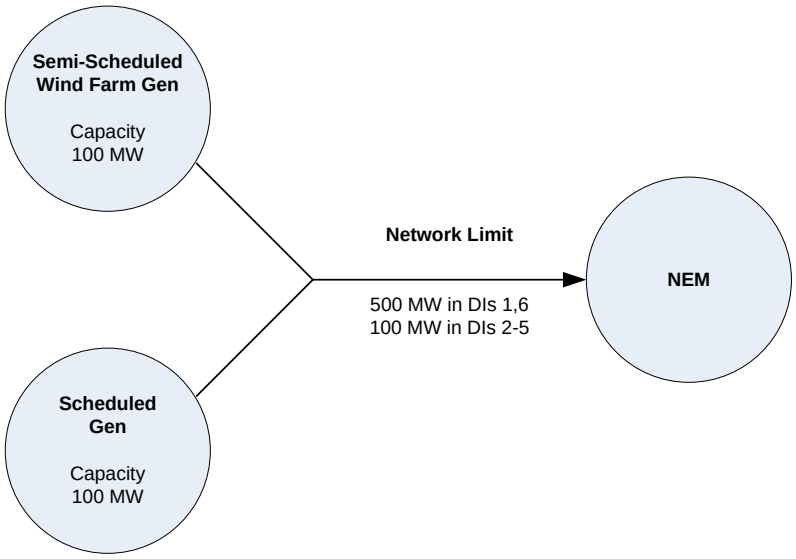
In the dispatch timeframe, AWEFS cannot distinguish between a reduction in wind energy and deliberate action to reduce wind farm output. When a wind farm is constrained off by a network constraint and its output is manually reduced by adjusting the wind farm's control scheme set-point, AWEFS incorrectly assumes that the wind speed must have dropped and produces a lower than expected generation forecast. During a period of network constraint this can progressively reduce the wind farm output to zero and then leave it at zero output.

Example

This example describes a scenario that compares the current, incorrect UIGF outcomes (without the real-time information) with "what-if" UIGF outcomes (where the real-time information is available). The difference between the two indicates how some semi-scheduled wind farms may have been affected by the scheduling error.

Consider a high-priced scheduled generator and a low-priced semi-scheduled wind farm, each physically available for 100 MW and connected to the NEM via a shared transmission line (refer to Figure 1 below).

Figure 1: Example of UIGF Error - Network Model



The scenario assumes the following:

- the semi-scheduled wind farm offer is at a lower price than the alternative scheduled generator offer, and that both generators are offered so that they will be dispatched up to their capacity or the capacity of the network
- ramp rates do not limit the dispatch
- the current wind forecasts (without real-time information) do not use wind speed but rather recent measurements of wind farm output
- the "what-if" wind forecasts, based on wind speed, are correct[5]

Initially, the combined output from the generators is not constrained by the network, with each having a calculated dispatch level of 100 MW for dispatch interval (DI) 1.

A network constraint limits the combined output from the generators to 100 MW in DIs 2 to 5. In DI 6 this network constraint is removed.

Figure 2 and Table 1 below summarise the impact of the incorrect UIGF on dispatch outcomes.

The "what-if" generation based on actual wind energy varies between 100 MW and 25 MW. The correct "what-if" UIGF follows the actual wind energy at the start of the DI, and the incorrect UIGF behaves as described below. The actual generation reflects the generator's compliance with the dispatch instructions based on the current UIGF.

- For DI 1:
  - AWEFS correctly calculates a UIGF of 100 MW for the semi-scheduled generator based on its previous, unrestricted output.
  - Dispatch calculates a dispatch level of 100 MW for the semi-scheduled generator based on this UIGF, and a dispatch target of 100 MW for the scheduled generator up to its physical capacity.
  - There are no binding network constraints affecting the generators, hence the semi-dispatch cap flag for the semi-scheduled generator is set to "False" and the generator is free to operate as the wind allows.
- For DI 2:
  - During DI 1, the wind drops off below forecast and the semi-scheduled generator output reduces to 50 MW. Based on this output, AWEFS correctly calculates a UIGF of 50 MW for DI 2.
  - Dispatch calculates a dispatch level of 50 MW for the semi-scheduled generator based on its UIGF, and a dispatch target of 50 MW for the scheduled generator, the remaining capacity of the network constraint.
  - The network constraint binds at the combined dispatch of 100 MW, and the semi-dispatch cap flag for the semi-scheduled generator is set to "True".
  - Based on this flag, the semi-scheduled generator complies and caps its output at the dispatch level of 50 MW during DI 2.
- For DI 3:
  - Based on previous output AWEFS interprets, absent the control set-point, that the wind has dropped, and incorrectly calculates a UIGF of 50 MW for DI 3.
  - Dispatch calculates a dispatch level of 50 MW for the semi-scheduled generator based on its UIGF, and a dispatch target of 50 MW for the scheduled generator, the remaining capacity of the network constraint.

[5] Note the current UIGF without real-time information uses recent measurements of wind farm output to forecast the wind farm output in the next dispatch interval. The real-time information indicates to AWEFS whether the current output has reduced to below the UIGF level, requiring a wind speed based forecast.

- The network constraint is still binding and the semi-dispatch cap flag for the semi-scheduled generator is set to “True”.
- Based on this flag, the semi-scheduled generator complies and caps its output at the dispatch level of 50 MW during DI 3.
- Based on wind energy the correct UIGF should be 75 MW, the dispatch level should only be capped to 75 MW, and hence the semi-scheduled generator has lost 25 MW of output. There is a scheduling error in this DI.

- For DI 4:
  - Based on previous output, AWEFS calculates an incorrect UIGF of 50 MW for DI 4.
  - Dispatch calculates a dispatch level of 50 MW for the semi-scheduled generator based on its UIGF, and a dispatch target of 50 MW for the scheduled generator, the remaining capacity of the network constraint.
  - The network constraint is still binding and the semi-dispatch cap flag is set to “True”
  - Based on this flag, the semi-scheduled generator complies and caps its output at the dispatch level of 50 MW during DI 4.
  - Based on wind energy the correct UIGF should be 85 MW, the dispatch level should only be capped to 85 MW, and hence the semi-scheduled generator has lost 35 MW of output. There is a scheduling error in this DI.
- For DI 5:
  - During DI 4, the wind drops off below forecast and the semi-scheduled generator output reduces to 25 MW. Based on this output, AWEFS correctly calculates a UIGF of 25 MW for DI 5.
  - Dispatch calculates a dispatch level of 25 MW for the semi-scheduled generator based on its UIGF, and a dispatch target of 75 MW for the scheduled generator, the remaining capacity of the network constraint.
  - The network constraint is still binding and the semi-dispatch cap flag is set to “True”
  - Based on this flag, the semi-scheduled generator complies and caps its output at the dispatch level of 25 MW during DI 5.
- For DI 6:
  - During DI 5, the wind picks up above forecast however the semi-scheduled generator output is capped at 25 MW. Based on this output, AWEFS incorrectly calculates a UIGF of 25 MW
  - The network constraint is no longer binding, and Dispatch calculates a dispatch level of 25 MW for the semi-scheduled generator based on its UIGF with its semi-dispatch cap flag set to “False”, and a dispatch target of 100 MW for the scheduled generator up to its physical capacity
  - Based on wind energy the correct UIGF should be 90 MW and the dispatch level should be 90 MW. However as its semi-dispatch cap flag is set to “False” the semi-scheduled generator is free to operate as the wind allows and can ignore its 25 MW dispatch level, hence no output is lost.

Table 1: Example of UIGF Error – Dispatch Summary Table

Physical Capacities

Limits	DI 1	DI 2	DI 3	DI 4	DI 5	DI 6
Network Limit	500 unrestricted	100 binding	100 binding	100 binding	100 binding	500 unrestricted
Scheduled Gen	100	100	100	100	100	100
Semi-Scheduled Gen as limited by actual wind energy	100	50	75	85	25	90

Current Dispatch Outcomes (using incorrect UIGF)

Outcomes			DI 1	DI 2	DI 3	DI 4	DI 5	DI 6
AWEFS	Semi-Scheduled Gen	UIGF	100	50	50	50	25	25
		Based on…	Actual Gen	Actual Gen	Actual Gen	Actual Gen	Actual Gen	Actual Gen
DISPATCH	Semi-Scheduled Gen	Semi-Dispatch Cap Flag	False	True	True	True	True	False
		Must Cap Output at Dispatch Level?	No	Yes	Yes	Yes	Yes	No
		Dispatch Level	100	50	50	50	25	25
	Scheduled Gen	Dispatch Target	100	50	50	50	75	100

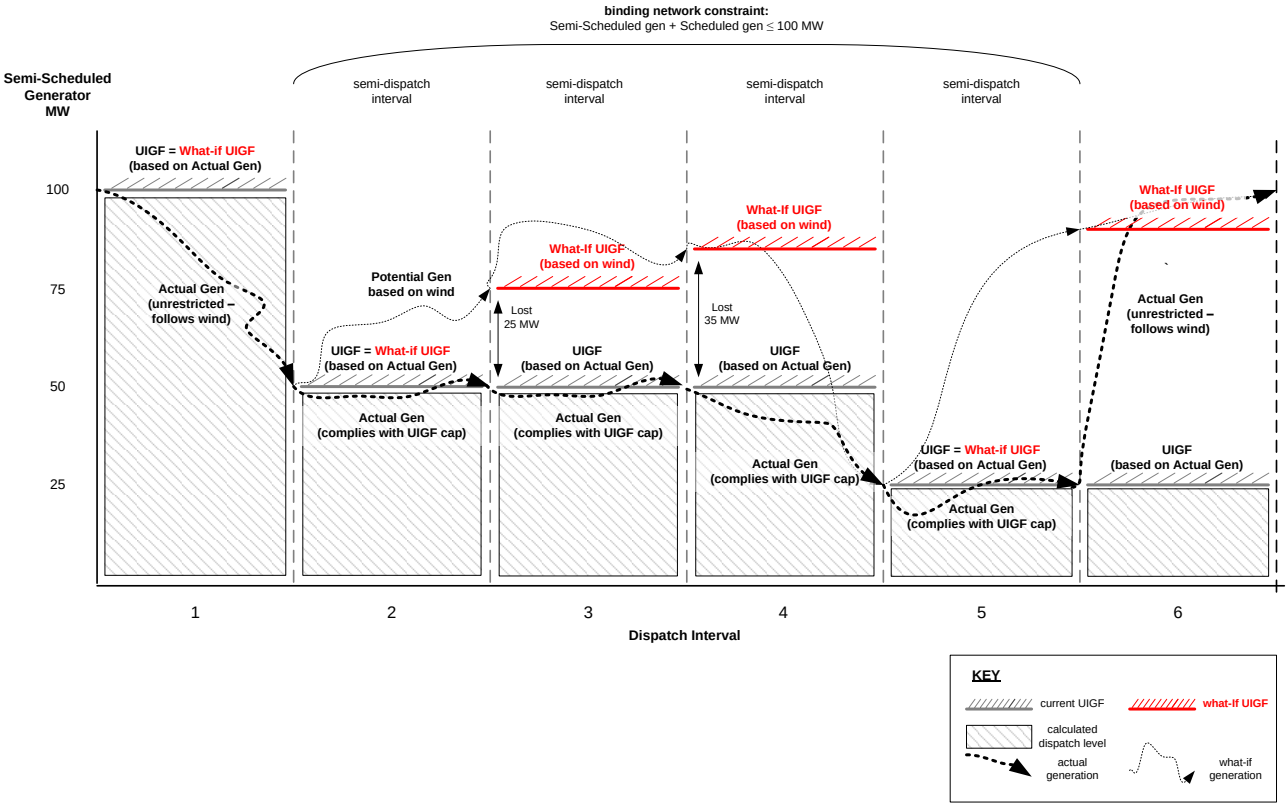
What-If Dispatch Outcomes (assuming correct UIGF)

Outcomes			DI 1	DI 2	DI 3	DI 4	DI 5	DI 6
AWEFS	Semi-Scheduled Gen	UIGF	100	50	75	85	25	90
		Based on…	Actual Gen	Actual Gen	Wind Energy	Wind Energy	Wind Energy[6]	Wind Energy
DISPATCH	Semi-Scheduled Gen	Semi-Dispatch Cap Flag	False	True	True	True	True	False
		Must Cap Output at Dispatch Level?	No	Yes	Yes	Yes	Yes	No
		Dispatch Level	100	50	75	85	25	90
	Scheduled Gen	Dispatch Target	100	50	25	15	75	100

Outcome	DI 1	DI 2	DI 3	DI 4	DI 5	DI 6
Scheduling Error?	NO	NO	YES	YES	NO	NO
Semi-Scheduled Gen MW Lost (What-If minus Current Dispatch Level, for DIs where must cap output)	0	0	25	35	0	0

[6] In this case, actual generation reflects actual wind energy

Figure 2: Example of UIGF Error – Dispatch Summary Graph



6 Scheduling Error Declaration

Under NER clause 3.8.24 (a)(2), a scheduling error occurs when AEMO determines that it has failed to follow the central dispatch process set out in rule 3.8.

AEMO has determined that it failed to follow the central dispatch process in that the UIGFs used in 5-minute dispatch do not assume there are no network constraints otherwise affecting its generation, and hence AEMO declares that a scheduling error has occurred.

The scheduling error occurred for a semi-scheduled generating unit during semi-dispatch intervals within the affected period where:

- the semi-scheduled generating unit's dispatch level was capped by its UIGF and was less than its available capacity, and
- the interval followed a semi-dispatch interval where the wind farm was involved in a binding or violated network constraint.

The affected period for each wind farm, noted in Table 2 below, is from its classification as a semi-scheduled generating unit until the necessary real-time information is provided and used by AWEFS to produce the correct UIGF.

Note that under NER clause 3.16.2 (a), Market Participants affected by a scheduling error may apply to the dispute resolution panel established under NER clause 8.2.6A for a determination as to compensation.

Table 2: Affected Period for Semi-Scheduled Wind Farms

Wind Farm	Semi-Scheduled from	SCADA Control Set-Point in AWEFS
Bluff	05/07/2011	08/03/2012
Clements Gap	17/04/2009	In progress
Gunning	25/03/2011	In progress
Hallett 1	09/04/2009	20/03/2012
Hallett 2	11/05/2009	08/03/2012
Lake Bonney 2	09/09/2010	19/03/2012
Lake Bonney 3	02/07/2010	Being tested
North Brown Hill	19/07/2010	08/03/2012
Oaklands	05/08/2011	14/04/2012
Snowtown	26/07/2010	In progress
Waterloo	20/08/2010	20/03/2012
Woodlawn	03/05/2011	In progress

7 Resolution and Further Actions

The UIGF error can be resolved by Semi-Scheduled Generators providing the control set-points for their semi-scheduled wind farms via SCADA, and AEMO feeding this into AWEFS. The AWEFS design uses the control set-point to indicate the reduced output is an operator action rather than due to a reduction in the wind speed.

AWEFS checks if the wind farm's output is at or close to (or above) the control set-point. If this is the case, AWEFS sets the wind farm output "down-regulation detected" flag and uses the current wind speed from SCADA to calculate the UIGF, provided it is of good quality.

This then results in a UIGF that correctly assumes the wind farm was not network constrained.

In December 2011 AEMO formally contacted all affected Semi-Scheduled Generators and requested them to voluntarily provide, via SCADA, the control set-point information for each wind farm so that their UIGF can be correctly calculated and to ensure the wind farm is not dispatched down unnecessarily.

AEMO requested a response by 31 January 2012, but placed no particular deadline on the provision of the information itself. At the time of writing this process is largely complete and all Semi-Scheduled Generators are either providing, are in the process of providing, or have agreed to provide, the control set-points for their semi-scheduled wind farms.

AEMO will also request future Semi-Scheduled Generators to voluntarily provide this information.

Before September 2012, AEMO intends to consult with Semi-Scheduled Generators and Transmission Network Service Providers (TNSPs) on changes to the Wind Energy Conversion Model guidelines to make the provision of real-time control set-point information via SCADA as mandatory provision for all existing and future Semi-Scheduled Generators.