POWER SYSTEM OPERATING PROCEDURE – LOAD FORECASTING

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History

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22	16/02/2021	E Harmer	R Selbie	T van der Walt	M Gatt	Update references for new Adelaide (West Terrace) weather station. Removal of Mandatory Restrictions references. Addition of DFS Area regional boundaries. Minor Review.
21	02/12/2019	E Harmer	J Fox	T van der Walt	D Sanford	Update forecast process for RERT automation, Solar Analytics improvements and weather stations used in DFS.
20	24/10/2017	P Pantic	J Fox	M Davidson	C Schaefer	Changes made to reflect incorporation of ASEFS2 into market systems processes. Added sentence to section 5.3 to clarify use of bias during RERT periods
19	26/05/2014	A Yohannan	T Vanderwalt	C Brownlee	M Stedwell	Changes made to reflect incorporation of ASEFS into market systems processes.
18	29/11/2013	A Yohannan	T Vanderwalt	B Webb	M Stedwell	Added Sections 5.1, 5.2 and 5.3 to provide clarity on DFS process
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15	05/08/2011	P Biddle	R Rigoni		H Gorniak	Major review
14	28/06/2010	P Biddle	S Trollope		P Ryan	Update section 5.1
13	29/07/2009	P Uribe	S Mathur		C Brownlee	Added definitions Updated Section 3 Added Appendix 3.3

Next Review

Next Review Date	Review Type
30/11/2021	Periodic

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Glossary

a) In this document, a word or phrase *in this style* has the same meaning as given to that term in the NER.

b) In this document, capitalised words or phrases or acronyms have the meaning set out opposite those words, phrases, or acronyms in the table below.

c) Unless the context otherwise requires, this document will be interpreted in accordance with Schedule 2 of the *National Electricity Law*.

Table 1 Glossary

Term	Meaning
AWEFS	Australian Wind Energy Forecast System
ASEFS	Australian Solar Energy Forecasting System
ASEFS2	Australian Solar Energy Forecasting System (Phase 2)
DFS	Demand Forecasting System
NER	National Electricity Rules
NEM	National Electricity Market
POE	Probability of Exceedance
PV	Photovoltaic
SCADA	Supervisory Control And Data Aquisition
STPASA	Short Term Projected Assessment of System Adequacy

1 Introduction

This document is designated as a *power system operating procedure* under clause 4.10.1 of the National Electricity Rules (NER), and has effect only for the purposes set out in the NER. The NER and the National Electricity Law prevail over this document to the extent of any inconsistency.

AEMO must produce indicative *load* forecasts for each *region* for the following timeframes

- Each day for the day ahead – *Pre-dispatch* forecast
- Each day for the period two to seven days ahead – Short term forecast

These forecasts are produced in accordance with the Spot Market Operations Timetable.

2 Purpose

To provide information about the *pre-dispatch* and short term load forecasts produced by AEMO.

3 Application

This Procedure applies to *AEMO*.

4 Related Policies and Procedures

Table 2 Related Policies and Procedures

Title
Spot Market Operations Timetable
Regional Demand Definition

5 General Principles

Pre-dispatch and short term *load* forecasts are produced on the basis of calendar days. Eight calendar days are required to fully cover the seven *trading days* of the short term forecast period.

The New South Wales, Victoria and South Australia *regions* are each forecast as a single area.

The Queensland *region* forecast is an aggregate of forecasts for the Northern, Central and Southern areas.

The Tasmania *region* forecast is an aggregate of the Northern and Southern areas and the four major industrial *loads*.

Refer to Appendix D for the electrical boundaries of these eight areas.

AEMO produces 10%, 50% and 90% probability of exceedence (POE) forecasts for all timeframes. The 50% POE forecast is used to set generation targets in *pre-dispatch.* The 50% and 10% POE forecasts are used in the STPASA process to calculate reserve levels.

5.1 Demand Forecasting System

The Demand Forecasting System or DFS generates the 10%, 50% and 90% POE demand forecasts to be used in *pre-dispatch* and STPASA processes. DFS generates the demand forecasts automatically every half-hour and, under normal circumstances, does not require manual intervention.

5.2 Demand Forecasting System (DFS) Inputs

There are a number of inputs that are used by the forecast models for generating the half-hourly demand forecasts. The key inputs are listed below:

1. Historical actual metered loads
2. Real-time actual metered loads (SCADA data from immediately preceding intervals)
3. Historical and Forecast Weather data (Temperature and Humidity)
4. Significant non-scheduled wind generation forecasts (from AWEFS)
5. Significant non-scheduled solar generation forecasts (from ASEFS)
6. Small-scale (rooftop) solar generation forecasts (from ASEFS2)
7. Type of day (Weekday/Weekend), School Holidays, Public holidays and Daylight savings information.
8. Reliability and Emergency Reserve Trader (RERT) schedules.

5.3 Demand Forecast Adjustments

AEMO conducts daily reasonability checks of the demand forecasts in every region. If the demand forecasts generated by the DFS are assessed as unreasonable, AEMO will manually adjust the

forecasts for the period it is seen to be inconsistent. Demand forecasts are also adjusted during periods of RERT activation and load-shedding.

5.4 Load Forecast Revision Timetable

As a minimum, each forecast will be produced in accordance with the Spot Market Operations Timetable. AEMO may also update forecasts at other times if it becomes aware of significant changes. Table 3 provides a summary of revision timeframes.

Table 3 Load forecast timetable

Load Forecast	Revision	Time (EST)
Pre-dispatch (Current Day)	Continuous	As required[1]
Pre-dispatch (Next Day) After 1230 hrs	Each Day	As each weather forecast is updated.
Short Term	Each Day	Prior to 1230 hrs

6 Weather Forecasts

For the purposes of *load* forecasting, a major regional load centre will be used as the weather reference for that area or *region*. Table 4, below, lists the weather reference locations that are used for each area or *region*.

Table 4 Weather reference location

Area / Region	Weather Reference
Northern Queensland	Townsville
Central Queensland	Rockhampton
Southern Queensland	Amberley, Archerfield, Coolangatta, Sunshine Coast Airport, Toowoomba Airport,
New South Wales	Armidale, Bankstown Airport, Campbelltown, Canberra Airport, Cessnock Airport, Coolangata, Gosford, Orange, Penrith, Sydney Airport, Terrey Hills, Wagga Wagga, Wollongong Airport
Victoria	Ballarat, Bendigo, Geelong Racecourse, Laverton, Melbourne Airport, Melbourne Olympic Park
South Australia	Adelaide Airport, Adelaide West Terrace, Edinburgh, Mt Gambier, Noarlunga, Port Augusta, Port Lincoln
Northern Tasmania	Launceston
SouthernTasmania	Hobart

[1] Refer to section 7

7 Load Forecasting in the Pre-dispatch Period

The *pre-dispatch* period starts at the next *trading interval* and continues to include the next *trading day* with a half hour resolution. At the time of initial publication the *pre-dispatch* covers the remainder of the day, the next day and the first 4 hours of the following day.

The methodology adopted for *pre-dispatch load* forecasting is detailed in Appendix A.

7.1 Pre-dispatch - Current Day Load Forecasting

Each *regional load* forecast for the current day is monitored and modified according to changing *regional load*, system or weather conditions.

Forecast error thresholds have been determined for each *region* and are presented in Table 5. The error thresholds are based on the historical peak demand for the *region* and previous *load* forecasting performance. The forecast error thresholds are reviewed on a regular basis.

Table 5 Pre-dispatch load forecasting error thresholds

Region	Forecast Error Threshold (MW)
Queensland	100
New South Wales	150
Victoria	100
South Australia	50
Tasmania	50

The *load* forecast for a *region* will be reviewed, whenever the forecast error is greater than the forecast error threshold in a *region* for two consecutive *trading intervals*.

8 Non-scheduled wind and solar generation forecasts

AEMO uses the output from the AWEFS, ASEFS and ASEFS2 to adjust the *pre-dispatch* and short term forecasts to account for the generation of any non-scheduled wind and solar farms as well as generation of any small-scale (rooftop) PV systems. Appendix B provides details of AWEFS and ASEFS. Appendix C provides details of ASEFS2.

9 Calculation of 10% and 90% Probability of Exceedence forecasts

The 10% and 90% POE forecasts are derived from the 50% POE forecast. The 10% and 90% POE forecast are produced by multiplying the 50% POE forecast by a scaling factor. A different scaling factor may be specified for each half-hour of the short term period. The 10% and 90% scaling factors are based on statistical analysis of historical *load* and forecast data.

Appendix A Pre-dispatch and Short Term Load Forecasting Methodology

The AEMO DFS uses statistical models to automatically generate Pre-dispatch and short-term forecasts every half-hour for all NEM regions including sub-regions that can have a significant impact on constraints.

The major factors considered in the statistical models are;

- Temperature profile
- Weather season
- Week day / weekend
- Unusual conditions (school / public holidays / daylight savings)

Figure 1 provides an overview of the process.

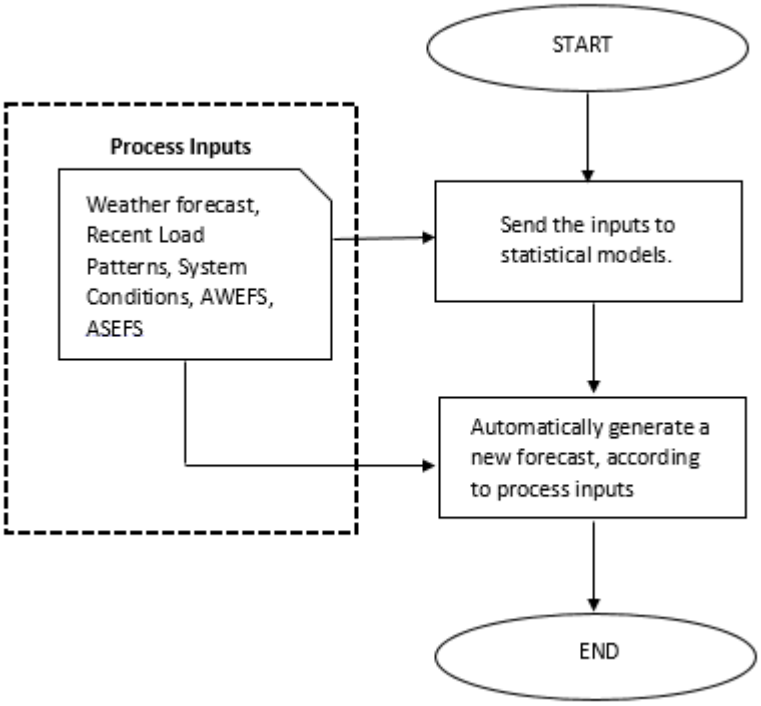

Figure 1 Statistical models forecasting flowchart

Appendix B Australian Wind Energy Forecasting System (AWEFS) and Australian Solar Energy Forecasting System (ASEFS)

The AWEFS and ASEFS provides wind and solar generation forecasts for all NEM wind and solar farms (with registered capacity >=30MW) for the following time frames:

- *Dispatch* - 5 minutes ahead
- 5 Minute *pre-dispatch* - 5 minute resolution, one hour ahead
- *Pre-dispatch* - 30 minute resolution, up to 40 hours ahead
- Short term – 30 minute resolution, 7 days ahead
- Medium term – daily resolution, 2 years ahead

Separate wind and solar generation forecasts are produced for[2]

- Each individual farm (available to the *Registered Participant*, and relevant *Transmission Network Service Provider*)
- Each *region* (available to all *Registered Participants*)
- Entire NEM (available to all *Registered Participants*)

The following inputs are required by the AWEFS

- Real time SCADA measurements of MW output, wind speed, wind direction, turbines in service, control system set-point (where available). It is the responsibility of the wind farm operator to ensure the accuracy and availability of this information.
- Numerical weather predictions
- Standing data provided by wind farms in accordance with the *Energy Conversion Model*. This is provided as part of the registration process.
- Availability information provided by the wind farm operator, that includes the number of turbines available and the upper MW limit on the wind farm. It is the responsibility of the wind farm operator to ensure the accuracy and availability of this information.

The following inputs are required by the ASEFS

- Real time SCADA measurements of MW output, Global Horizontal and Inclined Irradiation, wind speed, wind direction, no. of inverters available, barometric pressure, control system set-point (where available), module surface temperature and relative humidity. It is the responsibility of the solar farm operator to ensure the accuracy and availability of this information.
- Numerical weather predictions
- Standing data provided by solar farms in accordance with the *Energy Conversion Model*. This is provided as part of the registration process.
- Availability information provided by the solar farm operator, that includes the number of strings available and the upper MW limit on the solar farm. It is the responsibility of the solar farm operator to ensure the accuracy and availability of this information.

[2] Contact the AEMO Information and Support Hub for access details

AEMO uses the AWEFS and ASEFS forecasts in the following ways:

Dispatch forecast

- Used in the *dispatch* process to determine target MW for semi-scheduled wind and solar farms.

Pre-dispatch forecast

- Used to determine *pre-dispatch* targets for semi-scheduled wind and solar farms.
- Used to adjust the *pre-dispatch* forecast by subtracting the output of non-scheduled wind and solar farms.

Short term forecast

- Used to adjust the short term forecast by subtracting the output of non-scheduled wind and solar farms.

Appendix C Australian Solar Energy Forecasting System Phase 2 (ASEFS2)

The AWEFS2 provides solar generation forecasts for small-scale distributed PV systems, defined as less than 100 kilowatt (kW) system capacity for the following time frames:

- *Pre-dispatch* - 30 minute resolution, up to 40 hours ahead
- Short term – 30 minute resolution, 7 days ahead

Rooftop PV generation forecasts are produced for[3]

- Each *region* (available to all *Registered Participants* and the general public)

The following inputs are required by the ASEFS2:

- Numerical weather prediction data from multiple weather data providers
- Output measurements from selected household rooftop PV systems from PvOutput.org and Solar Analytics
- Static Data from selected systems from PvOutput.org and Solar Analytics, such as inverter size and model
- Aggregate kW capacity by installed postcode for small-scale solar systems as recorded by the *Clean Energy Regulator*

AEMO uses the ASEFS2 forecasts to account for the output of rooftop solar PV systems and the effect this has on the load shape when creating the load forecasts used in *pre-dispatch* and the short term horizon.

[3] Contact the AEMO Information and Support Hub for access details

Appendix D Load Forecasting Area Boundaries

The eight forecasting areas are divided by the following electrical boundaries:

Area Boundary	Transmission lines defining the boundary
Northern Queensland – Central Queensland	Dysart to Peak Towns Tee Dysart to Eagle Downs Nebo to Broadsound Bouldercombe to Nebo
Central Queensland – Southern Queensland	Calvale to Halys Teebar Creek to Wurdong Gin Gin-H6 to Calliope River
Southern Queensland – New South Wales	Terranora Interconnector (Directlink) QLD – NSW interconnector
New South Wales – Victoria	VIC to NSW Interconnector
Victoria – South Australia	Heywood Interconnector Murraylink
Victoria – Northern Tasmania	Basslink
Northern Tasmania – Southern Tasmania	Palmerston to Waddamana

Transmission line locations are available on the AEMO website for reference.