POWER SYSTEM OPERATION PROCEDURE: NETWORK MODELLING DATA

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VERSION RELEASE HISTORY

Version	Effective Date	Summary of Changes
1.0	13/10/2017	New Power System Operation Procedure: Network Modelling Data (as per Procedure Change Proposal AEPC_2017_08), includes items to allow for Power System Model data to be provided

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1   PROCEDURE OVERVIEW

1.1   Relationship with the Wholesale Electricity Market Rules

1.1.1   This Power System Operation Procedure: Network Modelling Data is made in accordance with clause 2.28.3A of the Wholesale Electricity Market Rules (**WEM Rules**).

1.1.2   References to particular WEM Rules within this Procedure in bold and square brackets **[Clause XX]** are current as of 1 October 2017. These references are included for convenience only, and are not part of this Procedure.

1.2   Interpretation

1.2.1   In this Procedure:

    (a)   terms that are capitalised but not defined in this Procedure have the meaning given in the WEM Rules;

    (b)   to the extent that this Procedure is inconsistent with the WEM Rules, the WEM Rules prevail to the extent of the inconsistency;

    (c)   a reference to the WEM Rules or Market Procedures includes any associated forms required or contemplated by the WEM Rules or Market Procedures;

    (d)   unless the context requires otherwise, references to AEMO include AEMO in its System Management capacity; and

    (e)   words expressed in the singular include the plural or vice versa.

1.2.2   In addition, the following defined terms in Table 1 have the meaning given.

Table 1: Defined terms

Term	Definition
Accurate	(In relation to information) The information is, in all material respects, true and correct and not misleading, whether by omission of any information or otherwise, and includes all relevant information..
At All Times	Available continuously 24 hours per day and 7 days per week.
EMS	An Energy Management System used by AEMO to monitor and control the SWIS in real time.
GIS	A Geographical Information System used by AEMO to display geographical data about physical assets (such as network and generator assets).
Hard Circuit Rating	The highest permissible load at which a network circuit can operate at the time based on any applicable Equipment Limit, Security Limit, Transmission Circuit Limit, Overload Rating, maximum allowable overload period, Security Constraint, temporary limit, or quasi-rating.
Overload Rating	Temporary ratings as per the WEM Rules **[Clause 2.28.3(a)(v)]** that are higher than the Transmission Circuit Limit to which the transmission circuit can be loaded for a maximum allowable overload period and provided to AEMO via Western Power's EMS.
Power System Model	Data representing components of the SWIS that can be used by a Power System Modelling and Analysis Tool to analyse how the SWIS will operate. The model data required by AEMO is in DigSILENT PowerFactory format.

Term	Definition
Power System Modelling and Analysis Tool	Power system grid modelling and analysis software used to model the SWIS and analyse it to determine how it will operate under various conditions. AEMO uses DigSILENT PowerFactory for this purpose.
SCADA	Supervisory Control and Data Acquisition used to describe telemetry and associated real-time control/indication functions.
SCADA Limit	A value, provided to an operator via the SCADA system that represents the value of a power system state variable, beyond which the SCADA warns the operator that a critical amount has been reached or exceeded.
Security Constraints	Security constraints as per the WEM Rules **[Clause 2.28.3A(a)(iv)]** that create Security Limits due to there being technical limits on the operation of the SWIS as a whole, or on a region of the SWIS, necessary to maintain Power System Security, including both static and dynamic limits, and including limits to allow for and to manage contingencies.
Transmission Circuit Limit	A limit as per the WEM Rules **[Clause 2.28.3A(a)(iii)]** that is applied to the operation of a transmission circuit in the SWIS caused by the load capability of the lowest rated component of the transmission circuit.
TSM	Transmission Security Management is a sub-system within the EMS that provides the ability to model the SWIS in real-time timeframes and monitor SWIS security against pre-defined contingencies.
TSM Limit	A value, provided to an operator via the TSM function of the EMS that represents the value of a power system variable, beyond which the EMS warns the operator that a critical amount has been reached or exceeded, or would be reached or exceeded in the future if the power system circumstances were to occur.
Up To Date	(In relation to information) The information is Accurate at the time when it is provided.

1.3   Purpose and application of this Procedure

1.3.1   The Procedure describes:

(a)   the information that a Network Operator must provide to AEMO for each of its Networks;

(b)   the processes to be followed by a Network Operator to enable AEMO to have access to the information;

(c)   the technical and communication criteria that a Network Operator must meet with respect to AEMO's ability to access the information; and

(d)   the processes to be followed by AEMO when accessing the information.

1.3.2   This Procedure applies to:

(a)   AEMO in following the processes when accessing the information provided by Network Operators; and

(b)   Network Operators in:

(i)   providing network modelling data;

(ii)   following the processes to enable AEMO to have access to the information; and

(iii)   meeting the technical and communication criteria to provide access to the information,

to enable AEMO to meet its obligations under the WEM Rules.

1.4 Associated documents

1.4.1 The following Market Procedures (available on the Market Web Site[1]) provide background information to this Procedure:

Table 2: Associated Documents

Reference	Title	Location
SO_OP_WA_3805	IMS Interface Market Procedure – Network Operators and AEMO	AEMO Website
N/A	Market Procedure: Monitoring and Reporting Protocol	AEMO Website
SO_OP_WA_3802	PSOP: Communications and Control Systems	AEMO Website
SO_OP_WA_3803	PSOP: Dispatch	AEMO Website
SO_OP_WA_3808	PSOP: Power System Security	AEMO Website

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[1] Available at: http://aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Procedures.

2   ACCESS TO INFORMATION

2.1   General

2.1.1   In accordance with the WEM Rules, AEMO has the function of ensuring that the SWIS operates in a secure and reliable manner **[Clause 2.2.1]**. To fulfil this key function, AEMO must have the ability to model the SWIS accurately to assess the effects of various operating scenarios (in accordance with the PSOP: Power System Security). This Procedure specifies information that AEMO requires from Network Operators so that it can carry out these assessments.[2] This Procedure also specifies processes to be followed by AEMO and Network Operators and the relevant technical and communication criteria as per the WEM Rules **[Clauses 2.28.3A(b) and 2.28.3A(c)]**.

2.1.2   It should be noted that at the effective date of this Procedure Western Power was the only WEM-registered Network Operator in the SWIS. Therefore, until this registration situation changes, references to a Network Operator in this Procedure are references to Western Power. Western Power will provide the network modelling data in the format, form and manner specified in this Procedure for AEMO to use to operate the SWIS in a secure and reliable manner.

2.1.3   The term Power System Model in this Procedure refers to Western Power's power system modelling data files for the SWIS (currently in PowerFactory format). These files can be loaded within AEMO's Power System Modelling and Analysis Tool (currently the DigSILENT PowerFactory system). These files contain SWIS modelling information that Western Power is able to share with AEMO. In accordance with the WEM Rules **[Clause 2.28.3B]** of the WEM Rules AEMO requires Network Operators to provide the Power System Model information in this format.

2.1.4   Currently AEMO is provided with access to Western Power's EMS[3] to use as its primary real-time system to ensure that the SWIS operates in a secure and reliable manner[4].

2.1.5   The confidentiality provisions under the WEM Rules **[Clause 10.2]** apply to all information provided to AEMO by Rule Participants. The information contemplated by this Procedure has a confidentiality status of Rule Participant Network Restricted.

2.2   Technical Information Requirements

2.2.1   This step describes the categories of information that are required, and AEMO's requirements for access to the information. Network Operators must provide the information below to AEMO in accordance with this Procedure.

(a)   Positive, Negative and Zero Sequence Impedances

(i)   <u>Data</u>

(A)   The WEM Rules **[Clause 2.28.3A(a)(i)]** require a Network Operator to provide impedance data for each of its Networks to AEMO. Impedance values are stored in Western Power's EMS and Western Power's Power

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[2]   This Procedure provides details of the information that must be exchanged and the communications and control systems required by Network Operators and AEMO to enable the SWIS to be operated in a secure and reliable manner. Access to Western Power's ICT systems is addressed in a Services Agreement between Western Power and AEMO. After the end of the Services Term in the Services Agreement, Western Power will no longer be obliged to provide access to the nominated ICT Services at the agreed Service Levels. However, after the end of the Services Term, Western Power will continue to provide all the required data in this Procedure to AEMO in the agreed format, form, manner and timeframe.

[3]   Western Power's current EMS for the SWIS is a GE XA21 system.

[4]   Planning is currently underway for AEMO to transition to its own independent EMS (GE's e-terra platform) for the SWIS.

System Model, noting that the negative and zero sequence impedance values inside Western Power's EMS are not currently used operationally – see steps 2.2.1(c) (Information on Security Constraints) and 2.2.1(e) (Short Circuit Capability) below.

(ii) <u>Access Requirements</u>

(A) AEMO requires access to Western Power's EMS At All Times (as specified in the IMS Interface Market Procedure – Network Operators and AEMO). AEMO requires an up-to-date copy of Western Power's Power System Model and associated files sufficient for the purposes of the WEM Rules **[Clause 2.28.3B]** to be provided (as specified in the IMS Interface Market Procedure – Network Operators and AEMO).

(iii) Process

(A) Western Power must maintain an Accurate network model within its EMS and Power System Model, updating those models no later than 5 Business Days (or as otherwise agreed by AMEO) prior to the network changing for network augmentations, including new or modified connections. Western Power must provide a copy of its Power System Model to AEMO no later than 5 Business Days (or as otherwise agreed by AMEO) of a major new release prior to the network changing, and after that release has been updated and verified (as specified in the IMS Interface Market Procedure – Network Operators and AEMO).

(B) Western Power's EMS model must be aligned as much as practicable with other models used for determining security constraints, such as its Power System Model.

(C) Where AEMO identifies an issue or a change requirement in the model within Western Power's EMS (including telemetry, telemetry data, or calculations, or calculations results that support the model and its functionality, such as the state estimator and contingency analysis), Western Power must agree on the requirements with AEMO and a timeframe for implementation. Where Western Power and AEMO cannot agree on the requirements or an implementation timeframe, AEMO (acting reasonably) will determine the requirements and a timeframe for implementation.

(D) AEMO will ensure access to Western Power's EMS and Power System Model is restricted as per AEMO's confidentiality obligations under the WEM Rules.

(b) Information on Network Topology

(i) Data

(A) The WEM Rules **[Clause 2.28.3A(a)(ii)]** require a Network operator to provide information on network topology for each of its Networks to AEMO. Information on network topology is primarily available to AEMO from Western Power's EMS, Power System Model and GIS tools. However, AEMO also requires periodic data transfers of current network topology for use in geographic display tools.

(ii) Access Requirements

(A) AEMO requires access to Western Power's EMS and GIS tools At All Times for this information, as well as periodic data transfers on transmission network topology (as specified in the IMS Interface Market Procedure – Network Operators and AEMO).

(iii) Process

(A) Western Power must maintain an Accurate network model within its EMS and Power System Model, updating the models no later than 5 Business Days (or as otherwise agreed by AMEO) prior to the network changing for network augmentations, including new or modified connections. Western Power must provide a copy of its Power System Model to AEMO no later than 5 Business Days (or as otherwise agreed by AMEO) of a major new release prior to the network changing, and after that release has been updated and verified (as specified in the IMS Interface Market Procedure – Network Operators and AEMO).

(B) Western Power's EMS model must be aligned as much as practicable with other models used for managing network topology, such as other GIS tools.

(C) Where AEMO identifies an issue or a change requirement in the model within Western Power's EMS, Power System Model or GIS tools, Western Power must agree on the requirements with AEMO and a timeframe for implementation. Where Western Power and AEMO cannot agree on the requirements or an implementation timeframe, AEMO (acting reasonably) will determine the requirements and a timeframe for implementation.

(D) AEMO will ensure access to Western Power's EMS and Power System Model is restricted as per AEMO's confidentiality obligations under the WEM Rules.

(c) Information on Security Constraints

(i) Data

(A) The WEM Rules **[Clause 2.28.3A(a)(iv)]** require a Network operator to provide information on security constraints for each of its Networks to AEMO. Information on security constraints is primarily provided to AEMO by Network Operators in accordance with the processes set out in the PSOP: Power System Security. However, AEMO also requires access to Western Power's EMS to monitor and assess the status of those constraints.

(ii) Access Requirements

(A) AEMO requires access to Western Power's EMS At All Times for this information, and updates to the Power System Model from time to time (as specified in the IMS Interface Market Procedure – Network Operators and AEMO).

(iii) Process

(A) Western Power must maintain an Accurate network model within its EMS and Power System Model, updating the models no later than 5 Business Days (or as otherwise agreed by AMEO) prior to the network changing for network augmentations, including new or modified connections (including any additional telemetry, telemetry data, calculations and calculations results to monitor the security constraint). Western Power must provide a copy of its Power System Model to AEMO no later than 5 Business Days (or as otherwise agreed by AMEO) of a major new release prior to the network changing, and after that release has been updated and verified (as specified in the IMS Interface Market Procedure – Network Operators and AEMO).

(B) Western Power must ensure sufficient, Up To Date, Accurate, and reliable telemetry data is available within its EMS to support the convergence of the EMS model.

(C) Western Power's EMS model must be aligned as much as practicable with other models used for determining security constraints, such as its Power System Model.

(D) Where AEMO identifies an issue or change requirement in the model within Western Power's EMS (including telemetry, telemetry data, calculations, or calculations results to support modelling of the constraint), Western Power must agree on the requirements with AEMO and a timeframe for implementation. Where Western Power and AEMO cannot agree on the requirements or an implementation timeframe, AEMO (acting reasonably) will determine the requirements and a timeframe for implementation.

(E) AEMO will ensure access to Western Power's EMS and Power System Model is restricted as per AEMO's confidentiality obligations under the WEM Rules.

(d) Transmission Circuit Limits and Overload Ratings

(i) Data

(A) The WEM Rules **[Clauses 2.28.3A(a)(iii) and 2.28.3A(a)(v)]** require a Network Operator to provide information on transmission circuit limits and overload ratings (including details of how long overload ratings can be maintained) for each of its Networks to AEMO. Information on transmission circuit limits is primarily accessed by AEMO in Western Power's EMS, and Western Power's limit management tools. Transmission circuit limits are standing limits but may be adjusted by AEMO if advised by Western Power as per the requirements in the PSOP: Power System Security.

(B) To allow AEMO to determine which SWIS Operating State the SWIS is in it requires overload ratings and the maximum overload period for it to determine Hard Circuit Ratings to enable it to determine if network equipment is overloaded. Unless otherwise advised, the circuit limits in Western Power's EMS will be taken by AEMO to be the allowable overload ratings with a maximum allowable overload period of zero minutes.

(C) Network Operators may advise AEMO of temporary overload ratings or other changes in ratings (e.g. quasi limits) in accordance with the processes set out in the PSOP: Power System Security. For each transmission circuit a temporary overload rating and its maximum allowable overload period may be advised by Western Power as per the procedure in the PSOP: Power System Security. For most transmission circuits operation of the circuit at loads above the standing limit up to the temporary overload ratings are limited to a maximum period of 15 minutes, but for some circuits (e.g. transformer circuits) the temporary overload period may be shorter or longer than 15 minutes.

(ii) Access Requirements

(A) AEMO requires access to Western Power's EMS and Western Power's limit management tools At All Times for this information (as specified in the IMS Interface Market Procedure – Network Operators and AEMO).

(iii) Process

(A) Western Power must maintain the following rating limits (SCADA Limits and TSM Limits) within its EMS (as per the PSOP: Power System Security):

1. SCADA Limits - SCADA Limits are primarily used in monitoring equipment loads in real-time operation of the SWIS.

2. SCADA Limit 1 – 90% of the continuous equipment rating

3. SCADA Limit 2 – 100% of the continuous equipment rating, or long term emergency rating where transformer is the limiting component. SCADA Limit 2 is the SCADA limit used for the transmission circuit limit and the

overload rating required in the WEM Rules **[Clauses 2.28.3A(a)(iii) and 2.28.3A(a)(v) respectively]**

4. TSM Limits - TSM Limits are primarily used in studies of SWIS security and SWIS reliability to alert AEMO to potential equipment overloads in contingency situations. TSM Limits may also assist AEMO to monitor equipment loads if SCADA telemetry is not available.

5. TSM Limit 1 – 100% of the continuous equipment rating, or long term emergency rating where the transformer is the limiting component. TSM Limit 1 is the EMS limit used for the transmission circuit limit and the overload rating required in the WEM Rules **[Clauses 2.28.3A(a)(iii) and 2.28.3A(a)(v) respectively]**.

6. TSM Limit 2 – 110% of the continuous equipment rating.

7. TSM Limit 3 – 115% of the continuous equipment rating.

8. When agreed with Western Power's Controller as per the procedure in the PSOP: Power System Security AEMO may allow the equipment load determined by TSM contingency studies to increase above TSM Limit 1 up to either a revised rating, or a temporary overload rating. When agreed with Western Power's Controller, for real-time operations AEMO may also allow the TSM determined transmission circuit load to increase above TSM Limit 1 up to a temporary overload rating for no longer than its maximum allowable overload period.

9. Western Power must ensure any alternative ratings (e.g. seasonal ratings) are available in its EMS or other limit tools for AEMO to use when assessing Power System Security and Power System Reliability outside of the current timeframe (in accordance with the PSOP: Power System Security).

10. Where AEMO identifies an issue or change requirement in Western Power's limit data (including missing limit data), Western Power must agree on the requirements with AEMO and a timeframe for implementation. Where Western Power and AEMO cannot agree on the requirements or an implementation timeframe, AEMO (acting reasonably) will determine the requirements and a timeframe for implementation.

11. Western Power must provide AEMO with historical limit values when requested. (The WEM Rules **[Clause 10.1.2]** require information to be retained for a period of seven years from the date of creation, or such longer period as may be required by law).

12. AEMO will ensure access to Western Power's EMS and limit management tools is restricted to those staff within AEMO that require it in order to meet AEMO's obligations under the WEM Rules (note that this includes access for training purposes).

(e) Short Circuit Capability

(i) Data

(A) The WEM Rules **[Clause 2.28.3A(a)(vi)]** require a Network Operator to provide the short circuit capability of facility equipment for each of its Networks to AEMO. Information on short circuit capability is provided to AEMO by exception, i.e. where Western Power identifies a short circuit limitation that requires active management, AEMO must be notified in accordance with the PSOP: Power System Security. For these instances, AEMO monitors the status of the short circuit limit in Western Power's EMS.

(ii) Access Requirements

(A) AEMO requires access to Western Power's EMS and Power System Model for this information (as specified in the IMS Interface Market Procedure – Network Operators and AEMO).

(iii) Process

(A) Western Power must maintain the necessary calculations, calculations results, telemetry and telemetry data to monitor the status of the short circuit limit, and ensure that those calculations, calculations results, telemetry and telemetry data are Accurate and reliable.

(B) Where AEMO identifies an issue or change requirement in calculations, calculations results, telemetry or telemetry data, Western Power must agree on the requirements with AEMO and a timeframe for implementation. Where Western Power and AEMO cannot agree on the requirements or an implementation timeframe, AEMO (acting reasonably) will determine the requirements and a timeframe for implementation.

(C) AEMO will ensure access to Western Power's EMS is restricted to those staff within AEMO that require it in order to meet AEMO's obligations under the WEM Rules (note that this includes access for training purposes).

(f) Technical and Communications Criteria

(i) Western Power must ensure the systems and tools required to access the data identified in step 2.2 above are available for AEMO to use, at both primary and backup control room locations, in accordance with the requirements in the IMS Interface Market Procedure – Network Operators and AEMO.

2.3 Process for AEMO

2.3.1 AEMO will access the systems and tools identified in step 2.2 above via dedicated computer workstations allocated by Western Power for this purpose, or otherwise as agreed between Western Power and AEMO. AEMO will notify Western Power via the nominated support process to raise issues and change requests and agree on resolution timeframes, in accordance with the requirements in the IMS Interface Market Procedure – Network Operators and AEMO.

2.3.2 After the expiry of the Services Agreement, Western Power is required to communicate information required by AEMO that was provided via access to Western Power's systems and tools via the mechanisms to be established as per the IMS Interface Market Procedure – Network Operators and AEMO[5]. The mechanisms will require amendments to this Procedure once they are finalised with Western Power prior to the expiry of the Services Agreement.

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[5] Some possible alternative mechanisms include the following:
- routine transfers of EMS and Power System Model based positive, negative, and zero sequence data;
- routine transfers of EMS, Power System Model, and GIS based network topology information;
- routine transfers of Power System Model and EMS based Security Constraint information;
- routine transfers of Western Power's limit management tool based Transmission Circuit Limits and Overload Ratings;
- routine transfers of network equipment short circuit current capabilities; and
- transfers of telemetry data in real-time timeframes via the ICCP link;

as required on occurrence of network changes. In this case AEMO would define data templates for publication and use by Western Power