

ELECTRICITY INDUSTRY ACT

ELECTRICITY INDUSTRY (WHOLESALE ELECTRICITY  
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WHOLESALE ELECTRICITY MARKET RULES

Power System Operation Procedure:  
Power System Security

**Commencement:** This Market Procedure is to have effect from 8:00am (WST) on the same date as the Wholesale Electricity Market Rule, in which this procedure is made in accordance with, commences.

## Version history

|                          |  |
|--------------------------|--|
| <u>21 September 2006</u> | <u>Market Procedure for Power System Security at Market Start</u>                    |
| <u>01 February 2009</u>  | <u>Amendments to the Procedure resulting from Procedure Change Proposal PPCL0002</u> |

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## **1 POWER SYSTEM SECURITY**

The Power System Security Procedure sets out the security standards that must be maintained on the SWIS and the processes for maintaining these standards while electricity is traded through the Western Australian Wholesale Electricity Market.

Specifically, this Procedure has been prepared to comply with the requirements of clause 3.2.7 of the Wholesale Electricity Market Rules.

## **2 RELATIONSHIP WITH MARKET RULES**

1. This Procedure has been developed in accordance with, and should be read in conjunction with sections 3.1 to 3.6, and 3.10 of the Wholesale Electricity Market (WEM) Rules (Market Rules).
2. References to particular Market Rules within the Procedure in bold and square brackets **[MR XX]** are current as at 1 October 2008. These references are included for convenience only, and are not part of this procedure.
3. In performing its functions under the Market Rules, System Management may be required to disclose certain information to Market Participants and Network Operators. In selecting the information that may be disclosed, System Management will utilise best endeavours and act in good faith to disclose only the information reasonably required by the application of the Market Rules.

## **3 SCOPE**

This procedure documents the processes which must be followed by:

- a. System Management and Participants in maintaining Equipment information;
- b. Network Operators and System Management in determining the Security Limits for the SWIS network, and maintaining Security Limit information;
- c. System Management in establishing and modifying the Technical Envelope;
- d. System Management to enable it to operate the SWIS according to the Technical Envelope applicable to each Operating State; and
- e. System Management and Participants in Load Shedding Control.

## **4 ASSOCIATED PROCEDURES AND OPERATING STANDARDS**

- a. SWIS Technical Rules and Operating Standards
- b. Power System Operation Procedure – Dispatch
- c. Power System Operation Procedure – Ancillary Services Procedure
- d. Power System Operation Procedure – Communications and Control Systems.
- e. Power System Operation Procedure – System Restart Overview

## **5 EQUIPMENT LIMITS**

The requirement that System Management must record details of all Equipment Limits of which it is informed are specified in the Market Rules **[MR 3.2.2]**, and includes all security limits as defined in section 6 of this procedure.

## **5.1 Equipment Limits**

1. The definition of an Equipment Limit is specified in the Market Rules and is derived from Standing Data.
2. The IMO must provide the Standing Data and any revisions of the Standing Data to System Management as soon as practical.
3. Equipment Limit information will include all thermal rating data for all generator and network equipment, as referred to in Standing Data, that form the SWIS and any other elements of Standing Data that are relevant to the capability of the equipment to operate at its maximum rating, especially information on security constraints for a network.
4. System Management will have regard to any additional information that it becomes aware of.

## **5.2 System Management to maintain list of Equipment Limits**

1. System Management must maintain a list of all Equipment Limits provided by the IMO to System Management through Standing Data, and must ensure that the database in System Management's SCADA monitoring system is updated to reflect any additions or changes to Equipment Limits.
2. Where a Rule Participant becomes aware that its Standing Data is deemed inaccurate or is no longer compliant with the requirements of the Market Rules it must as soon as practical seek revision in accordance with the Market Rules **[MR 2.34.2A]**. Rule Participants must ensure Standing data submitted to the IMO remains accurate in accordance with the Market Rules **[MR 2.34.2]**.
3. System Management must arrange for the SCADA system to monitor the power flow within each item of equipment or Facility for which Equipment Limits is provided.
4. System Management must update the SCADA database with any new Equipment Limit prior to the data becoming operational.
5. Where System Management becomes aware that a generator Equipment Limit is inaccurate or will become inaccurate in the future, System Management must notify IMO of this as soon as practical.

## **6 SECURITY LIMITS.**

1. The definition of a Security Limit is specified in the Market Rules.
2. The Security Limits will be those technical requirements and standards in the Technical Rules that represent constraints on the operation of the SWIS, imposed for the purpose of managing electricity quality and security.
3. A Network Operator must consult with System Management in determining any Security Limits.

4. The Security Limits include:
  - a. SWIS Operating Standards that stipulate maximum and minimum voltage and frequency conditions for the overall SWIS network; and
  - b. voltage and security limits that apply to a region of the SWIS network, and are specified by a Network Operator.
5. System Management must maintain a list of all Security Limits provided by Network Operators that represents actual or potential constraints on the transfer of energy across the SWIS network, in System Management's SCADA system and review the currency of these from time to time.
6. When a Network Operator has not provided sufficient Security, Network or Equipment Limit information, System Management must operate the SWIS network according to its best estimate of the Security or Equipment Limits based on prior information, or information it possesses which is relevant to similar equipment elsewhere in the SWIS.

#### **6.1 SWIS Operating Standards**

1. The SWIS Operating Standards are those quality and security standards that apply to the entire SWIS network and represent a minimum requirement or transmission limit that must be complied with.
2. The SWIS Operating Standards are included in Table 2.1 and subsection 2.2.2 of the Technical Rules. These standards are extracted in Appendix I of this procedure, and are current as at 26 April 2007. Readers should refer to the Technical Rules to ensure currency of the Standards.

#### **6.2 Regional Security Limits.**

1. A Network Operator may specify Security Limits additional to the SWIS Operating Standards that apply to a specific location or region of the SWIS network, as provided in Equipment Limits.

### **7 TECHNICAL ENVELOPE**

1. The requirements that System Management must follow in establishing and modifying the Technical Envelope are specified in the Market Rules **[MR 3.2.7(c)]**.
2. System Management must develop policies governing the process System Management must follow to incorporate real-time modifications into the Technical Envelope.
3. The processes which System Management adopts to establish and modify the Technical Envelope include:
  - The Technical Envelope is established by System Management by organising elements of Standing Data, provided by Market Participants, such as Frequency and Voltage Limit Data specified in the Technical Rules, and Stability Data derived from network simulation Study Reports.

- Plant rating limits are incorporated into System Management's SCADA system which triggers alarms in the System Management System Operations Control Centre ('SOCC') when limits are breached.
  - Where necessary operational data is included in the appropriate operational instructions which are provided to the System Management System Operations Control Centre.
  - Where necessary, Plant rating data is reviewed and updated by System Management on a monthly basis using semi-automated data comparison procedures.
  - Operational data is reviewed by System Management in the event that Standing Data and Technical Rules become subject to changes and when new Study Reports are received.
4. In a Normal Operating State, the conditions set out in the Technical Rules apply to the Technical Envelope.
  5. In a High Risk Operating State or Emergency Operating State:
    - the frequency for a multiple contingency event; and
    - the emergency condition voltage level,
 apply as specified in the Technical Envelope.
  6. The Technical Envelope must take into account the circumstances of a potential High Risk Operating State or Emergency Operating State and System Management's powers as set out in the Market Rules **[MR 3.4 and 3.5]**.
  7. System Management must operate the SWIS in accordance with the Technical Envelope applicable to each operating state.
  8. System Management from time to time will review the boundaries of the Technical Envelope in accordance with the Market Rules **[MR 3.2.5]** and make modifications as required.
  9. Where there are changes to the commissioning status of generation or transmission facilities or equipment, the boundaries of the Technical Envelope (ie Technical Limits and Security Data) must be dynamically updated in System Management's SCADA system, to reflect the application of the Technical Envelope. System Management must also update the network and generator topology accordingly.
  10. As System Management's Technical Envelope is based on elements of the Technical Rules, modifications to the Technical Rules may also modify the Technical Envelope, in so far as they are relevant.

## **8 VOLTAGE CONTROL**

System Management must use its reasonable endeavours to maintain voltage levels throughout the SWIS within the limits specified in the Technical Envelope.

## **9 FREQUENCY CONTROL**

System Management must use its reasonable endeavours to maintain the SWIS frequency within the limits specified in the Technical Envelope.

## **10 COMMUNICATION WITHIN THE SWIS**

An Operating State may be changed following requirements detailed in the Power System Operating Procedure: Communications and Control Systems.

## **11 NORMAL OPERATING STATE**

The definition of the Normal Operating State and the requirements that System Management must follow are specified in the Market Rules.

### **11.1 Normal Operating State Reliability Criteria**

1. A condition of a Normal Operating State is that the SWIS Security Criteria are met.
2. The SWIS Security Criteria require that the power system is capable of withstanding the occurrence of a credible contingency event without causing:
  - a. the unexpected disconnection of an item of equipment;
  - b. the overloading of an item of equipment beyond its Equipment Limits; or
  - c. the curtailment of non-dispatchable load, with the exception of the sudden loss of the largest generator connected at the time to the SWIS, where a portion of the first block of the under-frequency load scheme may be tripped if the frequency falls to 48.75 Hertz.
3. A credible contingency event means an event that System Management considers reasonably possible, and generally applies to the tripping or sudden loss of a generator unit or item of transmission equipment.
4. The credible contingency events which System Management must allow for are set out in Appendix II of this procedure.

## **12 HIGH RISK & EMERGENCY OPERATING STATES**

1. When in a High Risk or Emergency Operating State, one or more Power System Reliability Criteria may not be achieved or maintained by System Management.
2. The definition of a High Risk Operating State and the requirements that System Management and Rule Participants must follow are specified in the Market Rules.

3. The definition of an Emergency Operating State and the requirements that Rule Participants and System Management must follow are specified in the Market Rules.

### **13 READY RESERVE**

1. Ready Reserve generation is that class of generating Facility that can synchronise and generate a significant portion of its rated MW capacity within 15 minutes of receipt of a Dispatch Instruction or dispatch order, and operate at full output for at least 4 hours.
2. Ready Reserve generation provides an important contribution to the security of the SWIS power system by being available to start quickly and provide “make-up” energy in the event of the sudden loss of a large generating unit or energy in-feed. The “make-up” energy enables load tripped on under-frequency to be quickly restored, Interruptible Load to be reconnected and Spinning Reserve levels to be reinstated within four hours.
3. Sufficient generating capacity with Ready Reserve characteristics is normally available on the SWIS, such that Ready Reserve capacity does not need to be specially scheduled and dispatched to maintain the necessary minimum levels of Ready Reserve. However if a large amount of this class of generator is not available because of forced or consequential outages, it is possible there could be insufficient Ready Reserve generation to meet the objective of quickly restoring a Normal Operating State after tripping of a large generator.
4. The requirement to ensure adequate Ready Reserve is available following approval of Generator Outage Plans is covered in the Power System Operation Procedure – Facility Outage.
5. The requirement for a minimum level of Ready Reserve to be maintained will be managed through the Power System Operation Procedure - EGC Dispatch and the Power System Operation Procedure - Dispatch.

### **14 LOAD SHEDDING**

1. The requirements that System Management and Network Operators must follow in determining and implementing automatic under frequency load shedding and manual load shedding plans are specified in the Market Rules **[MR 3.6]**.

## APPENDIX I

## SWIS FREQUENCY OPERATING STANDARDS

[Extracted from Section 2.2 of the Technical Rules  
Current as at 26 April 2007]

**Table 2.1 Frequency Operating Standards for the South West Interconnected Network.**

| Condition                         | Frequency Band                      | Target Recovery Time  |
|-----------------------------------|-------------------------------------|---|
| Normal Range:                     |                                     |   |
| South West                        | 49.8 to 50.2 Hz for 99% of the time |   |
| Island <sup>(1)</sup>             | 49.5 to 50.5 Hz                     |   |
| <i>Single contingency event</i>   | 48.75 to 51 Hz                      | Normal Range: within 15 minutes.<br>For over-frequency events: below 50.5 Hz within 2 minutes   |
| <i>Multiple contingency event</i> | 47.0 to 52.0 Hz                     | Normal Range within 15 minutes<br>For under-frequency events:<br>(a) above 47.5 Hz within 10 seconds<br>(b) above 48.0 Hz within 5 minutes<br>(c) above 48.5 Hz within 15 minutes.<br>(d) For over-frequency events:<br>(e) below 51.5 Hz within 1 minute<br>(f) below 51.0 Hz within 2 minutes<br>(g) below 50.5 Hz within 5 minutes |

**Note:**

An island is formed when the *interconnection* between parts of the *interconnected transmission system* is broken, for example if the *interconnection* between the south-west and the Goldfields is broken.

## 2.2.2 Steady State Power Frequency Voltage

- (a) Except as a consequence of a non-credible contingency event, the minimum steady state *voltage* on the *transmission* system and those parts of the *distribution system* operating at *voltages* of 6 kV and above must be 90% of nominal *voltage* and the maximum steady state *voltage* must be 110% of nominal *voltage*. For those parts of the *distribution* system operating below *voltages* of 6 kV, the steady state *voltage* must be within:
- (1)  $\pm 6\%$  of the nominal *voltage* during *normal operating state*
  - (2)  $\pm 8\%$  of the nominal *voltage* during *maintenance conditions*,
  - (3)  $\pm 10\%$  of the nominal *voltage* during *emergency conditions*.
- (b) Step *changes* in steady state *voltage* levels resulting from switching operations must not exceed the limits given in [Table 2.2](#).

**Table 2.2 Step - change *voltage* limits**

| Cause                               | Pre-tap-changing ( <i>quasi steady-state</i> ) |                    | Post-tap-changing (final steady state)  |                                |
|-------------------------------------|--|--------------------|---|--------------------------------|
|                                     | $\geq 66$ kV                                   | $< 66$ kV          | $\geq 66$ kV  | $< 66$ kV                      |
| Routine Switching <sup>(1)</sup>    | $\pm 4.0\%$ (max)                              | $\pm 4.0\%$ (max)  | <i>Transmission voltages</i> must be between 110% and 90% of nominal <i>voltage</i> | Must attain previous set point |
| Infrequent Switching <sup>(2)</sup> | +6%,<br>-10% (max)                             | +6%,<br>-10% (max) | <i>Transmission voltages</i> must be between 110% and 90% of nominal <i>voltage</i> | Must attain previous set point |

**Notes:**

1. For example, capacitor switching, *transformer* tap action, motor starting, start-up and shutdown of *generating units*.
2. For example, tripping of *generating units*, *loads*, lines and other components.

- (c) Where more precise control of voltage is required than is provided for under clause 2.2.2(a), a target range of *voltage* magnitude at a *connection point*, may be agreed with a *User* and specified in a *connection agreement*. This may include different target ranges under normal and post-contingency conditions (and how these may vary with *load*). Where more than one *User* is supplied at a *connection point* such that independent control of the *voltage* supplied to an individual *User* at that *connection point* is not possible, a target must be agreed by all relevant *Users* and the *Network Service Provider*. Where voltage magnitude targets are specified in a *connection agreement*, *Users* should allow for short-time variations within 5% of the target values in the design of their equipment

## **APPENDIX II            SWIS SECURITY CRITERIA AND CREDIBLE CONTINGENCY EVENTS**

The Security Limits shall be maintained such that when operating in a Normal Operating State, the following contingency events can be sustained without:

- a. exceeding any Equipment Limit or
- b. causing the unexpected loss of another item of equipment, or
- c. exceeding the voltage limits applicable to the network, or a section of the network.

The sudden tripping of a:

- i. Transmission Circuit
- ii. Transformer
- iii. Capacitor
- iv. Reactor
- v. SVC
- vi. Connected load
  
- vii. Generator: except that where the tripping of a generator causes the SWIS frequency to fall to 48.75 Hertz as could be the case for tripping of the largest unit on the SWIS system, automatic under-frequency load shedding will commence and assist Spinning Reserve in returning the frequency to normal.
  
- viii. A known protection system that for a single event caused by external influences results in the loss of more than one transmission element (*eg* pilot cable).
  
- ix. The loss of a section of busbar in a substation or terminal station yard when (and only when) there are people working either:
  - a. in the section of busbar concerned under a primary system; or
  - b. on protection systems in the substation concerned.
  
- x. The loss of a particular transmission element or set of transmission elements as a history of causing the loss of a particular source of energy infeed or a load.

### **CREDIBLE CONTINGENCIES OF SIGNIFICANTLY LOWER PROBABILITY**

The following is considered a credible contingency of significantly lower probability:

- 1. The loss of a section of busbar when (and only when) there are people working on a non-adjacent or non-adjointing section of the same busbar.