ELECTRICITY INDUSTRY ACT

ELECTRICITY INDUSTRY (WHOLESALE ELECTRICITY MARKET) REGULATIONS 2004

WHOLESALE ELECTRICITY MARKET RULES

System Management

Power System Operating Procedure

Cleansing of Generation Facility MWh output data:

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	
21 September 2006	Power System Operation Procedure (Market Procedure) for Cleansing of Generation Facility MWh output data
4 June 2009	System Management amended changes to the procedure resulting from Procedure Change Proposal PPCL 0010

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1. CLEANSING OF GENERATION FACILITY MWH DATA

The Power System Operation Procedure: Cleansing of Generation Facility MWh output data ('Procedure') details processes that System Management and Rule Participants must follow when preparing the generating Megawatt hour (**"MWh"**) output data for each Generation Facility connected to the South West interconnected system (**"SWIS"**).

2. RELATIONSHIP WITH MARKET RULES

1. This Procedure has been developed in accordance with clauses 7.6A.7 and 7.7.9, and should be read in conjunction with clause 7.13 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 June 2009. 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

1. The Cleansing of Generation Facility MWh output data procedure details the processes that System Management will follow in preparing and verifying the Generating Facility Output derived from System Management's Supervisory Control and Data Acquisition ("SCADA") system and used to assess:

    a. Electricity Generation Corporation (**"EGC"**) facility MWh output data;
    b. Non-EGC facilities MWh output data; and
    c. the Operational System Load Estimate.

2. The processes covered by this procedure include:

    a. Collection of raw MW data from System Management's SCADA system and the processing of the data to produce generation facility MWh output figures;
    b. Verification and cleansing of the MWh data for Non-EGC generating facilities;
    c. Verification and cleansing of the MWh data for EGC generating facilities;
    d. The preparation of provisional MWh data for EGC generating facilities; and the replacement of these by final MWh data figures.

3. Details of the transfer process for settlement data from the System Management Market Information Technology System (**"SMMITS"**) to the Independent Market Operator's (**'IMO'**) WEMS system are not part of this procedure.

4. DATA TO BE PROVIDED TO THE IMO

The requirements that System Management must follow in providing settlement and monitoring data to the Independent Market Operator (**"IMO"**) are specified in the Market Rules **[MR 7.13].**

5. DESCRIPTION OF THE MW & MWH DATA RETRIEVAL SYSTEM

1. An overview of the SCADA data retrieval and cleansing process is set out in Appendix I. This is an overview only, and does not constitute part of this Procedure.

2. A description of the equipment and systems involved in the transmission of raw MW data from the Remote Terminal Units ("RTU's") at each power station to the central SCADA system located at East Perth, and the subsequent conversion of this data into a set of 48 Half-hour MWh figures is illustrated in Appendices II and III.

6. INTEGRITY OF SCADA AND ASSOCIATED EQUIPMENT

1. System Management must use MW data from System Management's SCADA system as the primary means of producing MWh output data for EGC and Non-EGC facilities.

2. Where a failure of the SCADA system occurs, the cause will normally be due to a failure of one or more of the components described in Appendix II of this Procedure.

3. Where the failure is minor, the gap in missing data may be treated through either the interpolation process described in section 7 of this procedure, or the manual cleansing process described in section 8 of this procedure.

4. An assessment of the risk to the MWh data retrieval and cleansing process through failure of individual items of equipment is set out in Appendix IV.

5. Where failure of delivery of MW data is due to a major failure downstream of the XA21 storage buffer or local PI Historian, System Management must endeavour to copy the missing data from the SCADA operational database and use it to re-populate the PI Processbook.

6. Where failure of delivery of MW data is due to a major failure of the RTU or the communication links from the RTU, there is no duplicate data available to repopulate data the PI Processbook and System Management must seek replacement MW or MWh data from other sources.

7. AUTOMATIC INTERPOLATION PROCESS

The SCADA system is not designed to deliver a continuous stream of MW data from the remote RTU terminals. Where a MW data point at an RTU experiences no change in MW value between one (4 second) time interval and the next, the RTU will

not transmit the second reading. Where there is no change in a MW value over a series of "4 second" intervals, the system will only record and transmit the first value.

7.1 Interpolation of Data using PI Processbook.

1. System Management must ensure that a process is undertaken to replace any short duration gaps in the MW data that occur as a result of the design of the SCADA system.

2. System Management should subject the MW data in the PI Historian (local) database to an automatic interpolation process that derives, through a process of linear interpolation, MW values that can be inserted in the gaps in the data received from the RTU.

3. The software system to undertake this process will be the PI Processbook software application.

4. PI Processbook will interpolate the missing MW data in the PI database by using a straight line interpolation between the data points on both sides of the data gap.

5. Subject to clause 8, there will be no limit to the length of the gap, or number of Trading Intervals, over which this automatic interpolation will take place.

6. System Management will identify the MW data where interpolation has been used to fill the gaps in MW data.

7. PI Processbook must calculate a MWh value for each Generation Facility for each Trading Interval using both raw MW data and the derived MW data from the interpolation process.

8. CLEANSING OF MWH DATA PROVIDED THROUGH SCADA SYSTEM

1. The PI interpolation process will produce MWh energy figures using both raw MW data and derived MW data.

2. There may be situations where the gaps in the raw data are extensive and have arisen because of some failure in the SCADA system to produce sufficient raw MW data.

3. System Management must check all MWh data derived from the interpolation process to verify that the MWh figures calculated by PI Historian are calculated from MW data containing a satisfactory level of raw MW data.

4. Where there are considerable gaps in the MW raw data and a MWh figure is identified as having a calculated value heavily reliant on data derived from the MW interpolation data, System Management must check this MWh figure against any one or more of the following:

    a. verified MW and MWh values from within the Trading Interval and from adjoining Trading Intervals;
    b. the capability of the Generator facility;
    c. any Dispatch Order or Dispatch Instruction issued to the Facility;
    d. the expected generation dispatch profile;

e. data obtained from System Management's state estimation process; and
f. other information available to or derived by System Management.

5. System Management may accept the MWh data derived from the automatic MW interpolation process in PI Processbook as cleansed MWh data.

6. System Management may run a manual interpolation process within PI Historian using additional MW information gained from the information options set out in subsection (4) above.

7. System Management may substitute the initial MWh data derived in PI Historian resulting from the automatic interpolation process with MWh data gained from the subsequent manual interpolation process.

8. System Management must maintain a copy of the initial MW and MWh data and any substitute MW and MWh data System Management produced as a result of the manual interpolation process.

9. Where System Management is unable to derive a substitute value of MWh using the manual interpolation process set out in subsection (6), System Management may seek a MWh figure using an alternative source of MWh data system for deriving or calculating MWh values.

9. ALTERNATIVE SOURCES OF MWH DATA

1. Where the SCADA data system is unable to derive a MWh value for the output of a Generation Facility in one or more Trading Intervals, System Management may seek MWh data from an alternative system.

2. When System Management uses MW or MWh data from an alternative source, the process by which this data is derived must be made available to the IMO.

9.1 Alternative MWh data source for Non-EGC facilities data

1. When System Management is unable to derive a MWh output value for a Non-EGC generation Facility from the SCADA system, System Management may use the MWh data recorded by the MWh revenue meters installed at the Non-EGC generating Facility interface with the Network.

2. System Management will use this information along with other data to produce the Operational Load Estimate for each Trading Interval of the Trading Day.

3. The process for obtaining the MWh measurement data from each Non-EGC Facility is set out in section 11 of this procedure

9.2 Alternative MWh data source for EGC data

1. When System Management is unable to derive a MWh output value for a EGC generation Facility using the SCADA system data, System Management may derive a substitute MWh figure from the measurements recorded on the MWh interval meters installed on each EGC generator.

2. A description of the MWh interval meter installations at the EGC generator terminals is set out in Appendix V of this procedure.

3. The process EGC and System Management must follow for the exchange of this data is set out in section 11 of this procedure

4. When System Management uses data from the EGC interval meters for providing EGC MWh output data to the IMO, System Management must follow the process set out in section 10 of this procedure.

10. PROVISION OF MWH DATA TO IMO

1. System Management must provide the IMO with the MWh information as specified in the Market Rules **[MR 7.13.1** and **MR 7.13.1A]** monitored by the SCADA system for each Trading Interval of the Trading Day, and the Operational Load Estimate in each Trading Interval of the Trading Day.

2. The MWh data will be provided through SMMITS, or as otherwise agreed.

3. Where System Management is unable to complete the data cleansing process by the time required, or there is some other issue that impacts on the completeness of the MWh data, System Management must follow the process set out in section 9 of this procedure.

10.1 Notification to IMO of delay in transmission of data

1. When System Management is unable to complete the cleansing process in time for the completed MWh data for each Generation Facility to be transmitted to the IMO, System Management must notify the IMO of the delay.

2. The notification should be in the form of an email to the IMO, and should be sent no later than the time that the IMO expects to receive the MWh data.

3. Following subsection 10.1.1, the IMO may extend the timeline of provision of such information in accordance with the Market Rules **[MR 7.13.1B].**

4. The notification to the IMO must include:

    a. the identity of the Generating Facility with missing or suspect MWh data;
    b. the trading Intervals affected by the missing or suspect data; and
    c. the expected time or date by which fully cleansed data will be available to the IMO.

5. System Management should endeavour to provide the IMO with the cleansed or replacement MWh data as soon as practical, and within the timeline prescribed by the IMO in accordance with the Market Rules **[MR 7.13.1B]** .

10.2 Recording of MW and MWh Data

1. System Management must maintain a record of all MW and MWh data that has been subject to cleansing, and the source of any replacement MW or MWh data.

2. The data record must include:

    a. all SCADA MW and MWh data prior to any cleansing process;
    b. any amended MWh data following the cleansing process, including:
        i. The associated Generation Facility,

ii. The affected Trading Intervals,
iii. the cleansing method employed;

c. the MWh data transmitted to the IMO; and
d. a record of any MW and MWh data used that has been derived from an external source.

11. PROVISION OF ALTERNATIVE MWH METERING DATA BY MARKET GENERATORS

Market Generators must provide copies of the MWh data recorded at the MWh interval meters installed at their Generation Facilities when System Management seeks this data as an alternative data source.

11.1 IPP revenue meter data

1. System Management may seek copies of the recorded output data measured at the Non-EGC Facility MWh revenue meter located at or close to the Facility's connection point to the network.

2. The Participant must provide System Management with the MWh data referred to in subsection (1).

3. The data should be provided in an exchange format and through a communication medium acceptable to both the Participant and System Management.

4. The Participant should endeavour to provide System Management with the MWh replacement data as soon as practical, but no later than two business days after the request.

11.2 EGC generator unit MWh interval metering

1. System Management may seek copies of the interval metering data recorded by EGC at their MWh interval meters located at the generator terminals of each EGC generator unit, and any other interval meter data associated with the generator unit.

2. EGC must provide System Management with the MWh data referred to in subsection (1).

3. The data should be provided in an exchange format and through a communication medium acceptable to both EGC and System Management.

4. EGC should endeavour to provide System Management with the MWh data as soon as practical, but no later than two business days after the request.

5. EGC must maintain a record of all MWh half-hour measurements taken from the meters referred to in subsection (1).

6. EGC should make the EGC MWh meters available to inspection by System Management when requested by System Management at three business days notice.

11.3 Calibration of SCADA derived MWh data against EGC MWh meter data

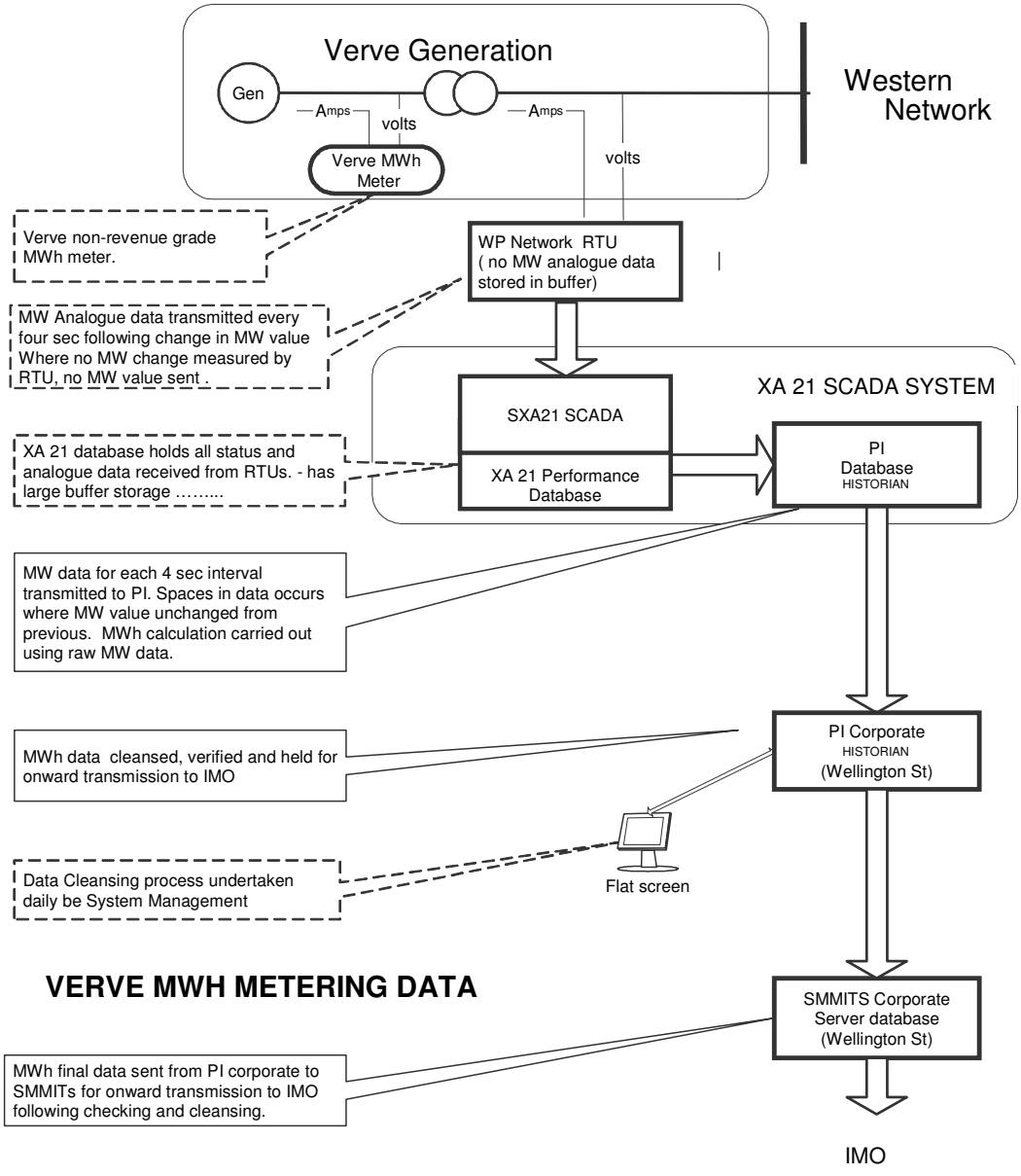
1. System Management may, from time to time, carry out an assessment of the relative quality of the MWh values derived from the SCADA based MWh process against the values obtained from EGC's MWh meters located at the EGC generator terminals.

2. System Management will use this assessment to calibrate the relative accuracy of the EGC generator terminal meters against the SCADA derived MWh values.

3. System Management will apply the calibration information when using MWh data obtained from the EGC MWh meters as alternative MWh data.

4. The calibration records made by System Management in verifying the relative accuracy of the EGC MWh generator terminal interval meters must be maintained by System Management.

APPENDIX I VERVE MWH METERING DATA



APPENDIX II DESCRIPTION OF THE MW AND MWH DATA RETRIEVAL PROCESS

This Appendix describes the individual components that make up System Management's data processing system, from the raw MW analogue data produced at the RTU in the power station high voltage switchyard through to the cleansed set of 48 Half-hour MWh figures that are provided to the IMO for each generation Facility following each Trading Day.

A. Facility RTU at EGC and Non-EGC facility sites

1. Adjacent to each Generating Facility at the point where energy from the facility is transmitted into Western Power Network is located an RTU that measures a number of status and power flow conditions relating to that section of network. This data is sent from the RTU to System Management's central SCADA processor at East Perth.

2. Measurements of voltage and current are made at the high voltage interface point of the Generating Facility with the SWIS Network. The signals are transmitted through transducer equipment into the RTU where they are used to compute a measurement of the instantaneous "sent out" MW power at the Facility boundary.

3. Each RTU is polled at 4 second intervals by the central SCADA processor located at System Management's East Perth control centre. The instantaneous MW values are transmitted to the centre and stored in the XA 21 central operating database.

4. The RTU unit has a buffer storage area, but due to the design of the system this is not available for the MW analogue data. If communication to the processor is lost, the MW data received from the transducers will also be lost.

5. Where there is a failure of an RTU unit, this failure should initiate an alarm that would be received at System Management's control room.

B. Communication link between RTU and central SCADA

1. The data communication between each Facility RTU and the central SCADA relies on a minimum of two individual communication links operating independent of each another. No impact on communication of MW data occurs with failure of a single link.

2. Historically, the availability of the communication systems is high and this performance is expected to continue. The downtime for any single link is historically low.

C. Central SCADA system and Local PI Historian database

1. All analogue and status data received by System Management's XA 21 SCADA system from the RTUs is immediately stored in the XA 21's performance database. The XA21 has dual processors and dual databases, and typically has a high availability. The XA 21 performance data and database is also safeguard through a process of regular back up and archiving.

2. The MW data held in the XA21 database is transferred across to a PI "Historian" database which is also part of the central SCADA data management system. The

transfer is continuous with all 4 second interval MW data written across into the local PI Historian database, except that where a MW value has not changed beyond 0.1MW of the previous value, no transfer will take place.

3. Where a period involves no change in MW level the PI database will record the beginning and end of that period. At the end, a series of new and changed MW data would appear.

4. The PI Historian database system is available for interrogation and extraction of data for power system support studies as well as market applications. The PI system is protected via a separate set of firewalls.

5. The MWh data for each Trading Period for each EGC and Non-EGC Facility is prepared within the local PI Historian system using the MW data received from the SCADA operational database. The MWh assessment is derived within PI Historian by summating and averaging the set of MW points over each Trading point for each Facility, then dividing the average by two. Both the raw MW and the resultant MWh information are permanently stored in the local PI Historian.

6. Where the PI data set shows an absence of a MW value in the chain of MW values for a Facility, this will indicate that the value is within 0.01 MW of the previous MW recorded, and the MWh calculation will be computed using the value for the missing MW point translated from the previous recorded MW value.

7. Where there is a series of unrecorded MW values, the MWh calculation will derive a set of MW figures to replace the missing MW figures, based on a linear interpolation over the period covered by the missing figures, interpolated from the recorded MW figures either side of the missing data.

8. A set of unrecorded MW figures within PI Historian may be due to a series of constant (unchanging) MW measurements being recorded at the RTU, but could also be due to a failure within the RTU or associated equipment to obtain and transmit MW measurements.

D. PI Corporate Historian database

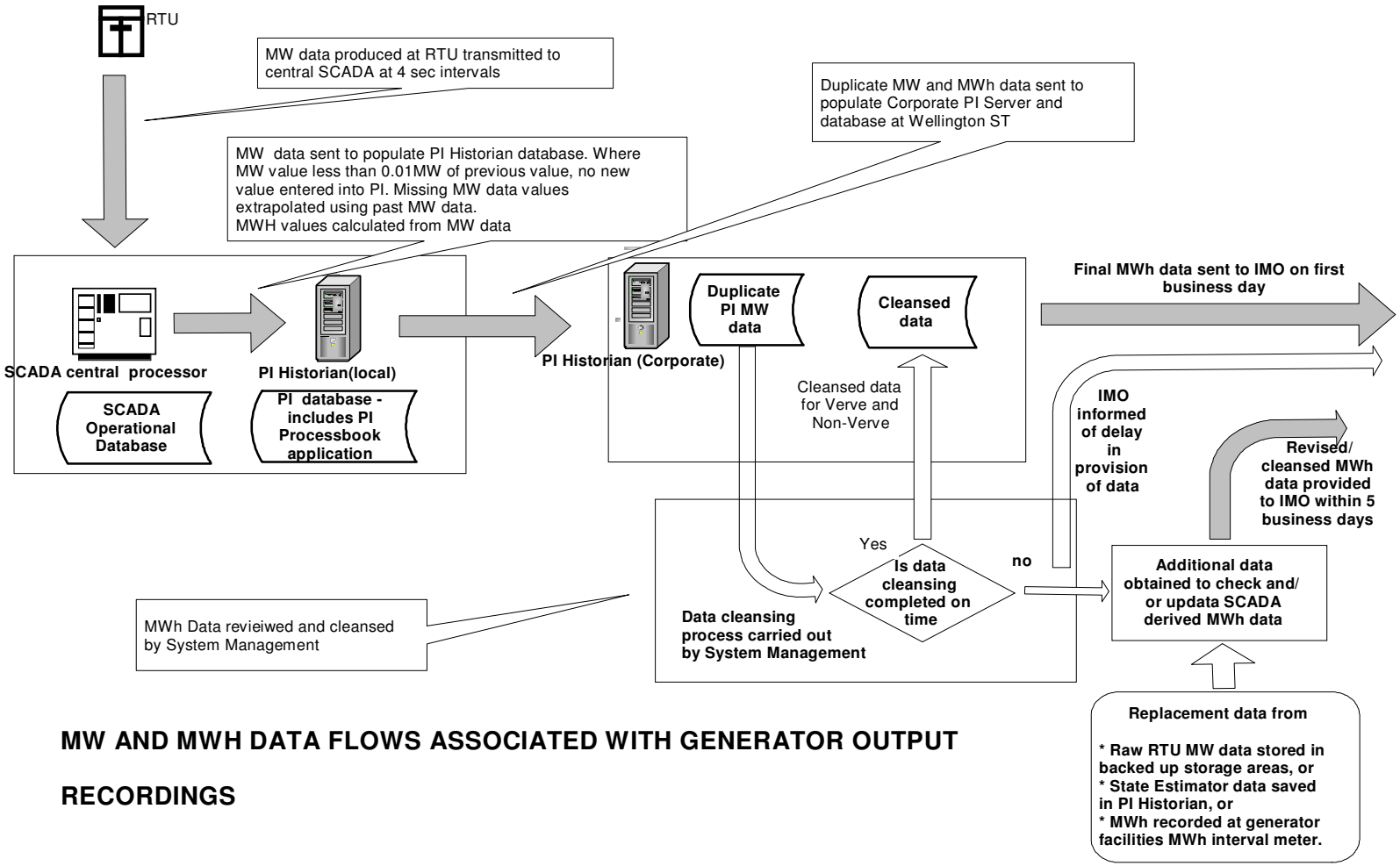
1. A remote PI server and database is located adjacent to the SMMITS server and database system at the Western Power Network computer site in Wellington Street. The “corporate” PI Historian system duplicates all Historian MW and MWh data held at the local site in East Perth. This data is continually updated with the receipt and processing of further data within local PI Historian.

2. System Management accesses the corporate PI Historian system for the purpose of checking and cleansing the EGC and Non-EGC facilities MWh data. Once the MWh data has been cleansed following the process set out in section 5 of this procedure, the data is sent via System Management’s SMMITS system to the IMO.

3. There are three different sets of MWh data stored on the corporate PI Historian system. These are
    a. the original MW and MWh data received from local PI
    b. the modified MW and MWh data resulting from the cleansing process
    c. the MWh data finally sent to the IMO.

4. The maintenance regime for the corporate PI Historian system is consistent with the maintenance regime for System Managements other market systems.

APPENDIX III MW AND MWH DATA FLOWS ASSOCIATED WITH GENERATOR OUTPUT RECORDINGS



MW AND MWH DATA FLOWS ASSOCIATED WITH GENERATOR OUTPUT RECORDINGS

APPENDIX IV IMPACT OF EQUIPMENT UNAVAILABILITY ON INTEGRITY AND CONTINUITY OF MW & MWH DATA PROVIDED THROUGH SYSTEM MANAGEMENT'S SCADA SYSTEM

Equipment Component	Criticalness of component to MWh data delivery process	Equipment availability and outage performance	Risk to MW/MWh data continuity through equipment performance
RTU and associated transducers	Critical as no duplicate RTU available. No local buffer storage to recording MW data	RTU subject to maintenance outages and occasional failure. An outage of an RTU for a day is a credible event	Medium to High Risk Failure of RTU would lead to unrecoverable MW data for up to one day
Communication link between RTU and Central SCADA	Duplicate communication. links provided. No local buffer storage to keep recording MW lost data	Comms link have high availability and reliability	Low Risk Low probability of failure of duplicate links, but failure will lead to loss of MW data
SCADA central processors and database	Duplicate processors and databases	High availability of duplicate system, and duplicated database systems.	Very Low Risk Very low probability of failure, and MW data should be recoverable from operating database
PI Historian (local)	Duplicate processors and databases	High availability through duplicate processors	Very low Risk Low probability of failure. MW and MWh data recoverable from SCADA database
PI Historian (Wellington St)	Duplication of PI Local.	High availability	Very Low Risk Very low probability of failure. MW and MWh data recoverable from local PI

APPENDIX V ALTERNATIVE SOURCES OF VERVE MWH DATA

A. State Estimator Output

1. System Management's XA21 system supports a "state estimator" application as part of its Energy Management systems. The application can operate continuously to check for consistency and conformity, all power system status and analogue data received from the RTUs. Where analogue data is missing, the state estimator has the capability of deriving new data for the missing values. Where analogue data is corrupted, the state estimator has the capability of identifying this corrupted data.

2. For the State Estimator to work successfully, the vast majority of RTUs and accompanying status and analogue data points must be available. Using the topography and characteristics of the network, the State Estimator calculates substitute analogue data that conforms closely to the data that would have been collected by the failed RTUs or missing data points if they had been operating correctly.

3. The state estimator software provides a means of checking MW data for quality and continuity. The MW figures derived from the state estimator calculation can be stored in the PI data base separate from the raw data received from the RTUs, enabling the state estimator figures to be interrogated and extracted when there are instances of suspect or missing raw RTU MW data.

4. The State Estimator can be run at standard intervals; either once a minute or where this regularity causes performance problems with the SCADA system, at a slower rate that does not cause such problems.

5. To use State Estimator data, System Management must undertake regular analysis of the State Estimator application to determine the extent of any variation of the MW figures produced by State Estimator from the "raw" MW values produced at the RTU.

6. From this analysis, System Management will produce an assessment of the possible adjustment that will be needed to be made to the state estimator solution in order for that the state estimator derived values to be consistent with the raw" MW values produced at the RTU.

B. EGC owned MWh Meters

1. System Management may obtain replacement MWh data for EGC Facilities from the MWh interval meters installed at EGC's generator terminals.

2. Each EGC generating facility has a MWh meter installed on each of its generating units. The meter is connected to the low voltage output terminal of the generator.

3. The MWh meters take their current and voltage indications from low voltage current transformers and voltage transformers at the generator terminal. The meters are revenue class meters, while the CT windings used for metering are protection class.

4. An assessment of the MWh output for a EGC generating unit for settlement purposes can be provided by using the EGC MWh meters as check meters, after

adjusting for the effect of the step up transformer and any load consumed by the generator unit's local service transformer.

5. System Management must develop a set of calibration curves for each EGC Generation Facility specifying the relationship between the MWh figures metered at the EGC meters and the MWh figures produced by the SCADA process.

6. The half hour meter readings at the individual EGC generating facilities must be recorded and stored at the generating facility. The process by which EGC makes this data available to System Management is set out in Section 8.4 of this procedure.