aeso
ALBERTA
ELECTRIC
SYSTEM
OPERATOR

Phasor Measurement Unit
Requirements

Version 2.00

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Change History

Version	Author	Description	Date
1.00	Darren McCrank, P.Eng.	Supercedes document "Ref_Doc_AESO_PMU_20030607_rev4" as the PMU requirements document in support of Site PMU Functional Specifications. This version is the first release as a requirements document. ABB 521 PMU added to list of recommended equipment.	2004-06-10
2.00	Darren McCrank, P.Eng.	Updated to replace Dropchute requirement with cygwin freeware and update PC and DMZ requirements. Addition of Hathaway IDM to approved list of PMUs.	2005-07-06

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1.0 INTRODUCTION

1.1.1 Scope

This document sets out the technical requirements for phasor measurement units (PMU) and supporting equipment installed on the Alberta Interconnected Electric System (AIES). The equipment will be used to measure system parameters from generators, lines or transmission facilities. The data will be used to assess the performance of the generators and the interconnected power system during steady state and transient conditions. This assessment will further be used to compare the actual performance of generating or transmission facilities, as indicated by the PMU, to results predicted by analytical models, hence leading to improvement in those models.

This document also sets out the PMU Owner to Alberta Electric System Operator (AESO) relationship requirements as the data acquisition shall be a shared responsibility.

1.1.2 Methods of Compliance

There are two basic options for meeting the technical requirements of this document

- The PMU Owner can choose to utilize equipment recommended by the AESO, which meet the specifications defined in this document. The recommended equipment is identified in section 2.0. The advantage of using this equipment is that it has been tried and tested within the WECC and has a proven track record.

- The PMU Owner can choose to utilize other equipment to meet the requirements set out in this specification.

1.1.3 Definitions

Product Vendor – The vendor or seller of the phasor measurement unit or associated equipment.

PMU Owner – Transmission or generation entity required to install a PMU on their premises.

PMU - Device capable of long term recording of electrical characteristics and disturbances in phasor format and providing continuous phasor measurements.

2.0   TECHNICAL REQUIREMENTS

2.1   PMU REQUIREMENTS

The AESO recommends the use of the Macrodyne model 1690M, the ABB model RES 521*1.0, or the Hathaway IDM 32/64. These units meet the PMU requirements specified within this section. The phasor monitoring unit and supporting equipment shall have the following capabilities:

2.1.1   Functional

- Shall have at least 15 analog inputs and 8 digital (event) inputs.

- Power supply to the equipment shall be provided by Uninterruptible Power Supply (UPS) capable of operating the recorder for at least eight hours in the event of loss of main power.

- The data interface of the hardware shall be PC compatible.

- PMU shall have one or more data ports – port(s) used for remote access, local access and for continuous data provision to an external system for AESO use.

- A frequency response of 0-10 Hz minimum.

- A sample rate of at least 20 samples per second and no more than 60 samples per second digital storage rate per analogue channel. Sample rates shall be user selectable.

- Data resolution no less than 12 bit.

2.1.2   Time Tagging Capability

An external antenna shall connect to the GPS clock in the PMU.   The PMU clock must be set to UTC time.   The monitoring equipment shall be capable of time synchronization, and shall have time accuracy and time tagging as follows:

- Capable of interfacing with satellite time clock.
- Phase angle accuracy within 1 degree.
- Events to be time tagged to within +/- 50 µs.
- Backup clock shall be provided to time events in case of GPS failure (manufacturer to state free run accuracy).

2.1.3   Triggers

External event triggers (digital triggers)

- Tripping of generator breaker (based on breaker contact status).

- Tripping of other breakers depending on station configuration (based on breaker contact status).

Manual Initiation

- Local

- Remote

Frequency and kV

- User defined thresholds of frequency, high and low from nominal 60 Hz levels.

- User defined thresholds of voltage, high and low.

- Separate rate of change triggering.

2.1.4   Output Data

Data Format

Data formats shall meet IEEE 1344 standard or PC37.118.

Data Conversion for Compatibility Using Other Data Analysis Software

The following data compatibility requirements shall be met:

- All records compatible for data conversion and display using other third party software applications (such as DADisp, MatLab, LabView v2.54, Power Technologies PSS/E, General Electric PSLF, PhasorFile, PSMtools v060200, etc.). WECC distributed PMU Streamreader software achieves this compatibility when using recommended PMUs in section 2.1. Using other technologies will require the PMU Owner to provide the interface software to achieve this.

Data Storage Capability

- Capability to store at least seven days of triggered data, as well as transmit continuous data streams.

Record Storage for Triggered Events

The monitoring equipment shall be capable of storing data associated with a triggered event as follows:

Pre trigger

- Minimum of 10 seconds (typical storage is 1 sec to 30 minute range).

Post trigger

- Minimum of 50 seconds (typical storage is 1 sec to 30 minute range).

- Will continue to store records when a trigger threshold has been initiated.

Measurable Data

Output data from the PMU unit will include, at a minimum, the following quantities:

- Positive sequence voltage and current .

- System frequency - based on monitoring selected channel(s) of input voltage(s).

- Phase Angle - the monitor must produce a voltage and current phase angle. When used with other system monitors, the voltage phase angle between buses can be measured.

2.1.5   Preferred Additional Features

The following features are suggested as being useful, but are not part of the basic the AESO requirements:

- PMU equipment shall have an output that indicates triggered event and unit failure.

- Scalable hardware (disk space) is desirable.

2.2 PMU SUPPORT SYSTEM REQUIREMENTS

This section of the document aims to specify the requirements of the support system equipment needed in getting the data to the AESO.

2.2.1 System Setup

This system design involves a local PC connected to the PMU that stores and then sends the data to the AESO via Internet access (or any better communication link available is encouraged). There are two key pieces of software required to read, store and send the data. One is the PMU Streamreader software, provided by the AESO, used to read streaming data from the PMU and create and store .dst files. The second software application, cygwin, sends the files to the AESO. Using one of the recommended PMUs and meeting the following minimum PC requirements will make the PMU Owner compliant to the technical requirements within this document.

Minimum PC Equipment Required

- Industrial rated unit with
  1. 20 GB hard drive partitioned such that the data is stored separately from the operating system. E.g. drive C:\ 7G drive D:\13G
  2. 256 M RAM
  3. Pentium 3 - 700 MHz with 512Kb cache
  4. 56 k dialup modem for remote access
  5. Mouse
  6. Ethernet card
  7. CD read and write capability
  8. 1024x768 or higher resolution video subsystem
  9. 99.8% uptime (100 hrs/year minimum participant outage time)

- An Internet connection via
  1. 56Kmodem (will require a second modem for this option); or
  2. xDSL connection or cable connection

- Software requirements
  1. Windows 2000 (NT or XP will also work)
  2. PC Anywhere software version 10 or greater
  3. Cygwin base packages with additional tools for the transfer script (freeware)
  4. Industry standard security requirements

- DB9 cable – pin-out supplied by the AESO.

Should Internet access be unavailable either for a short term or indefinitely to send data to the AESO, the PMU Owner shall take measures to regularly copy the data to CD and send it to the AESO.

2.2.2 Data and System Access Capabilities

The system shall have the following capabilities for data access and changing settings. The capabilities will be available by way of either a local or remote interface.

- Record downloading (either on request or automatically downloaded to a master station data concentrator).

- Change of channel, event, or trigger description.

- If applicable, change of calculation assignment for calculated displayed quantities (MW, MVAr, and MVA).

- When applicable, change of user defined trigger levels, trigger calculations and any bandpass conditions.

- Software and hardware diagnostics.

- AESO to have provisions of dial-up access

- Remote start/reboot of the monitor at the PMU transmission or generation facility site.

- Easy to navigate GUI (HMI) (local or remote).

2.2.3 Data Security

The system shall have, at a minimum, the following data security capabilities:

- Graduated security features.

- The PMU shall not lose any stored data for records that are either polled or automatically downloaded.

- Any system configuration files shall be secured through password protection of either the system measurement equipment or connecting modems.

- AESO highly recommends having the PMU Server behind the PMU Owners firewall.

- In addition AESO recommends the PMU Server be placed in the PMU Owners DMZ and the system configured with a static IP address.

2.2.4 Data Display Features

The following are desirable data display features (available when PMU Streamreader s/w is used). It is recognized that the actual features available will depend on the capability of third party software.

- On screen comparison of up to six selected quantities.

- Simultaneous display of selected channels for multiple records.

- Interpolation between samples or calculated quantities.

- Automatic scaling and scale display.

- User - adjustable scaling for either or both time and quantities selected for display.

3.0 PMU OWNER TO AESO RELATIONSHIP

Part of this relationship and listed responsibilities is based on the use of the recommended equipment. If alternate equipment is selected, more alignment is required.

3.1.1 Licensing Arrangements

- Software and hardware licensing shall be provided to the PMU Owner as well as the AESO.

- Both the AESO and the PMU Owner shall be provided with software to access and save data from the PMUs.

3.1.2 Setup, Commissioning and Support

- PMU Owner shall arrange a field visit by Product Vendor to provide orientation on system and aid in system setup and commissioning. This shall also include testing of all remote data access and setup features as specified.

- PMU Owner is responsible for resolution of all problems associated with the system measurement equipment located at the PMU transmission or generating facility.

- PMU Owner is responsible for the installation, verification, and setup of PCAnywhere. The AESO will require a phone number, admin account, and a password to access.

- The AESO is responsible for the installation of Cygwin and the additional packages needed for the transfer of PMU data to AESO. The AESO will assist in the set up of the encryption. The AESO will be responsible for the installation and commissioning of the PMU Streamreader.

- The PMU Owner is responsible to ensure there is a continual flow of information from the PMU site to the AESO. The PMU Owner shall attempt to resolve data issues within five business days of its discovery. Once a data issue or problem has been discovered, the AESO must have a pre-arranged contact from the PMU site available for consultation as soon as possible. If there has been a break in the transfer of data, the PMU Owner must store the missing data on a CD and send it to the AESO.

- PMU Owner to provide at least five-business days notice to the AESO if support, planned maintenance, or a site visit by the AESO personnel is required.

3.1.3 Documentation

Complete documentation is required to support system setup, operation and maintenance. The documentation shall include following:

1. Procedures for system setup and use with regards to all specified features.

2. Documentation of procedures regarding routine maintenance is to include use of system diagnostics.

3. Detailed connection diagrams showing how the PMU is installed at site.

A complete copy of all documentation shall be given to the AESO. Documentation shall be provided in a format that can be easily reproduced – electronic format is preferred.

3.1.4 Testing and Maintenance

Testing and maintenance shall be performed on all equipment in accordance with manufacturer's recommendation to ensure that equipment is in good working order at all times.

3.1.5 Responsibilities

PMU Owner

i) Purchase PMU.

ii) Install and configure the PMU.

iii) Provide a detailed connection diagram to AESO for review and comments followed by as-built connection diagram within two weeks of final commissioning.

iv) Purchase and setup a PC to cache the PMU data

- Ensure the PC is properly networked. To test the connection, open a command window and ping training.powerpool.ab.ca.

- Purchase, install and verify PCAnywhere is working.

v) Provide required support to AESO staff to conduct a site visit at the PMU as deemed necessary. During such visits, PMU Owner shall have staff available who are knowledgeable with all aspects of the PMU site.

AESO

i) AESO shall assist in installing StreamReader software at PMU Owner's site, upon request by PMU Owner.

ii) AESO shall create a CD for the customer with the PMU StreamReader software and 'ini' file.

iii) Build an 'ini' file for the PMU StreamReader presenting the PMU inputs.

iv) Configure cygwin (transfer s/w) after successfully using PCAnyWhere to take control of the customer PC.