



Phasor Data
Concentrator

Request for
Information

**Western Interconnection
Synchrophasor Program
(WISP)**

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1 Introduction

1.1 PURPOSE

The Western Electricity Coordinating Council (WECC) is requesting information on phasor data concentrator (PDC) devices to support the Western Interconnection Synchrophasor Program (WISP).

1.2 CURRENT SITUATION

WISP will deploy a large-scale synchrophasor measurement system in the Western Interconnection. This program involves the following:

- Deploying phasor measurement units (PMU) and PDCs throughout the Western Interconnection
- Implementing a new wide-area telecommunications network for synchrophasor data transmission across the Western Interconnection
- Engineering and deployment of new software applications to improve situational awareness, system-wide modeling, performance analysis and wide-area monitoring and controls for the Western Interconnection

Synchrophasor data and supporting technologies will be used by WECC and participating utilities to identify and analyze system vulnerabilities and disturbances as they are developing on the bulk electric system in the Western Interconnection. This “early warning” will enable WECC to take timely actions to avoid wide-spread system blackouts. It will also be used to ensure the accuracy of models used to simulate the power system in planning and operational studies, and in some instances to deploy automatic corrective actions to stabilize the power system.

1.3 WECC BACKGROUND

WECC is the Regional Entity responsible for coordinating and promoting bulk electric system reliability in the Western Interconnection. In addition, WECC assures open and non-discriminatory transmission access among members, provides a forum for resolving transmission access disputes, and provides an environment for coordinating the operating and planning activities of its members as set forth in the WECC Bylaws.

WECC is the successor to the Western Systems Coordinating Council (WSCC), which was formed in 1967 by 40 electric power systems serving all or part of the 14 Western States in the US, the 2 Canadian Provinces of British Columbia and Alberta, and a portion of the Baja Peninsula in Mexico. WECC was formed on April 18, 2002 by the merger of the WSCC, Southwest Regional Transmission Association, and Western Regional Transmission Association.

WECC is geographically the largest and most diverse of the eight Regional Entities that have Delegation Agreements with the North American Electric Reliability Corporation (NERC). WECC's service territory extends from Canada to Mexico. Due to the vastness and diverse characteristics of the region, WECC and its members face unique challenges in coordinating the day-to-day interconnected system operation and the long-range planning needed to provide reliable electric service across nearly 1.8 million square miles.

1.4 WISP OBJECTIVES

It is WECC's intent to engage a vendor partner that can deliver a PDC to meet the needs of WISP. The vendor should also be able to provide implementation planning, rollout, and support as required by WISP. The scope of this RFI is limited to the PDC. However, WECC expects to release two additional RFIs in the future - for WAN Services and Application Software - to support WISP.

1.5 SYNCHROPHASOR SYSTEM OVERVIEW

The following information provides a high-level description of the synchrophasor technology architecture for WISP.

Phasor measurement units (PMU) will be deployed at participating utility substations across the Western Interconnection. The participating utilities will deploy PDCs within their control centers to aggregate and concentrate synchronized phasor data collected from the PMUs. Synchronized phasor data will be collected at varying speeds (30 and 60 samples per second are expected, with upward scalability to 120 samples per second expected in the future).

A core wide-area network will be deployed to interconnect participating utilities and WECC. Redundant PDCs will be deployed at each WECC Reliability Office (Loveland, Colorado and Vancouver, Washington) and configured to collect streaming data from PDCs at each of the participating utilities. The data from the inbound PDCs will be persisted in both a real-time database and a post-event analysis data historian. Real-time situational awareness applications will be deployed to deliver enhanced visualization and understanding of the condition of the Western Interconnection.

Interoperability and security are fundamental requirements of the new synchrophasor architecture. As a consequence, interoperability between multiple PMU, PDC and application vendors will be required. Furthermore, WECC must maintain compliance with NERC CIP-002 through CIP-009.

1.6 DOCUMENTATION

RFI respondents are encouraged to submit supporting PDC architecture and design description documentation with the RFI response. Respondents should be aware that any documentation submitted as a response to this RFI shall become WECC property and will not be returned.

1.7 COMMITMENT

The issuance of this RFI by WECC in no way represents a commitment, or intention to commit, and WECC will not reimburse responders for expenses that occur as a result of responding to this RFI.

1.8 SCHEDULE OF EVENTS

The following schedule provides approximate dates associated with this RFI. WECC reserves the right to change any of the dates listed. Changes in the schedule of events will be provided to participants in the form of an RFI addendum and communicated directly through email and via the WECC Synchrophasor web site.

- Release RFI March 1, 2010
- RFI Responses Due March 15, 2010

1.9 WECC CONTACT

The following WECC email box shall be used to submit questions related to this RFI. Please email all questions to WISP@wecc.biz. The subject line must contain "WECC WISP PDC RFI" (without the quotes).

1.10 INSTRUCTIONS AND RFI RESPONSE FORMAT

The following sections detail the required response format for this RFI.

1.10.1 INSTRUCTIONS

Acceptable response formats include MS Word (versions 2007 or '97-2003') and Adobe Acrobat PDF files sent through email to the WECC contact identified above. Any graphics included in the response should be incorporated such that no other software, other than MS Word or Adobe Acrobat, is required for viewing the responses.

All answers / respondent provided information should follow the format of the RFI.

1.10.2 COVER LETTER

The cover letter shall be in the form of a standard business letter and shall be signed by an individual authorized to legally represent the vendor. It shall include the following:

- A statement specifying whether or not proprietary data has been included in the RFI response.
- Availability of product and support services.

1.10.3 PARTNER IDENTIFICATION

State the name and address of your organization and the nature of the company organization (individual, partnership or corporation, private or public, profit or non-profit). Subcontractors, if any, must be identified in a similar manner. Include name and telephone number of person(s) in your organization responsible for the RFI response. If this is a multi-partner solution, include this information for each organization that is part of the multi-partner team.

1.11 ADDITIONAL INFORMATION

This section should include additional information, whether functional or technical, that the responder believes to be important to the evaluation. For example, the respondent's application may provide additional information not otherwise specified by WECC's functional, technical, or general business questions. For example:

- What are the future goals and directions of the respondent's product offerings?
- Based on what you know of the WECC WISP, how can you differentiate your company, product or service?

1.12 REFERENCES

Provide a list of at least three (3) installed sites that WECC may contact. Please use examples that closely match WECC's size and business requirements.

The reference information should include:

- Client business name and address
- Client contact name and telephone number
- Description of the scope of PDC implementation and supporting services

2 GENERAL OVERVIEW of REQUIREMENTS

2.1 PROJECT OVERVIEW

The following requirements are considered essential to meeting the objectives of the project. Responses to the questions in Section 5 should indicate a complete understanding of WECC's general requirements.

2.2 PDC GENERAL REQUIREMENTS

- PDCs shall function as an integral part of the WECC WISP system providing an efficient low-latency path for data collected by multiple PMUs (including those aggregated by upstream PDCs) to reach the WECC Reliability Coordinators (RC).
- The WECC synchrophasor architecture shall support interoperability between multiple PMU and PDC vendors and products.
- PDCs shall be compliant with the IEEE C37.118 - 2005, and include the ability to upgrade to new synchrophasor standards.
- The WECC synchrophasor architecture shall be scalable to support growth from 19 participating utilities to 35 throughout the Western Interconnection.
- All networked components shall support TCP/IP and UDP/IP (v4 and v6).
- PDCs will collect and concentrate the data from PMUs and upstream PDCs.
- PDCs will forward the concentrated data to other requesting PDCs and to the WECC RCs.
- The PDC should be remotely configurable using vendor supplied software and ideally be compliant with IEC 61850.
- The PDC should include a simple visualization application for testing and viewing data concentrated by the PDC.
- The PDC may be an application only, or an application running on vendor specific hardware.
- The PDC may have additional capabilities; e.g. support older phasor data specifications and the ability to handle data other than phasor data.
- The PDC may have Phasor Gateway API (Application Programming Interface) for interacting with future NASPInet Phasor Gateway to exchange data with other entities through NASPInet.

2.2.1 SCALABILITY

Initially the PDCs at WECC will be receiving C37.118 data from approximately 150 PMUs concentrated through eight participating utilities PDCs at 30 frames per second. The PDCs should be able to scale to 300 PMUs concentrated through approximately 40 participating utility PDCs at 60 frames per second.

2.2.2 CENTRALIZED / DECENTRALIZED

WECC will provide centralized support for system upgrades, application and database administration, and infrastructure support for all PDCs. Therefore, the PDC will need to allow for remote update and control.

2.2.3 CLIENT INTERFACE

The PDC must have a vendor supplied application which will allow visualization of the data being passed through the PDC. This application should be accessible locally and remotely through a user interface.

2.2.4 PDC VENDOR IMPLEMENTATION SERVICES

The PDC vendor shall provide resources and technical support for the installation, integration and testing of the supplied component and service. The vendor should specify all other software, hardware, apparatus, equipment, and material required to create a completely commissioned and tested PDC. The vendor should provide a detailed tests plan (to prove compliance with all specified technical requirements) with all factory and site acceptance tests as well as commissioning tests.

The PDC vendor shall provide a user's manual, administration guide and associated training services for the production deployment and operation of the PDC(s).

2.2.5 PDC SOFTWARE

The PDC application must be IEEE C37.118-2005 compliant. PDC configuration should be IEC 61850 compliant

2.2.6 DATABASE CONNECTIVITY

The PDC may include the capability of inserting phasor data directly into a historical database.

2.2.7 CONNECTIVITY

Network support should be compatible with current WECC infrastructure, using TCP/IP and UDP /IP.

2.2.8 SECURITY

PDC shall support NERC CIP 002-009 requirements where applicable.

3 Company Description

Describe your company's legal structure (corporation, partnership, sole proprietorship) and ownership.

- Provide a copy of your company's Mission Statement.
- Based on the requirements listed in this RFI, clearly state how you propose to deliver products and services during the life of any resulting Agreement.
- Describe your company's ability to provide 24-hour service and support to WECC.
- List any special factors or qualifications that render your company well-suited to serve WECC in this program.
- Provide general information regarding how long your company has been in business providing similar products and whether your company is publicly traded
- Provide a copy of any information that would support the volume of business, credit worthiness, and financial stability of your firm. Information should include information such as already prepared recent Financial Annual Report, current Balance Sheet, and Profit and Loss Statements.

3.1 STAFF DESCRIPTION

Please describe your company staffing for hardware and software support as follows:

- 1) Functional Background
 - Number of employees, position, responsibilities, and qualifications.
- 2) Technical Background
 - Number of employees, position, responsibilities, and qualifications.
- 3) Implementation Support:
 - Number of employees, position, responsibilities, and qualifications.

3.2 SUPPORT SERVICES

Describe your approach to defining, pricing, and delivering support services. Describe your company's ability to support redundant PDC installations in the following WECC Reliability Office locations:

- Loveland, Colorado and Vancouver, Washington

3.3 SYSTEM ADMINISTRATION REQUIRED

Describe the required system administration necessary to support your PDC in a production environment.

3.4 SYSTEM INSTALLATION AND CONFIGURATION

Describe any services your company offers to support installation and configuration for the PDC.

4 Phasor Data Concentrator Questions

Please answer the questions in the matrix below. In the Comply? (Y/N) column, enter Y for Yes or N for No. In your response further explain a Yes answer or explain how you plan to comply to any area with a No answer, or if you do not intend to comply.

PDC general requirement:

- The PDC will aggregate and time-align (concentrate) real-time synchrophasor streaming data from distributed PMUs and other PDCs using a high speed WAN using IPv4 or IPv6.

Note: For the purpose of these questions the term **concentrate** means synchronize (time-align) data received from multiple sources and format into a single data packet meeting the IEEE C37.118-2005 and subsequent specifications. The term **real-time** will mean near real-time; specifically a latency no greater than the supported report rate plus a settable buffer time to allow aligning frames through different propagation delays from different sources. For example, if the PDC supports a frame rate of 60 frames per second, real-time means that it should be able to concentrate and forward all the data, from the maximum number of devices it supports in less than or equal to 16.66 ms plus X ms of buffer time to allow for time alignment of signals with different propagation delays. Data frames are described in section 6.3 of the IEEE C37.118-2005 specification

#	PDC Product Details	Comply? (Y/N)
	Communications Standards	
1.	Is the PDC compliant with IEEE C37.118-2005?	
2.	Can the PDC be upgraded to new standards superseding IEEE C37.118-2005?	
3.	What other communications standards are supported?	
	CONFIGURATION	
4.	Can the PDC determine its own spatial location using GPS, and if so can it insert the location into its configuration?	
5.	Will the PDC save any locally cached concentrated synchrophasor data after a configuration change?	
6.	Can the PDC use 61850 XML for configuration?	
7.	Can the PDC configuration be changed remotely via the 61850 protocol to change IP addresses it listens to?	
8.	Can the PDC configuration be changed via the 61850 protocol to change the route of the streamed concentrated data?	
9.	Can the PDC optionally subscribe to an external time alignment common service?	
10.	Can the PDC be configured to use TCP/IP or UDP/IP for different types of traffic?	
11.	Can the user configure the PDC with a maximum waiting time for incoming PMU data?	
12.	Is the PDC supplied with a local console application for configuration?	

#	PDC Product Details	Comply? (Y/N)
13.	Does the PDC store configuration locally in a non-volatile storage medium?	
14.	Does the PDC local configuration application allow for selection, deletion and modification of remote incoming PDCs and PMUs?	
15.	Does the PDC allow remote configuration using vendor supplied application?	
16.	Does the PDC allow configuration changes without requiring a restart?	
17.	Does the PDC allow configuration through settings only without requiring changes to application source code?	
18.	Does the PDC have clear documentation for configuration that will allow a user to configure the PDC without vendor assistance?	
19.	Has the PDC been made as easy as possible to maintain and configure, to include trapping of foreseeable input errors?	
	THROUGHPUT	
20.	Can the PDC support reporting rates up to 30 data frames per second?	
21.	Can the PDC support reporting rates up to 60 data frames per second?	
22.	Can the PDC support reporting rates up to 120 data frames per second?	
23.	Can the PDC be upgraded remotely to support higher reporting rates?	
24.	Can the PDC concentrate data from the maximum number of PMUs it supports in less than the time it takes for the next packet to arrive at its maximum reporting rate? E.g. if the PDC supports PMU reporting rates of 60 frames per second can the PDC concentrate the data in less than 16.66 ms?	
25.	What is the buffer time to allow for time alignment of signals with different propagation delays?	
	DATA	
26.	Can a PDC be setup to broadcast different concentrations of PMU data to different PDCs? For example if a PDC is concentrating data from 40 PMUs and sending the concentrated data of all 40 PMUs to another PDC at xxx.xxx.xxx.xxx, can it be setup to send the concentrated data from a specific 10 of the (40) PMUs to a different PDC at yyy.yyy.yyy.yyy?	
27.	Is the PDC able to selectively strip some channels e.g. current RMS from the PMU data before it is sent upstream	
28.	Can a PDC accept data from a group of PMUs and from another PDC that has already time aligned a different group of PMUs and then aligns everything. In other words are PDCs cascadeable?	
29.	Can the PDC support UDP multicast streams?	
30.	Does the PDC support receiving real-time data in other data frame protocols e.g. DST (BPA Stream) or DAT (Relay Plus)?	
31.	Can the PDC directly insert data into real-time operational databases?	
32.	Can the PDC concentrate data streams with different reporting rates?	
33.	Can the PDC concentrate data streams with different levels of time stamp accuracy? This is a specific reference to the C37.118-2005 data header specification of the field FRACSEC and the sub field 8-bit time quality flag	
34.	Can the PDC generate additional real-time data streams based on user configurable calculations performed on the incoming data streams?	
35.	Can the PDC indicate invalid data in the concentrated data stream?	

#	PDC Product Details	Comply? (Y/N)
36.	Can the PDC locally store up to 30 days worth of data in the event communication with the PDC is lost?	
37.	Can the PDC receive real-time data from TCP and/or UDP ports?	
38.	Can the PDC support multiple UDP and TCP real-time input data streams?	
39.	Can the PDC send multiple real-time data streams, each individually configurable, with different synchrophasor reporting rates?	
40.	Can the PDC align all synchrophasor data with an accuracy of 1 micro second?	
41.	Can the PDC waiting time be adjusted in the range of 1 millisecond to 60 seconds with a 0.1 millisecond or better resolution?	
42.	Can the PDC align all synchrophasor data with a processing time after waiting time expires or receipt of all relevant synchrophasor data; whichever is sooner, within ½ the corresponding configured output rate? For example if the output rate is 120 frames per second the processing time should be at a maximum 4.2 milliseconds.	
43.	Can the PDC include synchrophasor data which arrives after the configured waiting time but before the end of internal processing time? For example; while the PDC is time aligning PMU data, 9 out of 10 PMUs have reported. The wait period times out before 10 shows up so the PDC packages up the 9 and gets ready to transmit. During that processing time (packaging) but before transmit, if PMU 10 does show up can the PDC insert the data from PMU 10 into the packet and time align the late PMU.	
44.	Can the PDC operate with PDCs and PMUs from other vendors that are 37.118 compliant?	
45.	Can the PDC concentrate input data using the IEEE 1344-1995 protocol?	
46.	Can the PDC handle streams from PMUs supporting older versions of the IEEE C37.118?	
47.	Does the PDC take a generic approach to data storage, as oppose to, say, requiring a particular database engine?	
	LOGGING	
48.	Is the PDC equipped with a watchdog function?	
49.	Is the PDC equipped with self-diagnostics and recover functions?	
50.	Is the PDC equipped with user configurable alarms, e.g., alarms for data interruption or CRC check unsuccessful?	
51.	Is the PDC equipped with an error and alarm logging system which can log its own health as well as the performance of PMUs it is concentrating, e.g., CRC errors and data packets out of order?	
52.	Does the PDC log device status changes with a timestamp and include the user ID if the change was done manually?	
53.	Can the PDC be configured to identify a combination of flags over a period of time that will generate a warning or alarm?	
54.	Can the PDC collect and store PMU performance history?	
	COMMUNICATION	
55.	Does the PDC interface to other PDCs or PMUs through a private Internet Protocol (IP) network using either IPv4 or IPv6?	
56.	Does the PDC include an application to allow control of a remote PMU to start or stop streaming data?	

#	PDC Product Details	Comply? (Y/N)
57.	If the PDC includes an application to allow control of a remote PMU to start or stop streaming data does it log all such actions with timestamp and user ID?	
58.	If the PDC includes an application to allow control of a remote PMU to start or stop streaming data, does the application have an API to allow remote operation?	
59.	Can the PDC communicate through a secure (firewall) IP network using either IPv4 or IPv6?	
60.	Can the PDC receive and send data using TCP and UDP?	
61.	Can the PDC send and receive real-time data via multiple simultaneous TCP/IP and UDP/IP connections?	
62.	Can the PDC support communication with a PMU using both TCP/IP and UDP/IP?	
63.	Can the PDC use UDP/IP to support streaming data while simultaneously using TCP/IP for non-streaming requests such as configuration requests?	
64.	Does the PDC support IEEE C37.118-2005?	
65.	Does the PDC support 61850 UCA-GOOSE?	
66.	Does the PDC support DNP 3.0?	
67.	Does the PDC support OPC?	
68.	Does the PDC support IPv4 and IPv6?	
69.	Does the PDC support serial communications (RS-232 and EIA-422)?	
70.	Can the PDC send and receive a watchdog heartbeat signal from another PDC and activate code on cessation of heartbeat signal?	
	RELIABILITY	
71.	Is the PDC designed to have an availability of 99.999%? Please supply design details and calculations supporting the answer?	
72.	Can the PDC generate warnings when excessive (user selectable) data transmission interruptions are detected?	
73.	Does the PDC use GPS time synchronization?	
74.	Can the PDC monitor PMU condition including logging, reporting and alarming?	
75.	Can the PDC infer PMU condition by monitoring the quality of data received from the PMU, including rate of recurrence of missing data, variability in latency, CRC errors, and other statistics?	
	SUPPORT	
76.	Is formal training available for end users (please describe)?	
77.	Describe the vendor support organization.	
78.	Is training on the tool available using WECC data?	
	SECURITY	
79.	Can security be applied based upon user or user group authorization? For example, based upon the user profile, a user will not be allowed to see certain data or modify certain settings.	
80.	Can data access be restricted at the measurement channel level?	
81.	Can the PDC interact with Name and Directory Service to provide PDC registration and receive PMU registration, updates and deletions?	

#	PDC Product Details	Comply? (Y/N)
82.	Can the PDC interact with Security Service to perform secure information exchange?	
83.	Can the PDC interact with QoS Service to contribute to QoS assurance?	
84.	Does the PDC have an API for PDC to Phasor Gateway communications?	
85.	Does the PDC have hardware implemented security features?	
86.	Can the PDC features be upgraded in the field?	
87.	How does the PDC comply with NERC CIP-002 through CIP-009?	
	INSTALLATION	
88.	Can the PDC be installed in less than 1 hour (application only)?	
89.	Does the PDC include an application to test initial install?	
90.	Does the PDC include an application to test rudimentary communications?	
91.	Does the PDC include all apparatus and material required to completely test and commission the PDC?	
92.	Does the PDC include all apparatus and material required to test the PDC with PMUs of various reporting rates operating at 10, 12, 15, 20, 30, 60, and 120 frames per second?	
93.	Can the PDC be tested to show effective operation with various cases of missing and delayed data?	
	APPLICATION	
94.	Is the PDC open source?	
95.	Can the PDC application run on a Linux or Linux variant OS?	
96.	Does the PDC application run on a Microsoft Windows Server 2003 platform?	
97.	Does the PDC application run on a Microsoft Windows Server 2008 platform?	
98.	Does the PDC application require the Microsoft .NET CLR?	
99.	Was the PDC application written by on staff developers?	
100.	Can the PDC application source code be put into an escrow?	
101.	For application only PDC, state hardware requirements.	
	HARDWARE (if the PDC includes hardware)	
102.	Is the PDC power supply capable of operating on a wide range of power supply voltages and available with one of three power supply types: 85–300 Vdc or 85–264 Vac, 38–140 Vdc or 85–140 Vac, or 20–60 Vdc?	
103.	Is the PDC capable of continuous operation over a temperature range of –40° to +75°C (–40° to +167°F) to allow mounting in an outdoor control cubicle; type tested to IEC 60068-2-1:1990 (Test Ad 16 hr @ –40°C), IEC 60068-2-2:1974 (Tested 16 hr @ +75°C), and IEC 60068-2-30:1980 (Test Db 12 + 12-hour cycle @ 25° to 55°C, 6 cycles)?	
104.	Is the PDC tested to the same standards as protective relays? These standards shall include IEC 60255-21-1, IEC 60255-21-2, IEC 60255-21-3, IEC 60255-22-1, IEC 60255-22-2, EN 61000-4-2, IEC 60255-22-3, IEC 60255-22-4, EN 61000-4-4, and IEEE C37.90.1 (see Specifications for details).	
105.	Does the PDC have serial ports?	
106.	If the PDC has serial ports do the ports contain pins available for a demodulated IRIG-B time-synchronization signal?	

#	PDC Product Details	Comply? (Y/N)
107.	If the PDC has serial ports are they capable of operation at 300–115200 bps?	
108.	Are all the PDC communication ports, including Ethernet, ESD and RFI protected?	
109.	Does the PDC exclude all rotating disk drives, fans, moving parts, and vent holes?	
110.	Is the PDC warranted for a minimum of 2 years?	
	Specific Detail	
111	Can the PDC accept streaming data from two PMUs that are configured to be redundant, but only concentrate and forward data from one of the PMUs (the primary), unless the primary fails then automatically switch to the secondary PMU?	
112	Is the design of the PDC focused to be primarily deployed in a substation? i.e. Concentrate data from a small number of PMUs with a focus on quick response time and rules based threshold detection for local control	
113	Is the design of the PDC focused to be primarily deployed in a Control center? i.e. Concentrate data from a mix of PMUs and other PDCs in large quantities with a focus on error logging and stream routing and low latency	