SCE WASAS Combined Disturbance Fault Recorder (DFR) and Phasor Measurement Unit (PMU) Specifications

Anthony Johnson
Anthony.Johnson@SCE.com
Summary

• Specifications for combined DFR/PMU to be used as part of a Wide Area Situational Awareness System (WASAS)
  – Fault/disturbance recording and phasor measurement in one box.
    • PRC-002
  – Functional requirements
  – Hardware specifications
  – Design for expandability
DFR/PMU Specification

- Hardware requirements
- Communication requirements
- Common functional requirements
- DFR-specific functional requirements
- PMU-specific functional requirements
- Other Requirements
DFR/PMU Hardware Requirements

• Typical transmission substation control room
  – Ambient temperature: 0°C to 55°C.
  – Humidity: non-condensing, 5 to 95 percent
  – DC power supply (with option for AC)
    • 200 ms bridging
  – EMC and environmental standards (IEEE and IEC series)
    • IEEE C37.90, C37.90.1, C37.90.2, C37.90.3
    • IEC 61000-4-2/3/4, 60255-21-1/2, 60255-25, 60255-22-6

• Minimum 16 voltage or current inputs per DFR
  – 120V, 69V, 5A
  – Optional low voltage interface (C37.92)
  – Optional digital per IEC 61850-9-2 and 61869-9-2
  – Accuracy specifications
  – 3-dB bandwidth 3.8 kHz
DFR/PMU Hardware Requirements (cont’d)

• **Timing:** internal GPS, 1 pps input, IRIG-B input
  – 1 μs timing accuracy
  – UTC time
  – Synch and timing signal loss alarms
  – Less than 1 ppm internal clock drift

• **Network interfaces:**
  – Minimum 2 metallic or optical (preferred) Ethernet connectors
    • IEEE 802.3u 100BASE-TX or IEEE802.3ab 1000BASE-T
    • IEEE 802.3u 100BASE-FX or IEEE 802.3z 1000BASE-SX
Communication Requirements

• Interface to PDC through a private IP network (IPv4/IPv6)

• Both IPv4 and IPv6 shall be supported (but not necessarily at the same time from the same port)

• Receive and send real-time data through TCP and UDP ports, user configurable (minimum of two ports)
  – Each port individually configurable

• Communication using both TCP/IP and UDP/IP protocols
  – The streaming PMU data shall use UDP/IP protocol,
  – UDP/IP, configurable destination IP address
  – Capable of sending multicast data
  – Other messaging and non-streaming communications, such as control signals, and DFR records, shall use TCP/IP
Common Functional Requirements

• Flexible and configurable software
  – Enabling intelligent measurement using various inputs

• Expandable design

• Independent PMU and DFR functionality

• Support for multiple data and messaging protocols, such as IEEE C37.118-2005, IEC 61850, DNP 3.0, and OPC.

• Security requirements

• Field upgradability
DFR Functional Requirements

• Recording
  – Transient Recording
    • Sampling rate: minimum 7680 Samples/s
    • Fault record length – 60 seconds @7680 Samples/s
  – Long Term Recording:
    • Sampling rate: minimum 960 Samples/s
    • Pre-fault record length – 16 min
    • Post-fault record length – 16 min
  – Continuous Recording:
    • Minimum requirements as per NERC PRC-002-RFC-01
    • 30 day frequency file based on sliding window
    • One frequency file for each day
    • 30 day RMS envelope file created on single RMS data point, calculated every 2 cycles
    • One RMS file created for each day
    • Available for frequency, real and reactive power, power factor and impedance
DFR Functional Requirements (Cont’d)

• Self monitoring and alarms
• WASA System wide triggering capability
  – Triggers are configurable and parameter driven
    • Over/ Under Current/ Voltage – 3 Phase
    • Over/ Under Current/ Voltage – 1 Phase
    • Positive/Negative/Zero Sequence voltage
    • dP/dt, dQ/dt, df/dt – 1ph/ 3 ph
    • Over/ Under Frequency
    • Rate of change of Voltage/ Current
    • External contact operation
    • Event contact status change
    • Cross trigger signals
• IEEE C37.111 format for DFR data (COMTRADE)
• Minimum storage of 6000 seconds at 7680 samples per second per channel
• FIFO (first in first out) storage overwriting policy
PMU Requirements

- 12, 15, 20, 30, 60, and 120 frames/second
- IEEE C37.118 - 2005
- Multiple data streams to PDCs
  - All data streams independently configurable
    - Which data, data rate, port, …
- Performance requirements
  - IEEE C37.118 Level 1 performance requirement
  - Frequency response
    - < -3dB at 5 Hz;
    - < -40dB at > Nyquist frequency (half of sampling rate);
  - <20 ms latency
- Continuous phasor recording at 30 Samples/s for 30 days
Other Requirements

• Construction Details

• Testing
  – Hardware tests
    • Electrical tests
    • Mechanical tests
    • Environmental tests
  – Performance tests

• Seismic requirements

• Manuals and documentation
For more information on SCE’s Smart Grid strategy, news, and updates, go to: www.sce.com/smartgrid