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

ADVANCED TECHNOLOGY
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Summary

- Specifications for combined DFR/PMU to be used as part 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

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