Alignment of openPDC Deployments with ENTSO-E WAMS Requirements

This document outlines how openPDC-based WAMS deployments at TVA (Tennessee Valley Authority), Dominion Energy, and ONS (Operador Nacional do Sistema Elétrico) align with the core requirements defined by ENTSO-E for Transmission System Operators (TSOs) engaged in wide-area monitoring and control. SSEN (Scottish and Southern Energy Networks Transmission) is a TSO within ENTSO-E, so it has been left out of this document.

1. Real-Time Synchrophasor Data Acquisition

ENTSO-E Requirement: Continuous, high-resolution measurements of voltage, current, frequency, and phase angle for observability and system awareness.

All three TSOs have deployed openPDC to ingest and align PMU data in real time using IEEE C37.118.

The systems provide millisecond-level resolution and timestamp synchronization using GPS clocks, ensuring precise monitoring across large transmission footprints.

2. Data Validation and Quality Control

ENTSO-E Requirement: Ensure reliability and accuracy of input data streams.

openPDC performs real-time validation, dropout detection, and substitution logic to manage data integrity.

In all three deployments, data quality flags are used to trigger filtering and alarms for data loss or latency issues.

3. Data Routing and Redundancy

ENTSO-E Requirement: Resilient architecture capable of streaming data to multiple users or systems.

openPDC has been configured at all three TSOs to stream synchrophasor data to both real-time operators and long-term historians.

Redundant instances are deployed to support failover and regional backup operations, consistent with ENTSO-E's expectations for operational resilience.

4. Support for Cross-Border Data Exchange

ENTSO-E Requirement: Interoperability with regional coordination centers (e.g., Coreso) and neighboring TSOs.

While cross-border exchange was not a primary use case for TVA or Dominion, openPDC's multi-endpoint streaming and protocol flexibility supports this capability.

At ONS, inter-regional visibility is supported across Brazil's interconnected national grid, demonstrating capability for regional coordination.

5. ROCOF and Event Detection

ENTSO-E Requirement: Early detection of disturbances using Rate of Change of Frequency (ROCOF) and event alarms.

TVA and Dominion receive ROCOF data directly from PMUs and forward it via openPDC.

At ONS, openPDC is part of an event detection chain that feeds openHistorian for analysis, alarming, and visualization.

6. Integration with Storage and Visualization Systems

ENTSO-E Requirement: Long-term archiving and visualization for diagnostics, forecasting, and operator support.

All three TSOs integrate openPDC with openHistorian, SCADA systems, and/or custom dashboards.

This meets ENTSO-E's guidance on leveraging WAMS for system planning, outage analysis, and post-event forensics.

7. Modularity and Extensibility

ENTSO-E Requirement: Support for system evolution and future standard compliance.

openPDC deployments at all three TSOs include custom adapters and plugins, allowing for tailored filtering, event tagging, and integration with SCADA.

While openPDC does not natively support IEC 61850 or CIM, adapters or middleware solutions are feasible for aligning with evolving interoperability needs.