Asset Health, Online Monitoring and Safety Enhancements at AEP

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Agenda

- Asset Health Center Project Overview
- Operational Data and Failures
- Improved Safety Procedures
- Failure Prevention Experiences

Project Overview

ASSET HEALTH CENTER

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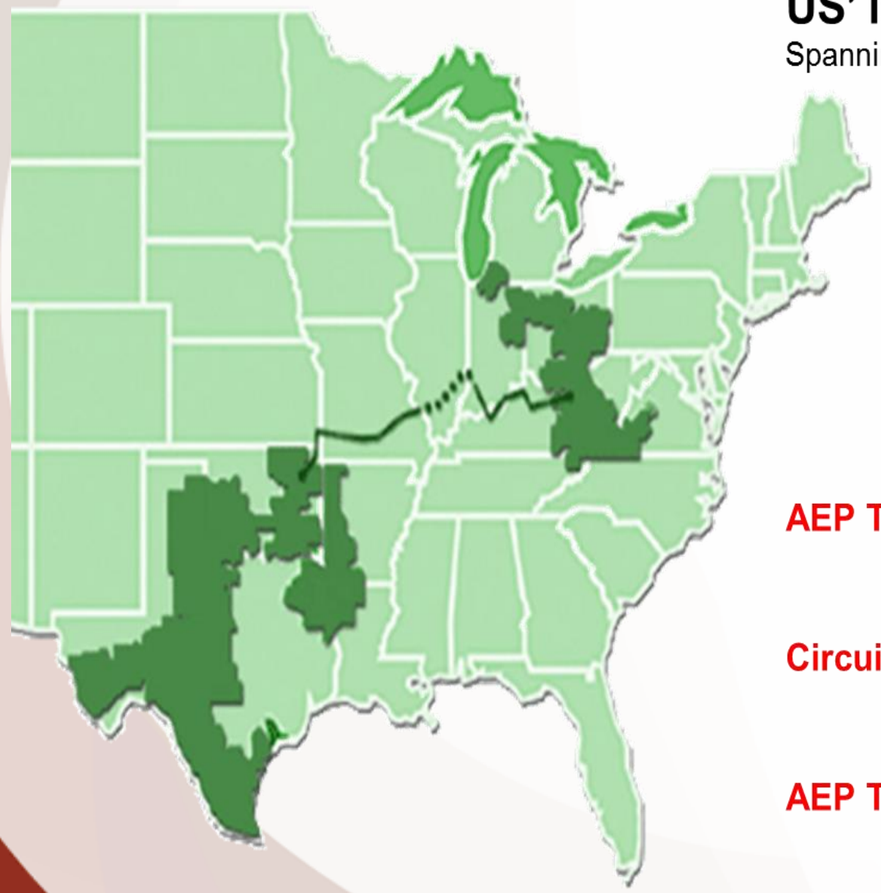
AEP Transmission



US' largest transmission owner

Spanning from Canada to Mexico

11	States
3	Regional transmission operators
200,000	square miles (518,000 square km)
40,000	miles of T-lines (64,000 km)
3,500	T&D substations
5,500	transformers
14,000	circuit breakers

AEP Transformer Age profile

33% > 50yrs old

18% > 60yrs old

Circuit Breakers

33% > 30 yrs old

AEP T-Line Age profile

38% > 60yrs old

Time Based Renewal and Maintenance

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Condition Based Renewal and Maintenance

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Asset Health Center Project

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AEP

Asset Health Center Project

Project Scope

Data Integration and Analytics

Communication Philosophy

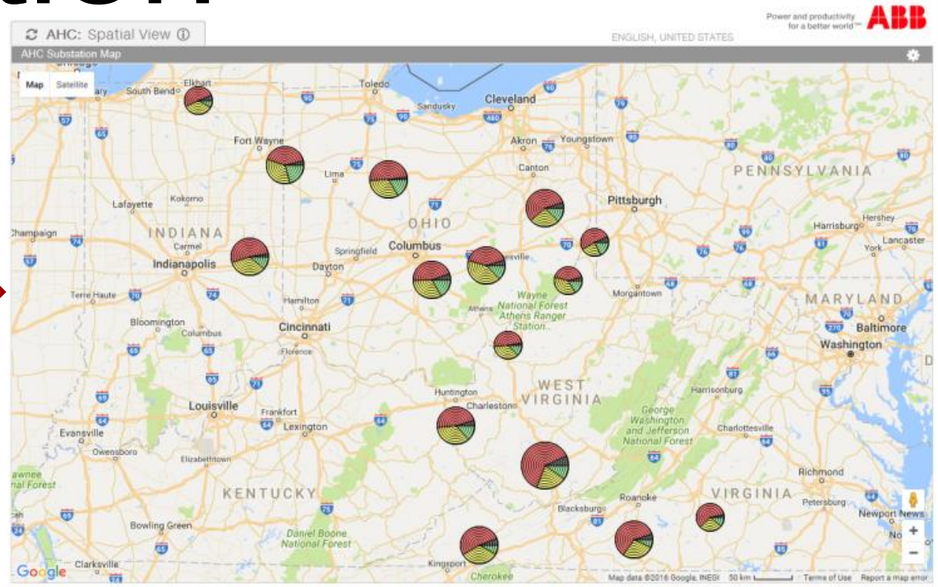
AHC Purpose

- Failure Prevention
- Optimize Maintenance
- Prioritize Renewal

AHC Application

Operational, Sensor, Inspection, and Equipment Data

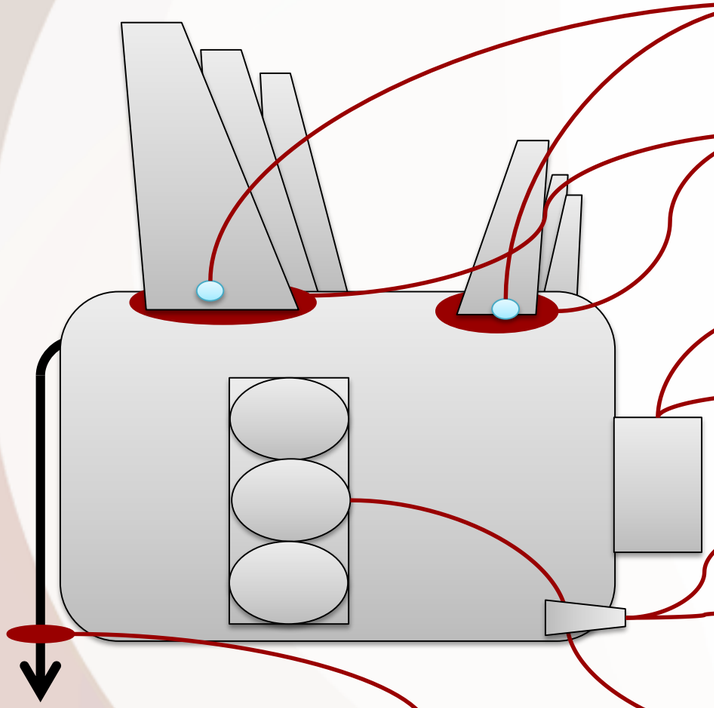
Asset Health Center



Web Based Interface – Data Trending and Visualization

- ❑ Health Score
- ❑ Maintenance Priority
- ❑ Replacement Priority
- ❑ Mobile Application

Online Equipment Monitoring



- Bushing Health
- Partial Discharge
  - UHF
  - Electrical
- Temps and Fan Currents
- Hardwired Alarms
- 8 Gas Monitor
- Composite Gas Monitor
- Temperature controller
- GIC Sensor

→ Data Concentrator

Online Monitoring

OPERATIONAL DATA AND FAILURES

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Original Communication Philosophy

- Do No Harm
- Lessons Learned from Alarms
- Two Alarming Categories
- Lessons Learned from Experiences

Operational Data and Failures

Case 1: Violent transformer failure in Q1 2014

- ❑ 765kV Transformer catastrophically failed shortly after being put into service
- ❑ No one was hurt
- ❑ This was the first fully monitored equipment failure in AEP history
  - UHF Partial discharge showed a distinct “signature” prior to the failure
  - No additional data indication prior to failure

Operational Data and Failures

Case 2: Transformer failure in Q1 2015

- ❑ 765kV Transformer failed after a year in service
- ❑ No one was hurt
- ❑ Second Fully Monitored Failure
  - Fast Acting over 3 Hour Duration
  - UHF Partial discharge showed the same “signature” as previous failure
  - Unit Failed in between Gas Monitor Sample Frequency

Partial Discharge

IMPROVED SAFETY PROCEDURES

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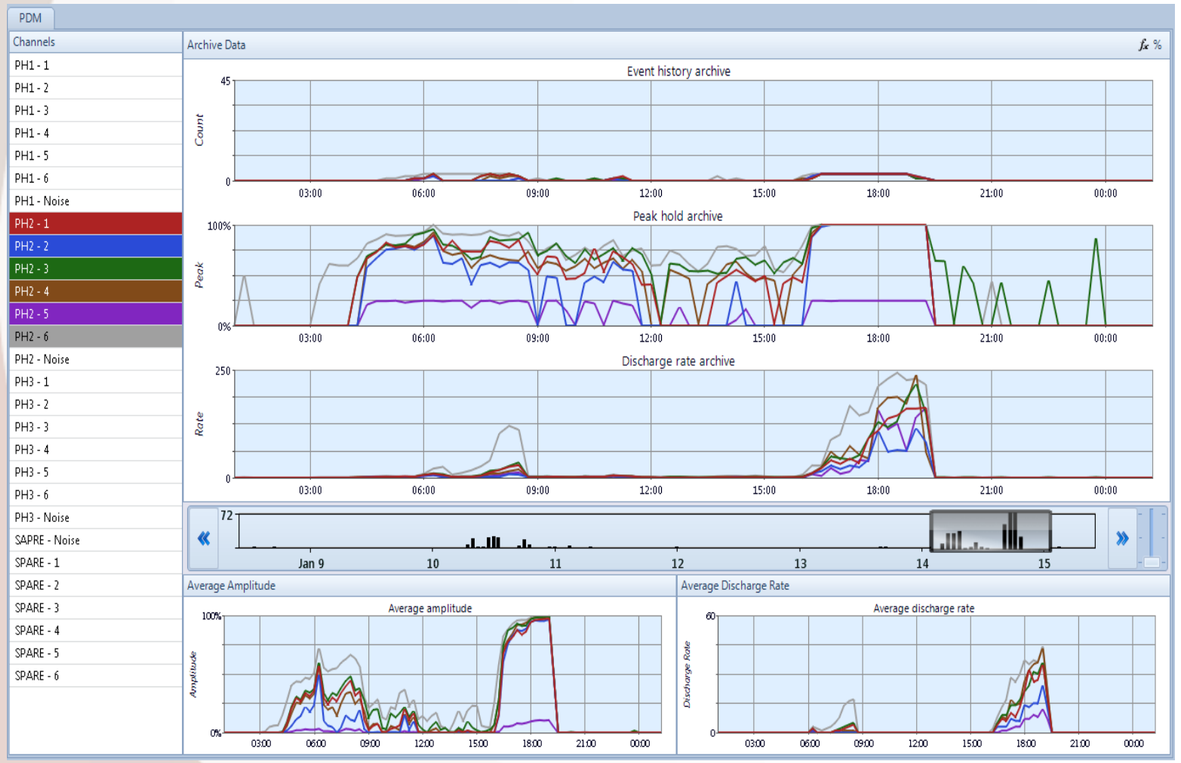
Safety Culture

AEP's number one priority is the safety of it's employees.

- ❑ AEP's defines Zero Harm as: "No one gets hurt and everyone goes home in the same or better condition than they came to work."
- ❑ How can the knowledge gained from the fully monitored failures improve safety procedures in the field?

ZERO Harm

Partial Discharge Alarming



New Alarming Scheme for UHF PD

- ❑ Multi-Sensor Alarms
  - One Sensor at or above a magnitude of 95%
  - Two Sensors at or above a magnitude of 75%
  - Activates Rapid PD Alarm to Transmission Operations
- ❑ Single-Sensor Alarms
  - Alarms/Warnings sent via email

Improved Safety Procedures

Ballistic Wall Structure Scenario

- ❑ Field Personal contacts AHC Team Member
- ❑ Team Reviews Data and Approves Entry
- ❑ If conditions change, the employee is alerted

Sirens and Strobe Lights

- ❑ Activated when there is a PD Alarm
- ❑ Signals Employees to evacuate area

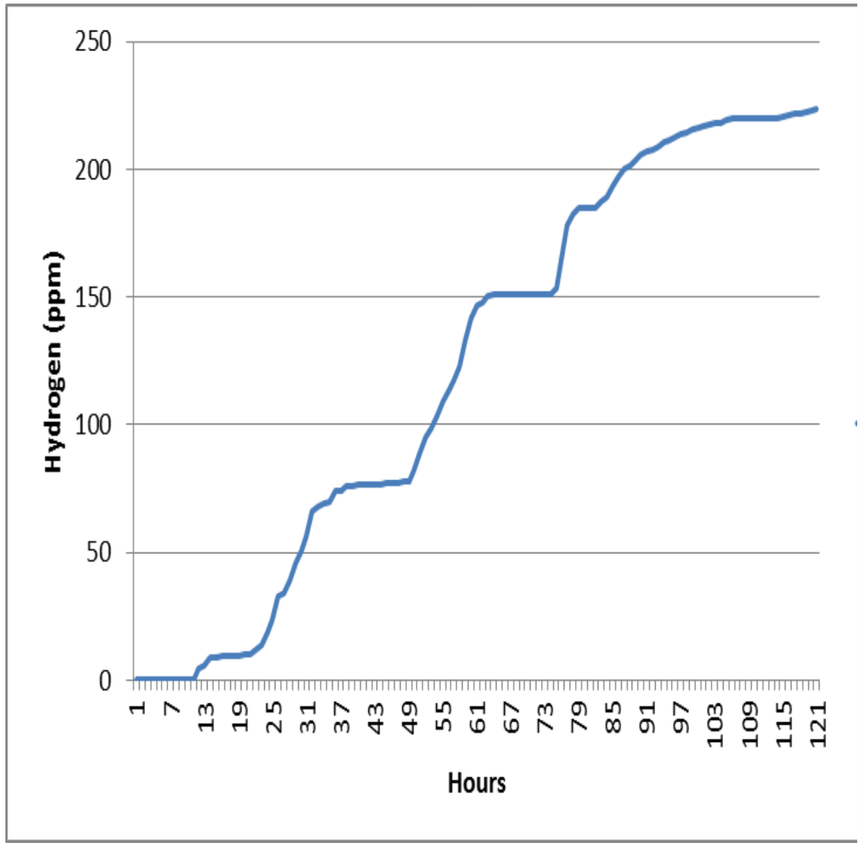
Online Monitoring

FAILURE PREVENTION EXPERIENCES

Failure Prevention Experiences

Case 3: First Failure Prevention in Q2 2014

- ❑ Transformer began gassing
  - Hydrogen and Acetylene levels rose quickly
  - Electrical Partial discharge was seen in conjunction
- ❑ Manual DGA sample was taken
  - Transformer was taken out of service before sample was analyzed
- ❑ Online data was confirmed from manual sample
- ❑ Transformer was confirmed to have loose leads
- ❑ First prevented failure by AEP AHC



Failure Prevention Experiences

Case 4: Failure Prevention in Q1 2016

- ❑ Single Phase 765 Auto Transformer
  - Retrofitted with standard package on 1970s era XFMR
  - High levels of gas, acetylene levels increased
  - Electrical PD Monitor showed high levels of PD
- ❑ Transformer taken out of service, internal inspection
  - Found Micro-sparking on DETC shaft
- ❑ Unit repaired and put back into service
- ❑ Second prevented failure by AHC Team

Failure Prevention Experiences

Case 5: Failure Prevention in Q4 of 2016

- ❑ Spare Phase placed into service acting as Phase 3 in Q3 of 2016
- ❑ Spare Phase showed UHF PD Activity
  - Spare had been in service for ~2 Months
  - Activity confirmed with increased gassing
  - Bucholz Gas Accumulation Alarms
- ❑ Transformer was taken out of service
  - Beginning to investigate
  - ~12 Hour Duration before unit was out of service

Questions?

THANK YOU FOR YOUR TIME

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