“ASSET MANAGEMENT ANALYTICS FOR A SUSTAINABLE GRID”

BY QASIM AZIZ P.E., & GAUTAM SONDE
ABOUT THE AUTHORS

BRIEF BIOS

Qasim Aziz is an Asset Management Consultant in the Asset Management Analytics and Strategy department in CenterPoint Energy based out of Houston, TX. He has more than 20 years’ experience in substations asset management, engineering, protection & controls, T&D planning and program management in the electric power industry.

Gautam Sonde is a Solutions Architect for the Operational and Corporate Analytics team at CenterPoint Energy based out of Houston, TX. He has more than 20 years’ experience in Information Technology. He has been charged with delivery of innovative solutions in several areas such as finance, asset management and smart meter analytics.
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ABSTRACT

Electric Substation related analytics are being used in formulation of asset management strategies in support of a sustainable power grid. This presentation focuses on presenting a methodology around development of analytics for substation assets including transformers, circuit breakers and protective relaying. It discusses use of substation analytics to assess system risk associated with electric assets based on condition and system impact. It describes application of substation related analytics in developing long-term asset management strategies encompassing asset replacements, maintaining adequate levels of Capitalized Emergency Materials (CEM) and best maintenance strategies.

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Electric power industry planned replacements are carried out for several types of substation assets including transformers, breakers, switches etc. Assets are identified and prioritized for replacement based on risk of failure.

Annual capital budget dollars are then allocated for targeted pro-active replacements. Station assets are prioritized for replacement based on analytics information using factors such as vintage, diagnostic test results, probability & impact of failure, O&M cost and design etc.
“NEAR REAL TIME” AWARENESS

- Asset Replacement Strategy
- Spare Assets Strategy
- Asset Maintenance Strategy

THE ELEMENTS

A mixture of elements formulate a successful asset replacement strategy

ONE
Pro-active

TWO
Holistic

THREE
Condition Based

FOUR
Balanced
Substation transformers are important assets in an electric substation. Static devices that operate at primary voltages ranging from 12 kV to 500 kV. These are used to step down electricity from high voltage to a lower voltage level appropriate for distribution to local areas.

Industry-wide age profiles of in-service substation class transformers at all voltage levels shows average age around 33 years while the failure age to be around 28 years.

Condition of core and coils dictate useful life of a transformer. These components undergo operating stresses like over-loading, short circuit, thermal and electro-magnetic effects plus transient and dynamic over-voltage. These stresses cause cumulative and non-reversible degradation to paper insulation inside the transformer.

LTC’s have shorter life cycle than the transformer core assembly. Analytics provide alerts regarding LTC’s that have not crossed neutral for extended periods of time.

On-line monitoring of substation is used for real-time data for operational and condition determination such as insulation degradation etc.

1 Industry-Wide Transformers Database Key Findings and Case Studies – EPRI Product ID: 3002007831
Asset Class Selection – Assets Type Spectrum

High $ - Low Volume

Transformers:
- Count: 60 Auto
- Count: 600 Power
- Average $: $$$$$$$
- Note: More Individual Asset Analysis

Low $ - High Volume

Distribution Breakers:
- Count: 2200 12 kV
- Count: 700 35 kV
- Average $: $
- Note: Less Individual Analysis with Some System Analysis

URD Cable:
- Count: 340,000 spans
- 19,000 loops
- $/Foot: $
- Note: Cable Assessment Program, System Analysis and Work Tracking
Asset Parameters Weightages - Typical

**Transformers**
- Fault levels – 20%
- Age – 18%
- Financials (O&M) – 10%
- Alarms – 3%
- Maintenance Activity – 12%
- Peak Loading – 7%
- Dissolved Gas Analysis – 30%

**D-Breakers**
- Age – 30%
- Financials – 20%
- Ultimate Fault – 25%
- Maintenance Activity – 20%
- Loading – 5%

**T-Breakers**
- Fault levels – 10%
- Misoperations – 10%
- Tank Type – 5%
- Age – 15%
- Financials – 7%
- Operations – 15%
- Maintenance Activity – 10%
- Breaker Type – 10%
- Operating mechanism – 10%
- Interrupting Capability – 8%

**T&D Protective Devices**
- Age (P)
- MTBF (P)
- Financials (P)
- Misoperations (P)
- Type & Obsolescence (P)
- Station Impact (I)
- Bus Configuration (I)
- Protection Scheme (I)
- No. of trips (P)

**Dashboards/Report**

Impact Score = \((40\% \text{ Station Impact}) + (30\% \text{ Protection Scheme}) + (30\% \text{ Bus Configuration})\)

Health Score = 80\% \text{ Sum of all Performance Indices} + 20\% \text{ Age}

Total Score = \((40\% \text{ Impact Score}) + (60\% \text{ Health Score})\)
Simplified Analytics Landscape

**Old Way**
Traditional Data Analytics Technology

- Decision-maker obtaining business intelligence
- Calculation Engine
- Query Results
- Aggregates
- Indexes
- Data Warehouse
- Operational Data Store
- Data in enterprise business applications

- Latency between data creation and analytics usage
- Expensive and infrastructure intensive
- Duplicative and slow

**New Way**
In-memory Data Analytics Technology

- In-memory analytics
- Data in enterprise business applications
- Decision-maker obtaining business intelligence
- Up to 1,000x faster
- No optimizations required
- More data in less space
- Faster business intelligence
Conclusions
PAPER Q&A
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Qasim Aziz – qasim.aziz@centerpointenergy.com
Gautam Sonde – gautam.sonde@centerpointenergy.com

Centerpoint Energy
Houston, Texas