14PESGM2743: Predictive Reliability Analysis Tools Utilizing OMS Data

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PacifiCorp Service Area

Investor owned utility
Subsidiary of MidAmerican Energy Holdings Company
6,447 staff in U.S.
1.8 million customers in six Western states:
Utah (42%)
Oregon (25%)
Wyoming (17%)
Washington (8%)
Idaho (6%)
California (2%)

PacifiCorp Peak Load: 12078 MW
PACW: 4348 MW
80+ Ties with other Balancing Areas
PACE: 7825 MW
50+ Ties with other Balancing Areas
Reliability Analysis History

- Automated outage management system (OMS) implemented in phased approach between 2001 and 2004
- Developed much richer data set for analysis of outage events
- Required addition of outage historian, named Prosper/US
- Outage details surfaced need for data mining methods
- Homegrown tools were the needed, developed by business collaboratively with Information Technology organization
Reliability Toolset History

• Initially began with tabular, then graphical data presentation methods

• Determined methods to display geospatially were needed

• Required evolution to predictive tools to support field and reliability engineers
Reliability Toolset History

- Developed tools for rendering graphics based upon filter criteria
- Used tool extensively to highlight pockets of underperforming areas
- Developed filtering methods to target fuse coordination and underground deterioration opportunities
- Created coordination placement tool, called Isolation Point Analysis (IPA)
- Created underground deterioration inspector, called Underground Wizard
IPA - Introduction

• Purpose
  – The IPA tool is intended to assist TDAP in making quicker and quantifiable fuse coordination recommendations. Additionally, to provide a tool to field engineers to assist in their fuse coordination projects.
  – Provide the ability to virtually implement isolation schemes to view the increase in reliability vs. installation costs.

• Bottom line:
  The functionality of the IPA tool is unique in the fact that it performs more than just reliability viewing. It will display the reliability calculations, suggest where to install devices, and allow you to virtually design a new isolation scheme.

• For more information including a user guide and an example:
  http://pacrat/great/IPA.aspx
IPA – How does the tool work?

- Full connectivity model
- Isolation zone model
- Downstream customer counts
- Segment fault counts by:
  - Outage fault distribution
  - Direct Outage Fault Association
- Separation of momentary and sustained outages
IPA – Primary Calculations

- Segment Fault Counts (SFC)
- Fault Rate (FR) and Faults per Mile (FM)
- Customer Interruptions (CI) for a segment
- CI Reduction of a potential isolation device installed on a segment
Isolation Point Analysis (IPA)

- Single feeder and batch run modes
- Outage association
- Advancements in virtual design and plotting controls
- Cost to benefit plotting schemes
IPA – Results, Plotting and Design

- Momentary and sustained calculations
- Feeder and analysis summations
- Exporting

- Virtual design by removal or addition of existing or new isolation devices
- Control the look of the plot
- View a cost to benefit design plot
IPA - Virtual Isolation Scheme Design

• What’s the purpose of it?
  Provide the ability to add and remove devices to develop a cost effective scheme to improve the reliability of a circuit.

• Remove existing isolation device(s)

• Install a new isolation device(s)

• How do you know the proposed improvements are worth it?
IPA – Design Work

*Gang operated, electronically controlled with two days of labor considered.
IPA – Design Mode

Once you have added a virtual device the Design Mode adds a visual assist in your decision making. Not only can you see the total and average reduction in Customers Interrupted, the tool will show the feeder in one of three colors:

1. Green – represents a virtual feeder that exceeds the design criteria
2. Yellow – represents a virtual feeder that is marginal but doesn’t necessarily fall short of being a realistic decision
3. Red – represents a virtual feeder that falls short of the design criteria

These numbers are reached using criteria entered in the “Cost to Benefit Design Assistant” box. You are able to enter the cost you will pay for a device, the amount of money you are willing to spend per reduction in one Customer Interruption, and a marginal or “borderline” area where you may not meet the requirement but you are forced to place a fuse in a location due to pole locations or other decision making factors.
Outage Fault Association

• Issue
   Long circuits with limited device and segmentation lead to imprecise fault rate calculations.

• Aha moment
   Field engineers typically have substantial location wisdom in supporting field operations or when circuit improvements are being considered.

• Concept
   Provide a way to associate a precise fault location with an outage that had previously only been associated with a device and downstream segment(s).

• Proposal and benefit
   Allows for a more precise segment fault rate calculation with leads to:
   greater precision and accuracy in CI reduction calculations,
   provides better precision of fault locations than simply a device (which could be useful for other maintenance activities, i.e. hazard tree management).

• Storage and availability
   All of the fault associations are stored on our app server in Portland, but as yet are not part of the Prosper/US repository.

   Companion tool to IPA and GREAT
Outage Fault Association

Why is it important?

– More precisely identifying areas with the worst reliability
– More accurate reduction in CI calculations and segment level contributions to reliability
– Simply knowing where faults are occurring... (example time)
– Provide dataset to consider developing reliability centered maintenance (RCM) activities
What is the goal?

- Provide a simple and stable method to associate a fault to a location and store the information for future use.
- Use the combined knowledge of field engineers throughout the company to develop a map of fault locations to better understand where outages are occurring.
- Determine the actual increase in reliability projects years after they are complete.
Underground Wizard

Filters for selecting area, components, interruption patterns significant for analyzing underground system reliability
Underground Wizard

Outage events (donuts) with underground system colorized
Underground Wizard

Underground age distinguished and related to outage events
**Underground Wizard**

Filtering tools lets investigator dig into the local performance.
Underground Wizard

Line sections are highlighted to diagnose best improvement opportunities based on underground failure fault rates within section.
Summary

• PacifiCorp has just scraped the surface of predictive reliability analysis using the rich data sets it has available.
• It has experienced benefits by building upon a solid foundation and allowing business drivers to dictate the next area for improvement.
• I look forward to seeing what the next developments are!