COST MANAGEMENT:
SUBSTATION & TRANSMISSION
TRANSMISSION LINE BREAKER TESTING

INTRODUCTION BY:
Paul Barham
SVP, Delivery Eng Integ Planning Sub & Trans

PRESENTED BY:
Darrell Clifton
Senior Director, Substation & Transmission

February 18, 2019
Informational Only
COST MANAGEMENT

TRANSMISSION BREAKERS

345kV Breaker
Number of Breakers: 80
Purchase Price/Breaker: $210K

138kV Breaker
Number of Breakers: 561
Purchase Price/Breaker: $78K
High voltage transmission breakers are tested using 2 methods:

- Conventional
- Breaker profiling

Comparison of Breaker Testing Methods

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Conventional</th>
<th>Breaker Profiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance Program</td>
<td>Time-based testing process</td>
<td>Condition-based testing process</td>
</tr>
<tr>
<td>Components Tested</td>
<td>Insulation, contact resistance, &amp; timing</td>
<td>Detailed electrical performance data</td>
</tr>
<tr>
<td>Testing Period</td>
<td>~2 days – breaker removed from service</td>
<td>~2 hours – breaker remains in service</td>
</tr>
<tr>
<td>Performance Testing</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Breaker profiling benefits:
- Establishes a standard profile for breaker operating performance
- Most effective test for accessing condition of breaker performance
- Focuses maintenance on the breakers that need it most
- Savings will be used to offset other critical testing & expenses

Breaker profiling man hours and cost savings:
- Annual Cost Savings Results: 2,136 Hours $130,000

### Conventional VS Breaker Profiling Cost Comparison (Annual Expenses)

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Breaker Profiling (New)</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Breakers</td>
<td>128</td>
<td>214</td>
</tr>
<tr>
<td>Man Hours</td>
<td>2,564</td>
<td>428</td>
</tr>
<tr>
<td>Total Average Cost</td>
<td>$156,000</td>
<td>$26,000</td>
</tr>
</tbody>
</table>

Detailed diagnostic testing of more breakers allows for targeted, proactive maintenance, and improved reliability.
Thank You