Circuit Breaker Users Group
Open Session Briefing

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Senior Project Manager
Circuit Breaker Users Group Meeting
June 6, 2012
Presentation Overview

• Safety
• CBUG Mission
• CBUG Issues List
• History; Cornerstone documents
• Operating Experience Review and Analysis
• EPRI Circuit Breaker Initiatives
• Future Meetings
Be Safe !!

• Be aware of surroundings; Avoid suspicious characters

• Travel in groups; Do not walk alone at night

• Stick to well-lit, well-populated areas.

• Take a taxi rather than walking unfamiliar streets.

• Avoid driving / parking
Our Mission

- Provide information, guidance, and tools to help increase reliability, reduce costs, and improve safety.

- Resolve issues via working groups and guidance
- Develop/Maintain preventive maintenance basis
- Information repository (Website; Collaboration tools)
- Contact network
- Workshops and training opportunities
- Facilitate interaction with vendors and suppliers
Circuit Breaker Users Group Issues Brief
EPRI 1021243 (Available to anyone via www.epri.com)

• Better define electrical bus inspection and testing, and monitoring
• Provide Guidance for Motor Control Center Maintenance
• Identify Lessons Learned from Circuit Breaker Replacements
• Provide Guidance for Training of Circuit Breaker Specialists and Program Owners
• Update EPRI guidance on circuit breakers and switchgear
• Review / develop PM Basis Templates
# Historical Background; Circuit Breakers

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1990</td>
<td>EPRI began developing circuit breaker guidance</td>
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<tr>
<td>1994</td>
<td>1st Circuit Breaker Users Group meeting (Magne-Blast)</td>
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<tr>
<td>- 1994</td>
<td>EPRI added meetings for other breaker models</td>
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<tr>
<td>1997</td>
<td>NRC proposed potential generic letter</td>
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<tr>
<td>1998</td>
<td>NEI Task Force formed to respond to NRC</td>
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<tr>
<td>1998</td>
<td>INPO SOER 98-02 issued</td>
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<td>1999</td>
<td>IN 99-13 issued.</td>
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<tr>
<td>2000</td>
<td>EPRI issues 1000014, Circuit Breaker Maintenance Programmatic Considerations</td>
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<tr>
<td>2009?</td>
<td>Breakers topic in Regulatory Information Conference</td>
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Cornerstone Documents for Circuit Breakers

• INPO SOER 98-02 and Training material supplement
  – Circuit Breaker Reliability

• NRC IN 99-13
  – Insights from NRC Inspections of Low and Medium-Voltage Circuit Breaker Maintenance Programs

• NRC Open Letter to the Industry
  – Subject: Insights from NRC Circuit Breaker Maintenance Program Inspections; Letter is an addendum to IN 99-13; Letter received in 1999, but not dated; Reprinted in EPRI 1000014

• EPRI 1000014
  – Circuit Breaker Maintenance Programmatic Considerations
Common Cause Analysis

<table>
<thead>
<tr>
<th>Number of Events</th>
<th>Cause Code Description</th>
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<tbody>
<tr>
<td>16</td>
<td>PM deficiency</td>
</tr>
<tr>
<td>14</td>
<td>Human Performance</td>
</tr>
<tr>
<td>10</td>
<td>Defective Part</td>
</tr>
<tr>
<td>12</td>
<td>Indeterminate</td>
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<tr>
<td>6</td>
<td>Design deficiency</td>
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<tr>
<td>3</td>
<td>Procedure deficiency</td>
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OE Review - PM Deficiencies

• Failed fuse on PT secondary; Reactor scram; Sequoyah
• Failed relay in control circuit; EDG output breaker; Limerick
• DS-416; Binding of trip shaft and trip latch; Hardened grease; South Texas
• Update on Farley bus failure; Farley; May 2011
• Anderol grease hardening on HK; Comanche Peak
• Loose wiring at PT; Extended outage 4 days; River Bend
• Update on Magne-Blast arc chute failure at STP; Nov 2010
• Anderol grease hardening on K-Line; Catawba (Gene Black to discuss)
• Breaker-Cubicle issues with AK-25s; Hatch; (Request Ashok Vora to discuss)
OE Review – Procedure Deficiencies

• Inadequate cleaning of inertia latch and pivot pin on DB-50; Indian Point
• Asbestos found during overhaul of K-Line & Magne-Blast; Salem
OE Review – Indeterminate

- Breaker fault; Unknown 480 V breaker; Seabrook
- Failure of two Eaton vacuum breakers after 6 year PM; Hatch; Request briefing
- Magne-Blast failure; Cause unclear; VC Summer
- HK; Vogtle; Relay or the breaker?
- DS-206 failed to fully open; Byron
- Finger clusters damaged and off bushing; Powell vacuum; Calvert Cliffs
- Intermittent trips; Ft. Calhoun.
- Update on DS-416 failure at Vogtle; Likely cause of breaker opening related to recently installed solid state protection system under-voltage driver circuit board. April 2011
OE Review – Human Performance

• Half scram due to radio transmitter in vicinity of susceptible equipment; Grand Gulf
• Reactor trip; Short circuit while performing maintenance; Palisades
• Safety: Twice found 4KV voltage on stabs; Robinson
• Safety: Improperly hung clearance tags; Robinson
• 50% Power reduction due to screwdriver shorting terminals; Palo Verde
OE Review - Defective Parts

- Reactor trip due to failed relay coil in RCP circuit; Robinson
- ABB Control device failure; Breaker type unknown; Comanche Peak; Request briefing from Al Garza
OE Review - Design Deficiency

• Update on Fort Calhoun fault/fire from breaker-to-cubicle design deficiency; June 2011 failure

• Replaced thermal-magnetic MCCB with solid state after considering temperature increases in a postulated event; Oconee (Request briefing from Duke)

• Insufficient margin on instantaneous MCCB setting for large cyclic load; Quad Cities

• Supply breaker tripping on instantaneous due to trip setting calculation; South Texas; Request briefing from Rodrigo
OE Analysis

- Two largest contributors to common cause: Human Performance and PM deficiency
- Two events with aging of Anderol grease
- 11 Human performance events including 1 plant trip and 2 power reductions
- PT fuse/fuse clips and wiring; 2 events; One reactor scram
- EDG output breaker control relay failure (FMOP engine)
- Key OE updates on previous failures: STP Magne-Blast arc chute failure; Ft Calhoun breaker-cubicle fault; Farley bus failure
OE Analysis – Power Reductions

• PTs
  – Scram due to failed fuse on PT (Sequoyah)
  – Outage ext: Loose wiring; PT fuse holders; Outage extension only (River Bend)
OE Analysis – Power Reductions

• Human Performance
  – Scram due to worker practices; Palisades
  – Half scram; Use of Radio transmitter; Grand Gulf
  – 50% power reduction due to worker practices; Palo Verde
  – 2% power reduction; Human performance; Catawba

• Scram due to relay in RCP control circuit; Robinson
• Potential cable failure?? May 24th; River Bend
EPRI Circuit Breaker Initiatives

• Guidance for Development of Circuit Breaker Specialists
  – Mike Tulay will discuss this morning
  – Review and comments requested by June 15th (1 week)

• Revision of K-Line PM and Overhaul guidance
  – PM in progress; Review and comments requested
  – Overhaul; Sept 12-13; EPRI offices in Charlotte, NC

• Motor control center (MCC) maintenance
  – Planned future project
EPRI Circuit Breaker Initiatives

• Lessons learned from Exelon bus inspections

  – Exelon’s extensive inspection and testing program represents **a unique and significant opportunity** for EPRI and the industry to capture data, photographs, and lessons learned.

  – EPRI working with Exelon to publish this information
    • Tom Figiel (Exelon) and Jim Bothwell (Consultant)
Future Meeting Locations and Dates

• Dates - Target dates: First two weeks in June
  – Week of June 3\textsuperscript{rd} or June 10\textsuperscript{th} (No Fathers Day Conflict)

• Location - Primary considerations for meeting location
  – Cost
  – Adjacent to switchgear/breaker facility (potential tours)
  – Centralized location (US and center-city)
  – Identified one year in advance
Questions?