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UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Farley Breakers: Lessons Learned

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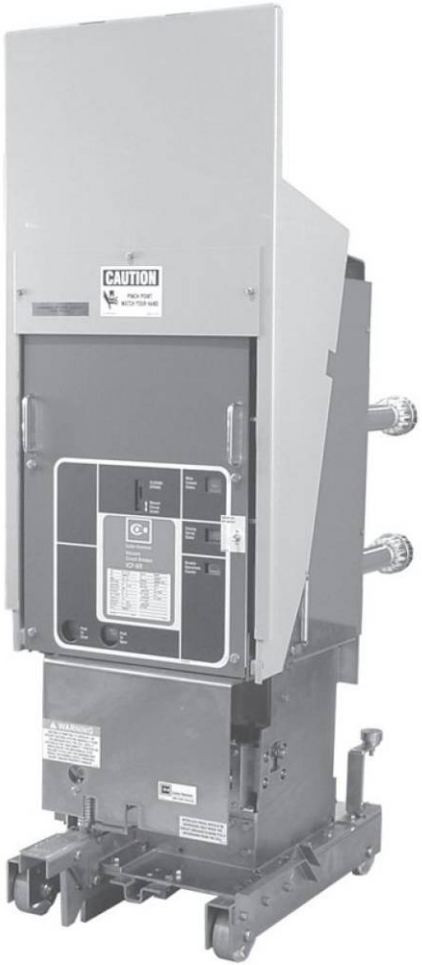
TOPIC AREAS

1. Quick History: Farley Breaker Replacement
2. Farley Breaker Failures
   - NRC Response
   - Fit up Issues
   - Quality Issues
3. Farley Breaker Lessons Learned

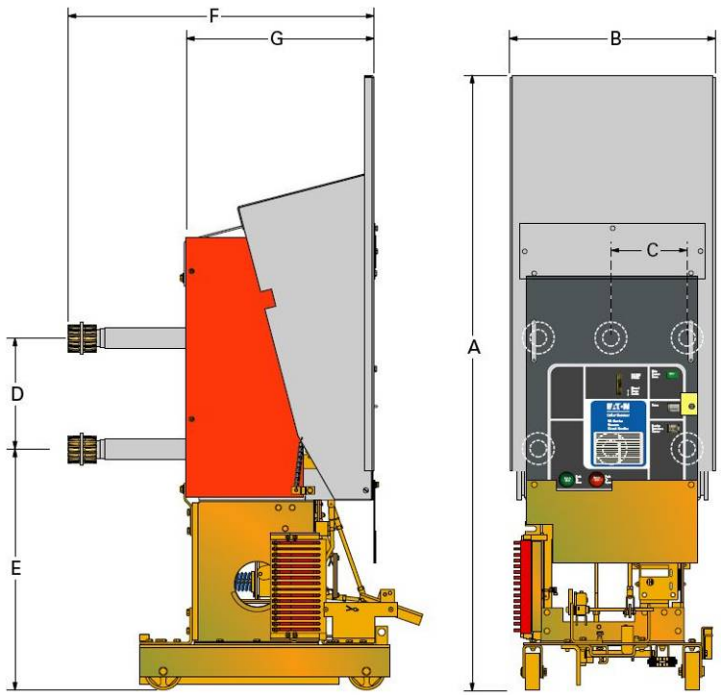
Quick History: Farley Breaker Replacement

- Farley purchased replacement breakers for aging Allis-Chalmers breakers from Areva
- Breakers manufactured in Cabo Rojo, Puerto Rico, by Eaton Cutler-Hammer (ECH) as commercial grade
- Breakers shipped to South Carolina for final assembly by ECH
- Areva dedicated the breakers at ECH facility (Method 1 – Special Tests and Inspections)
- Areva had access to ECH's proprietary design documents which simplified dedication



Farley Breaker Replacement (Cont'd)

- 4.16KV vacuum circuit breakers. Type MA-VR350 used in Safety-Related systems
- Vacuum replacements for obsolete air-magnetic technology
- Designed as a direct replacement for Allis-Chalmers breakers
- Designed so that no modification required to original Allis-Chalmers cubicle



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Farley Breaker Failures

- February 2007: Switch contacts did not operate properly, leading to incorrect indications (SW)
  - Caused by incorrect Mechanism Operated Cell (MOC) switch alignment
- April 2007: Switch contacts did not operate properly, leading to incorrect indications (EDG)
  - Caused by incorrect MOC switch alignment
- September 2007: Breaker failed to close (CCW)
  - Manipulation of foot pedal placed breaker in trip-free condition
- October 2007: Breaker failed to close (RHR)
  - Mis-aligned latch check switch arm precluded a micro switch from making up.
- October 2007: Breaker failed to close during testing (Station Service Transformer)
  - Anti-pump relay found out of socket

Farley Breaker Failures

- Many fit up and quality issues identified
- Minimal Vendor-Licensee Engineering interface
- Farley had “unofficial” assurance that the breakers would fit
- Purchase requirement to test-fit first breaker removed from POs.

Figure 4-4 Insertion of MA-VR

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Farley Breaker Failures: NRC Response

- Farley experienced multiple breaker failures in Safety-Related systems in 2007
  - NRC conducted 95001 Augmented Inspection (AIT)
  - NRC conducted vendor inspection of Areva at Eaton Cutler-Hammer (ECH) facility

- Farley experienced more failures in 2007 resulting in a Degraded Cornerstone
  - NRC conducted 95002 Supplemental inspection (Additional NRC Oversight)

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Farley Breaker Failures: NRC Response (Cont'd)

Vendor Inspection of Areva determined that vendor's process was adequate with the exception of the following:

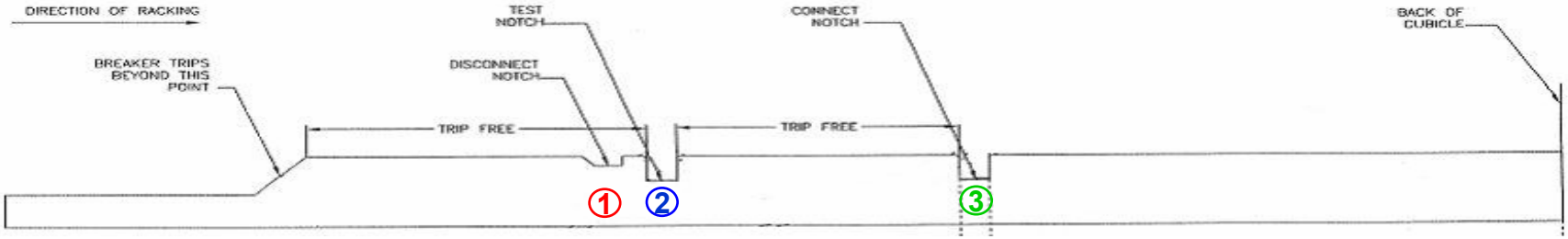
1. Two examples of functional testing protocol deficiencies
2. Use of ECH individuals not appropriately trained and indoctrinated
3. Identified Areva's lack of M&TE control at the ECH facility
4. Two examples where Areva failed to adequately document the basis for acceptability of critical design differences between the original and replacement items
5. Procedural deficiency that introduces the possibility of circumventing the reporting requirements set forth in Part 21

Farley Breaker Failures: Fit up Issues

Figure 4-11 Disconnect Position ①

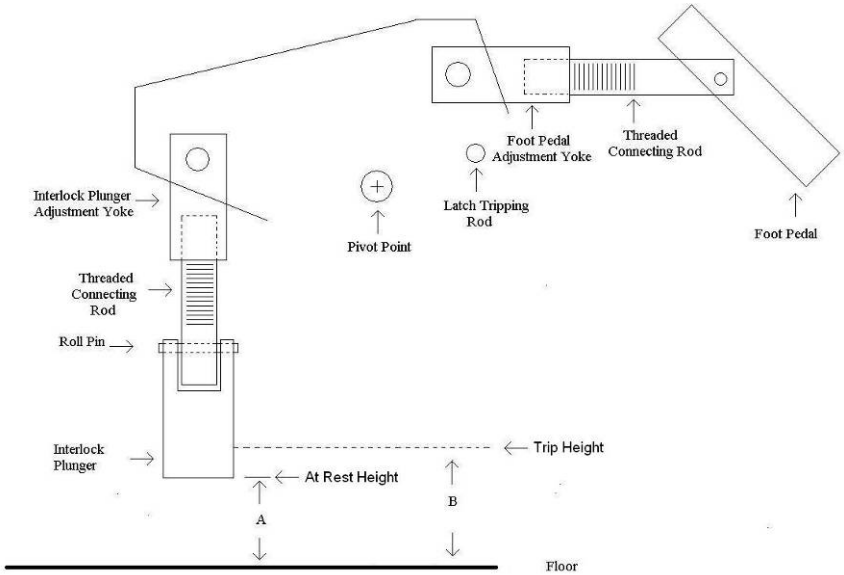
Figure 4-5 MA-VR Test Position ②

Figure 4-10 Connected Position ③



Farley Breaker Failures: Fit up Issues (Cont'd)

- Improper manipulation of foot pedal rendered breaker inoperable



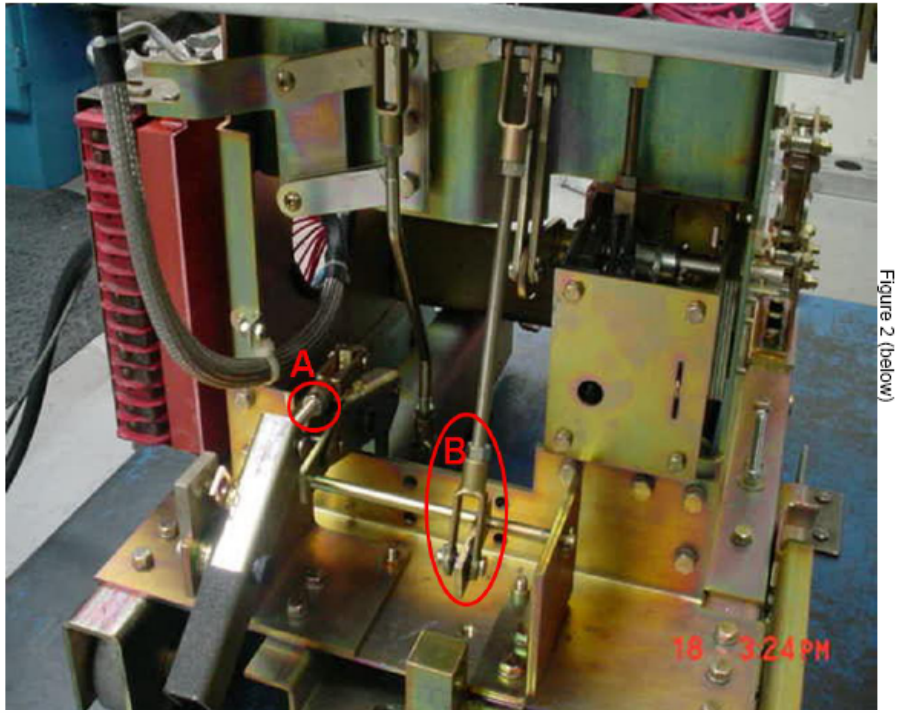
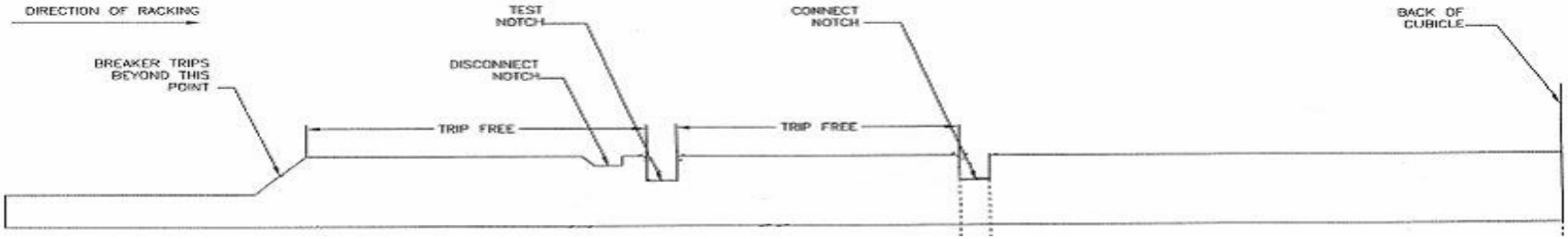


Figure 2 (below)



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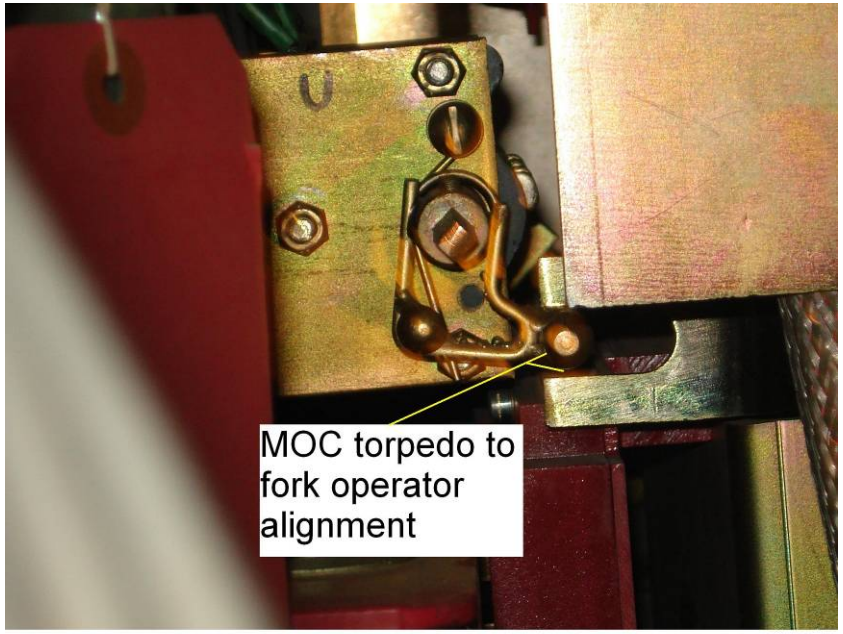
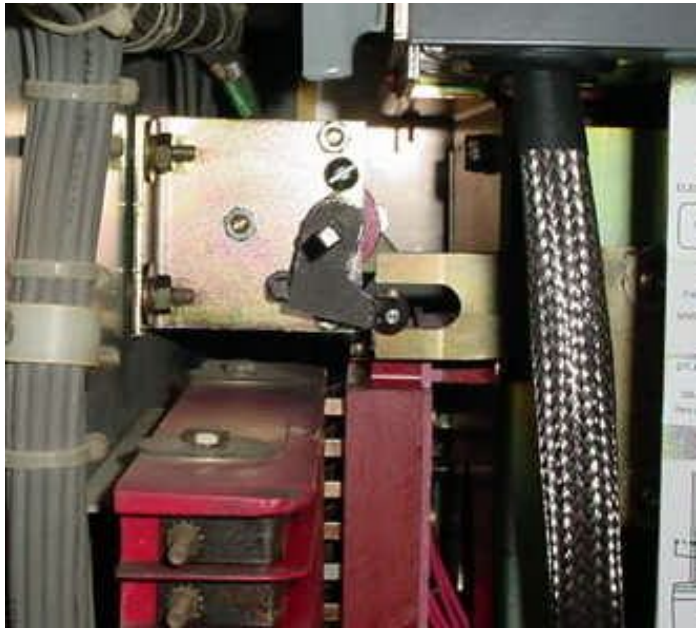
Farley Breaker Failures: Fit up Issues (Cont'd)

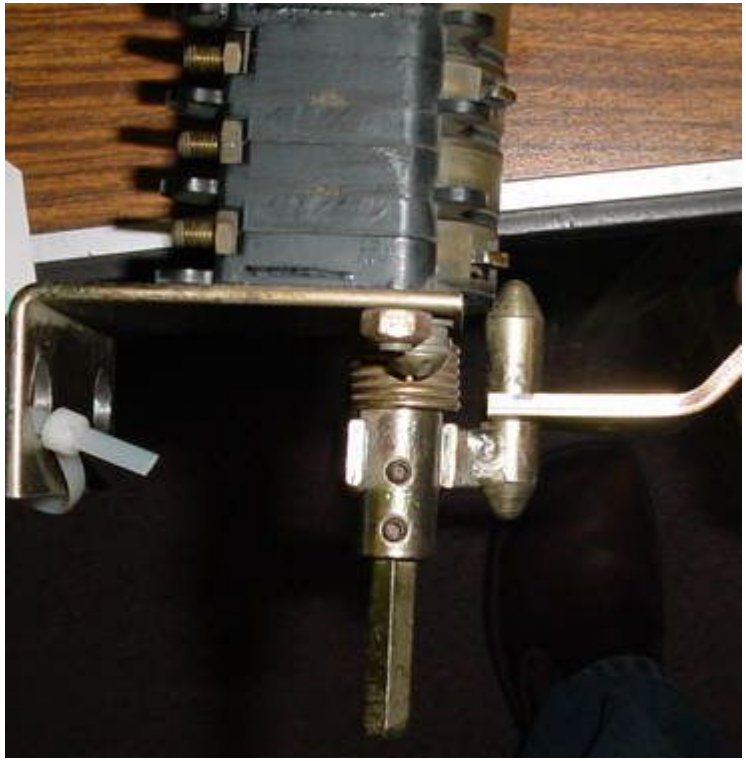
- Mechanism Operated Cell (MOC) Switch Alignment

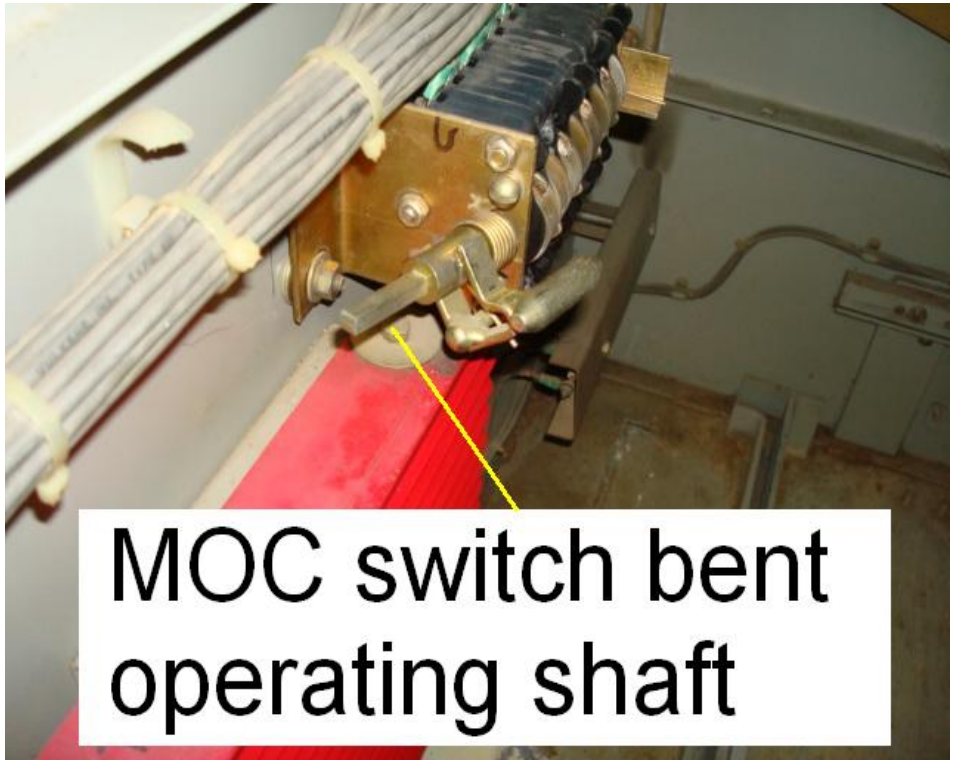




Farley Breaker Failures: Fit up Issues (Cont'd)

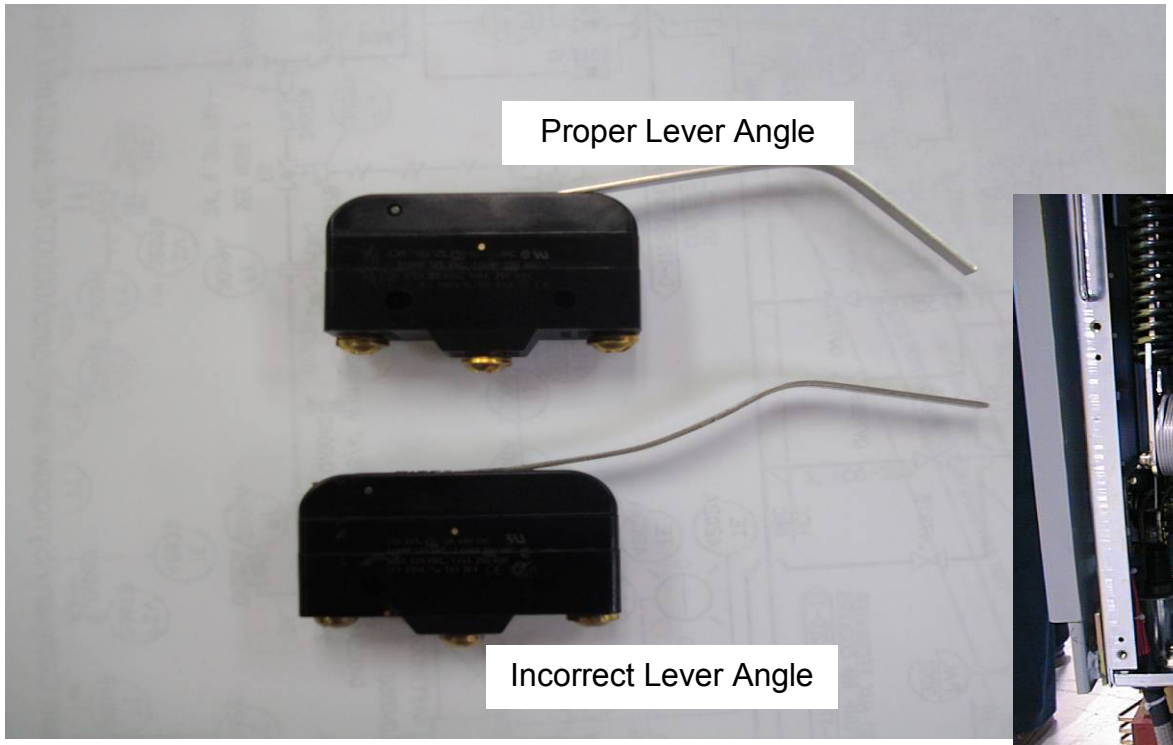
- MOC switch damage during racking

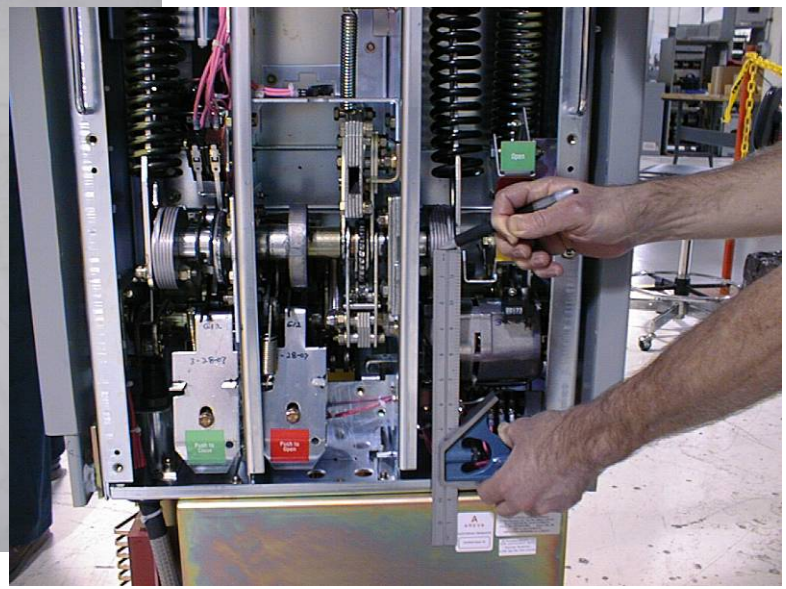




Farley Breaker Failures: Quality Issues

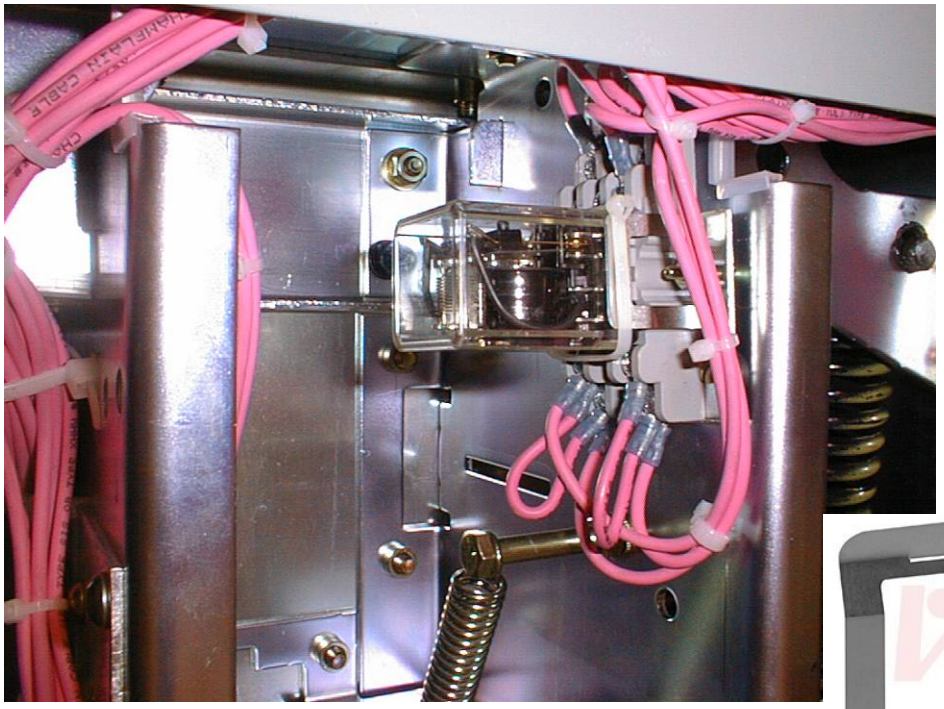
- Latch Check Switch improperly bent

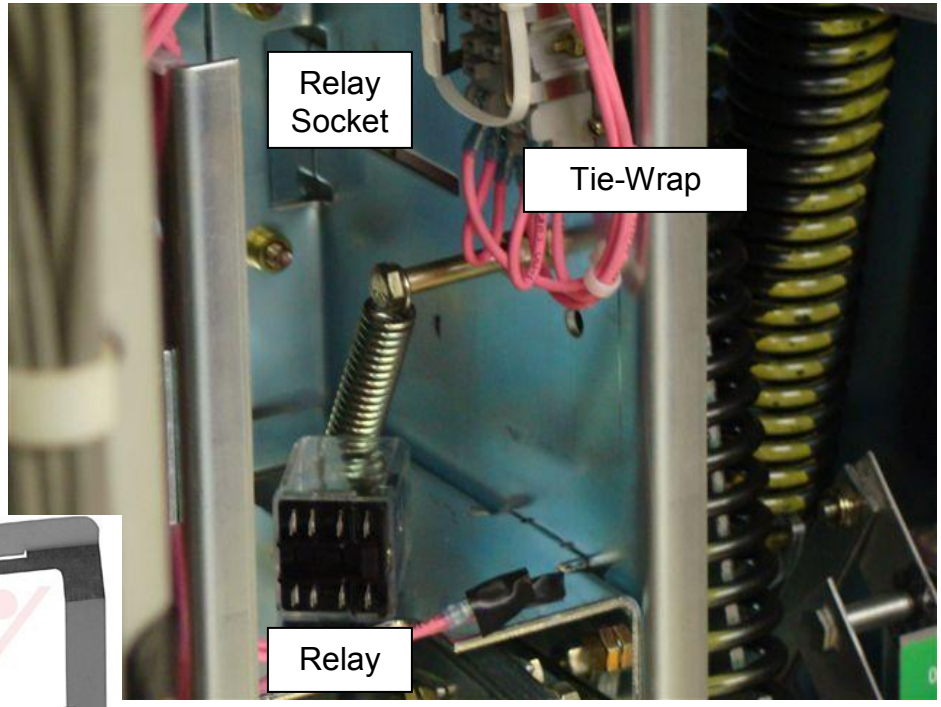




Farley Breaker Failures: Quality Issues (Cont'd)

- Anti-pump relay found out of socket

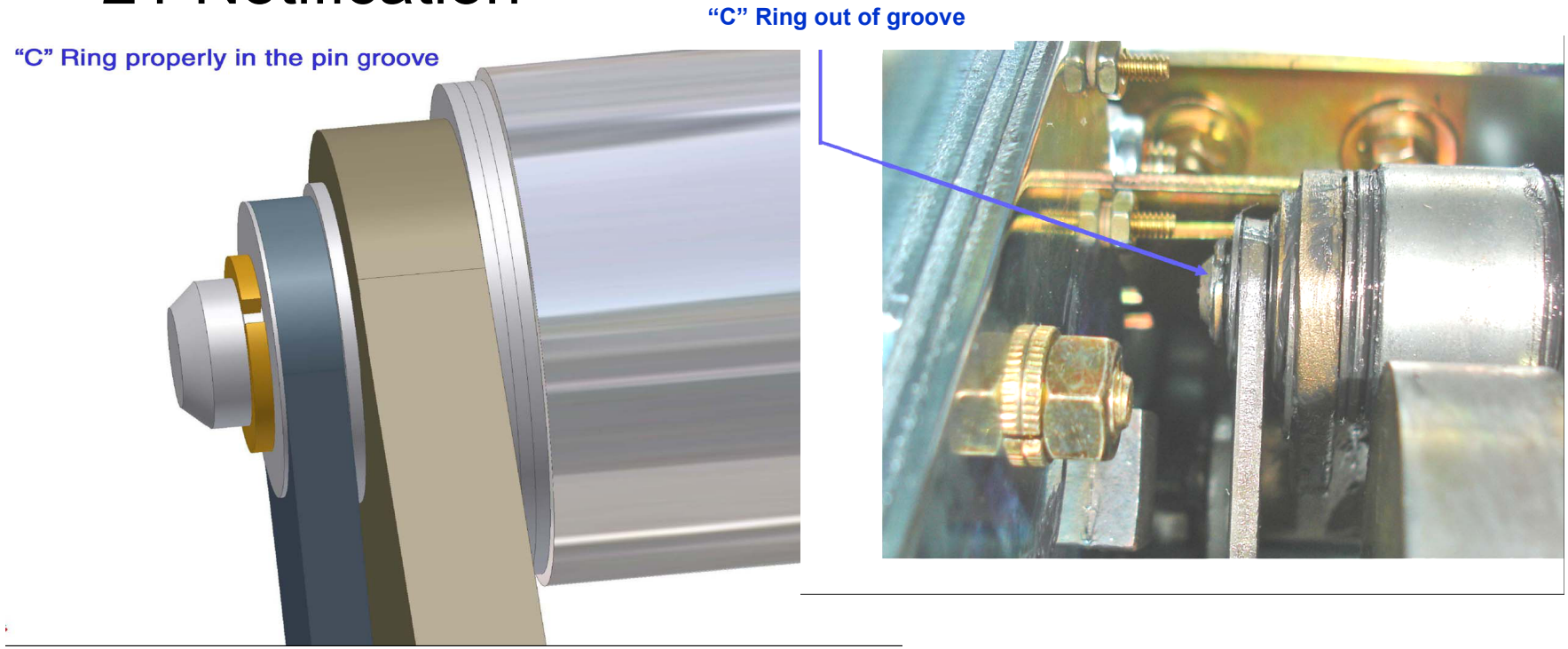




Spring Clip

Farley Breaker Failures: Quality Issues (Cont'd)

- "C" Ring on Main Link Roller: Led to Part 21 Notification



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Farley Breaker Lessons Learned

- Farley performed extensive Root-Cause Analyses for 95002 inspection
- Farley determined that many factors led to breaker failures including:
  - Deficiencies in design
  - Inadequate Vendor Oversight
  - Failure to apply Operating Experience
  - Shortfalls in knowledge and training
  - Procedural deficiencies for receipt, installation, testing, and maintenance
  - Inadequate Corrective Actions
  - Management Philosophy

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Farley Breaker Lessons Learned (Cont'd)

- Initial dedication was inadequate
  - Critical Characteristics were not extensive enough to ensure proper Fit up or catch Quality issues
  - Inadequate **Engineering** involvement from Farley
  - Failures resulted in Design Changes
- Failures could have been avoided with more rigorous checks during **Procurement** and **Receipt Inspection**

Questions or Comments?

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References can be found on the NRC website:

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