ACRS Briefing: Brunswick Nuclear Power Plant Emergency Diesel Generator Commercial Grade Dedication Finding

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Allen Bradley 700-RTC Relay



Allen Bradley 700-RTC Relay Internals







TIMELINE

- 3/17/15 Emergency diesel generator (EDG)3 output breaker fails to close during LOOP portion of LOOP/LOCA test
- 3/18 New RCR and RCR-X Allen Bradley 700-RTC relays are installed, EDG3 passes LOOP/LOCA test satisfactorily
- 3/19-21– EDG4 taken out of service for maintenance, RCR relay is proactively replaced. EDG4 LOOP test performed, output breaker attempted to close four times (chattered) before finally closing
- 3/21 all 9 Allen Bradley 700-RTC relays in stock were bench tested and all chattered
- 3/22 EDG4 original RCR relay reinstalled, no chattering
- 3/23 Due to EDG4 issues, EDG3 relay was re-tested and this time failed due to relay chatter. Licensee installed a suppressive diode across the RCR-X relay to prevent electromagnetic interference (EMI) determined to be the cause of the relay chatter. It was later determined that the installation of a recorder across the RCR-X relay had acted as a suppression device, masking EMI and resulting in a SAT test on 3/18



What causes the trip of the output breaker -

On a LOOP, the RCR relay has a 0.7 second time delay between the time the DG output breaker is tripped and when it can reclose (breaker itself takes longer).

The RCR relay energizes first on an emergency diesel start signal, closing the contact to energize the RCR-X relay.

The RCR-X relay energizes to close the DG output breaker. DG3 passed the LOOP/LOCA portion of the test where the DG is originally in standby when the output breaker is closed, but **failed the subsequent LOOP portion of the test where the DG is running when the output breaker is opened and then recloses.** The failure occurred when the breaker closed and reopened several times, causing an anti-pump lockout, and a trip of the output breaker.

Issue

Testing confirmed that the 'new' series of Allen Bradley relays had a complex programmable logic device (CPLD) instead of the old style 16 pin Motorola timing IC chip, and were now susceptible to 'DC Inductive Kick' produced by the downstream RCR-X relay when it de-energizes.

5/1/15, Nuclear Logistics Inc. (NLI) issues a Part 21, stating that Allen Bradley 700-RTC relays had undergone an unannounced design change by the manufacturer sometime in the 2009-2010 timeframe.

These relays are commercial grade items. Brunswick commercial grade dedication did not detect the vendor design change.

A CPLD meets the NEI definition of a 'digital-device' per NEI guidance 01-01

What Happened Next

- PI&R follow-up inspection conducted week of June 15
- This issue was complex and encompassed several different aspects to include:
 - Design control
 - Operability of the other diesels
 - Past operating experience (North Anna, Diablo Canyon, and Vogtle). Same Brunswick EDG 3 relay chattered in 2013; however, breaker still closed
 - Duke commercial grade dedication processes
 - Vendor issues for both relay manufacturers and commercial grade dedication entities
 - Part 21 reporting
 - Cyber issues with the introduction of digital assets

Where We Ended Up

RII issued two GREEN, NRC Identified violations to Brunswick for:

- Failure to meet requirements of 10CFR50 App. B, Criterion III Design Control
- Failure to meet the requirements of 10CFR50 App. B, Criterion XVI – Corrective Action, more specifically for failure to promptly identify conditions adverse to quality, one of which was significant

HQs issued the following generic communications:

- "The Operating Experience Note," #008, July 2015 included an article concerning the subject relays
- Issued OpE COMM in August 2015 detailing the BNP issue
- Issued IN 16-01 and a RIS concerning Commercial Grade Dedication

Questions