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Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: QualTech NP Response to 10CFR Part 21 notification on Allen Bradley Timing Relays, Event # 49911, Docket No. 99901414

Dear Sir or Madam:

This letter provides QualTech NP's response to the subject 10CFR Part 21 notification filed by Entergy, Waterford Steam Electric Station. The subject Part 21 notice from Waterford stated that the subject relays would spuriously and intermittently de-energize. The report further stated that manufacturing deficiencies concerning poor quality solder connections, and a capacitor coupled with operating near the maximum specified operational temperature resulted in accelerated aging of the subcomponents within the relay. Although implied, the Part 21 did not draw a definitive conclusion that the failure mode (spurious/intermittent de-energizing of the relay) was caused by these manufacturing deficiencies under the operating conditions for the specific application.

Based on the subject Part 21 details, supporting documents and subsequent discussions with plant personnel the following information is provided:

1) Relays are installed in fire rated/sealed panels (no ventilation, cooling or intentional air movement in the panel).
2) There has been a total of 5 failures, all that failed are located near the top, right hand side of the panel.
3) Relays are continuously energized in a 118°F to 125°F ambient temperature.
4) Relays are continuously energized at or near maximum coil voltage ratings (134 VDC vs 137.5 VDC, the manufacturer's specified upper limit).
5) Waterford could not replicate failure at room temperature bench testing.
6) All failures occurred after a minimum of three years in service.
7) Per Waterford, the Fitzpatrick plant also use these relays but at a lower ambient temperature, and has not had any failures of this type.

Waterford sent two of the five failed relays to two independent laboratories for evaluation and one of the five to QualTech NP for evaluation (all reports are on file at QualTech NP). A combined summary from these three reports follows:

1) The failure could not be replicated by any laboratory, even when exposed to 140°F (maximum allowed by OEM) at high line voltage for weeks at a time (Note: QTNP used an air-circulating chamber for this testing).
2) Soldering joint's quality was sub-par however could not be proven as the cause of the reported failures.
3) All relays functionally operated to OEM's published specifications.
4) Relays plastic housing's color changed which is typical for high localized temperatures for an extended period of time.
5) Review of electrolytic capacitors showed that the gel within the electrolytic capacitors, which is responsible for the "self-healing" attribute to recover from voltage spikes, had prematurely dried out. This is consistent with accelerated aging caused by exposure to continuous high temperatures.

These results showed that no laboratory could replicate the described failure or identify any direct cause of failure. Poor or marginal solder joint quality was observed along with signs of excessive heat, which was likely due to several factors including lack of air circulation in the panel, continuous ambient temperatures near the maximum

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rated temperature, and the relays being continuously energized at or near maximum line rated voltages. These combined factors could result in even higher internal temperatures which would further exasperate aging conditions and possibly cause the reported failure mechanism. Also note that although the maximum rated temperature for the relay is 140°F and maximum rated coil (control) voltage is 137.5 VDC the manufacturer does not define a service life at these operating conditions; thus, there is no basis for assuming a relatively long service life at the plant specified conditions.

All capacitors that were identified as being outside of the capacitor's OEM specifications were the result of symptoms consistent with end-of-life conditions as a result of thermal aging. Whether or not the conjecture of broken seals on the electrolytic capacitor contributed to the failure mechanism is true, the only difference is the amount of time until the capacitors would fail (they degrade slower at lower ambient conditions and at lower power line voltages).

QualTech NP's conclusion is that although marginal solder quality and a degraded electrolytic capacitor was found, there is no link to the reported failure. In general, even with the poor solder quality and degraded capacitor, the parts worked within manufacture ratings. So the only consistent conjecture is real time thermal aging that provided the expected results of drying out gel materials which degrade the performance of the electrolytic capacitors.

QualTech NP therefore does not consider this a part failure due to flaws in design, materials, or manufacturing process since they operated per specification in all cases at rated conditions and showed no signs of invalidating the existing qualification. Thus, we consider this to be an application induced condition resulting in premature aging.

If you have any questions or wish to discuss this further, please call me at 513-528-7900 x 2176

Respectfully,

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