UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PLANT SYSTEMS BRANCH

ENVIRONMENTAL QUALIFICATION OF TAPED SPLICES

FOR USE IN INSTRUMENTATION CIRCUITS SUBJECTED

TO HARSH ENVIRONMENTS

COOPER NUCLEAR STATION

DOCKET NO. 50-298

By letter dated July 31, 1990, Nebraska Public Power District (NPPD) informed Region IV that tape splices were installed in instrument circuits subject to harsh environments at the Cooper Nuclear Station (CNS). By letter dated August 31, 1990, Region IV requested that NPPD provide an evaluation of the qualification of these tape splices. By letter dated September 12, 1990, NPPD provided this evaluation.

The licensee contends that Patel test report PEI-TR-870200-2, along with an analysis, constitutes qualification of the splices in accordance with 10 CFR 50.49 (f). Test PEI-TR-870200-2 was performed to substantiate the qualification of the tape splices over braided wires. The splices tested in PEI-TR-870200-2 were neither thermally aged nor irradiated prior to this test.

The licensee's position is that since another Patel test report (PEI-TR-842900-1) included aged tape splices, it was not necessary to use aged splices for test PEI-TR-870200-2. (PEI-TR-842900-1 was evaluated under TAC No. M75348 and found to be unacceptable to substantiate qualification of tape splices used in instrument circuits subject to a harsh environments.)

We have completed our review of the information provided by the licensee which included test report PEI-TR-870200-2 and an accompanying analysis. The analysis included consideration of test report PEI-TR-842900-1. It is our understanding that the licensee's intentions are to use the two test reports together (i.e., PEI-TR-842900-1 and PEI-TR-870200-2) to demonstrate environmental qualification of Okonite T95/35 tape splices.

The stated objective of the test program represented by test report PEI-TR-870200-2 was to demonstrate the operability of Limitorque control and power wiring and Okonite tape splices, when subjected to a steam accident and functional simulation. However, neither in the introduction, nor in Figure 1 of the report, are two of the items tested sufficiently identified as they need to be, in order for the test results to be transferable to identical items in similiar environments. The two items in question are (1) Limitorque switch control wire (black braid) and (2) Limitorque motor (power) lead wire (yellow braid). On the other hand, the lead wire that is not a test specimen, described

as Rockbestos Firewall SIS 16 AWG 600V Nuclear Cable, and the Okonite T95/35 tape splices, which are test specimens, are identified in a manner that will provide for subsequent comparision with identical items in similiar environments if the need arises. Nevertheless, we recognize that the primary item of interest is the Okonite T95/35 tape splice which is sufficiently identified, and is the subject of this evaluation.

The NRC staff previously reviewed test report No. PEI-TR-842900-1. As a result of that review the staff concluded that the test report does not demonstrate qualification of Okonite T95/35 tape splices for instrumentation circuits. This conclusion is documented in a letter dated May 16, 1990, from Gary M. Holahan, Acting Director, Division of Reactor Projects - III, IV, V and Special Projects, Office of Nuclear Regulations, to Samuel J. Collins and Leonard J. Callan, Directors, Divisions of Reactor Projects, Region IV and Reactor Safety, Region IV, respectively. The primary reason for the staff's conclusion was that the test report does not contain functional performance data (i.e., insulation resistance) for the specimens during the LOCA simulation.

The staff has also reviewed the additional information provided by the licensee in a submittal entitled "Evaluation of the Environmental Qualification of Okonite T95/35 Tape Splices in Instrumentation Applications at Cooper Nuclear Station". This submittal was transmitted to NRC headquarters as Attachment 1 to a letter dated October 16, 1990, from L.J. Callan, Director, Division of Reactor Safety Region IV to Martin Virgilio, Associate Director for Region IV & V Reactor, Division of Reactor Projects - III/IV/V and Special Projects, Office of Nuclear Reactor Regulation. As indicated previously, the staff's primary concern is the lack of insulation resistance data during the LOCA simulation. In the accompanying NPPD analysis we have noticed that the licensee pointed out that the circuits (in test report PEI-TR-842900-1) were monitored for excessive leakage current and for ground faults by use of a 0.1 ampere fuse. Since 0.1 ampere is equal to 100 milliamperes the circuit could have leaked up to 99 milliampere without being detected. Because the circuits of interest operates in the 4.0 to 20.0 milliamperes range, this method of monitoring leakage current does not provide information of any significant value. Therefore, even if it was possible to resolve all the other anomalies in the test report, we would still not have any quantative measure of leakage current or insulation resistance in the range of 4 to 20 millamperes.

To address this issue of functional performance during LOCA simulation the licensee provided test report No. PEI-TR-870200-2. The objective of the test represented by this report was to demonstrate the operability of Limitorque control and power wiring and Okonite tape splices, when subjected to a simulated steam accident and functional simulation. The test assembly included two circuit loops installed inside a NEMA-4 enclosure. Each loop contained three bolted T95/35 tape splices. The test assembly was installed in the test chamber with the opening of the conduit for the lead wires oriented downward. Loop 1 and 2 were energized with 120 VAC and 480 VAC respectively.

In accordance with the stated conclusions in the test report, "The naturally aged Limitorque control wiring (Circuit Loop 1) successfully met the functional

requirements...Leakage current remained below 2 milliamps during the entire steam exposure. The minimum insulation resistance measured was 30-40 megohms. Circuit Loop 1 remained continuously energized at 120 VAC during accident testing." In the conclusion it is also stated that failure of the naturally aged Limitorque power wiring (Circuit Loop 2) to meet the defined functional requirements was the result of an interruption in the cable insulation due to unknown causes. In our evaluation we have considered this conclusion and we have also reviewed the tabular test results and the record of anomalies outlined in Appendices 2 and 4 respectively.

As a result of our review we have concluded that, of the two circuit loops tested (loops 1 and 2), loop 2 failed relatively early in the test and although we have considered the record of anomalies pertaining to this test, sufficient information to determine qualification for instrumentation circuits is not provided. For loop 1, it is stated in the test report that there were less than two milliamperes of leakage current. This statement raises a number of questions, i.e. What is the source of that leakage? Is it from one splice or is it the loop leakage? If it is one splice, then which one? If it is the loop leakage then what is the leakage from each splice? Should we assume they all leak equally? Exactly how much leakage is there? Is it 1.01 milliampere or is it 1.99 milliampere? These are the kind of questions that should be answered when we are considering circuits that operate in the range of 4.0 to 20.0 milliamperes. 1.99 milliampere leakage on a 4.0 milliampere circuit can be quite significant.

Finally, and most importantly, is the method that the licensee is using to qualify these splices. Two test reports are being used. In the first test functional performance data (IR) were not recorded. In the second test the specimens were not pre-aged to the end of qualified life prior to the LOCA simulation. It is not acceptable to add the results of the two tests. It is not reasonable to assume that an unaged and an aged specimen will performed equally in a LOCA simulation. We are aware of the information in the licensee's submittal that states, "Although no notation was made in the report covering the physical condition of the splices, discussions with the test engineer indicate that the physical condition at the T95 high voltage insulating tape was superior to its pre-aged condition..."

It is our position that this approach does not provide a quantitative measure of an insulator's dielectric strength. It is also our position that the dielectric strength of an insulator during LOCA simulation must be determined during LOCA simulation. Consequently it is our conclusion that the two test reports cannot be used collectively to demonstrate qualification. It is also our conclusion that, even if it were possible to resolve all the anomalies in each of the test reports, neither of the two reports alone would provide sufficient information to demonstrate qualification. The first test omitted functional performance data and the second test omitted aging. When considering qualification of splices for instrumentation circuits, this information must not be omitted.