



OLIVER D. KINGSLEY, JR.
Vice President
Nuclear Operations

March 20, 1987

U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Document Control Desk

Gentlemen:

SUBJECT: Grand Gulf Nuclear Station
Unit 1
Docket No. 50-416
License No. NPF-29
Determination of Circuit
Operability for "As Found"
GGNS Raychem Sealed Splices
AECM-87/0045

References: 1) MAEC-86/0203, dated June 26, 1986; IE Notice 86-53:
Improper Installation of Heat Shrinkable Tubing
2) AECM-86/0355, dated November 17, 1986; Raychem
Shrinkable Tubing
3) AECM-86/0409, dated December 19, 1986; Raychem
Shrinkable Tubing, Update of Reportability
Determination

By letter dated November 17, 1986 (Reference 2) MP&L (SERI) stated its intent to conduct an evaluation on the "as found" condition of certain GGNS splices where Raychem heat shrink tubing was used in configurations that were not previously covered by existing GGNS test reports. In a subsequent letter dated December 19, 1986 (Reference 3), SERI indicated the need to delay the evaluation based on the issuance of a supporting industry test report which was being finalized. SERI has subsequently obtained the subject test report and has completed the evaluation of these circuits given the "as found" Raychem sealed splice configurations. A summary of this evaluation is attached. In addition, two circuits which were found unsealed have also been evaluated and are addressed in this attachment.

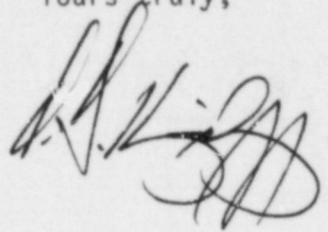
Those splice seals where qualification was not directly supported by available documentation were reworked during the first GGNS refueling outage. Therefore, this evaluation was conducted to provide a basis for previous "as found" circuit operability and does not constitute a need for justifying continued operation.

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Based on the evaluations conducted, SERI concludes that the affected circuits would have remained operable given their "as found" condition. Therefore, SERI does not consider the "as found" condition of these circuits to be reportable under 10 CFR 50.72/50.73.

Yours truly,

A handwritten signature in dark ink, appearing to be "R. Nelson Grace", written over the typed name "Yours truly,".

ODK:baa
Attachment

cc: Mr. T. H. Cloninger (w/a)
Mr. R. B. McGehee (w/a)
Mr. N. S. Reynolds (w/a)
Mr. H. L. Thomas (w/o)
Mr. R. C. Butcher (w/a)

Dr. J. Nelson Grace, Regional Administrator (w/a)
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I. BACKGROUND

A primary concern of improperly sealed circuits involving stranded wire cable is the potential effects of moisture intruding through the cable to electrical components (i.e., transmitters and limit switches) which could cause circuit failure. In addition, moisture intruding into a splice can cause reduced insulation resistance (IR) in a circuit which in turn may allow leakage currents beyond that required to maintain instrument accuracy. These conditions could occur during the postulated post-LOCA high pressure, temperature and moisture conditions. As a means to assure that the subject circuits are properly sealed, SERI maintains plant procedures (based on an engineering standard for sealing of components for equipment qualification) that specify certain terminations to be sealed with Raychem heat shrink tubing.

Based on the concerns raised in NRC IE Notice 86-53 (Reference 1) and some initial GGNS findings, MP&L (SERI) elected to conduct a walkdown of the circuit splice locations where environmental sealing using Raychem heat shrink tubing is required. This walkdown was conducted in the fall of 1986 during the first refueling outage. In accordance with the GGNS engineering standard for environmental sealing, this walkdown involved approximately 315 splice locations as discussed in Reference 2. Splices where sealing could not be readily determined to meet existing qualification documentation were reworked during this outage. The inspection results are discussed in Section II below.

SERI is a member of the Nuclear Utility Group on Equipment Qualification which coordinates closely with other utilities in the nuclear industry and with the NRC Staff on programs and issues affecting environmental qualification of equipment. Documented findings and testing information for issues such as Raychem sealing concerns have been made available to SERI and other member utilities within the group for plant specific application. The conclusions on some of the evaluations performed for this report are based on testing conducted by certain other utilities as it relates to GGNS.

II. INSPECTION RESULTS

- A. Inspections at each of the 315 splice locations were conducted using acceptable splice sealing test report guidance as provided by Raychem Corporation or other accepted qualification test reports applicable to GGNS. The results of the inspections were reviewed by GGNS Nuclear Plant Engineering (NPE) and Bechtel support personnel to determine whether specific splices needed to be reworked. Certain circuits were eliminated from further consideration for splice rework due to their unique considerations that made them acceptable "as found". This included 1) thermocouple circuits which do not have stranded conductor cables that would allow moisture intrusion under the insulation and are not sensitive to IR drops, 2) an Appendix R fire wrapped circuit penetration which could not be directly inspected but was considered acceptable based on the satisfactory sealing of similar circuits at their penetration, 3) cable lengths

that are in excess of those requiring sealing for moisture intrusion and 4) certain MSIV solenoid valve and limit switch connections which were analysed to demonstrate that there was no need to environmentally seal the terminations and as such were removed from the GGNS sealing program.

The remaining splices not found to be within the specifications provided by the GGNS sealing guidelines were reworked to conservatively assure that full environmental qualification could be readily established prior to plant restart.

- B. Based on the inspection program, approximately 60 splice locations were reworked to Raychem specified guidelines. The inspection results included examples of the following "as found" splice conditions:
- o The usage range of the heat shrink tubing was below that recommended for its specific application (i.e. the heat shrink tubing was apparently too small for the particular splice).
 - o The usage range of the heat shrink tubing was beyond that recommended for its specific application (i.e. the heat shrink tubing was too large for the particular splice).
 - o The seal length of the tubing over the wiring insulation was shorter (i.e., one half inch) than that covered by previously existing GGNS overlap qualification documentation.
 - o A Raychem breakout kit (where a single conductor is spliced with two or more conductors) was not apparently used or proper sealing of the breakout could not be determined.
 - o Additional heat shrinking of the tubing appeared to be required due to the absence of red adhesive protruding from the seal ends which may be an indication of an improper seal.
- C. Two cables were landed on terminal blocks and were not sealed in accordance with the GGNS engineering standard. These circuits were for limit switches inside containment in the MSIV leakage control system which provides MSIV position information. (1B21ZSN101A6 and C6).

III. EVALUATION OF REWORKED SPLICES

- A. Additional testing has been conducted within the industry and qualification test reports generated which support applications of Raychem seals to other standards than that specified by Raychem Corporation. The following test reports conducted within the nuclear industry on various Raychem sealing configurations were used by SERI to perform evaluations on the "as found" GGNS splices for circuit operability:

Reference 1) NTS Report No. 22414-87, dated August 27, 1986
(Conducted for Toledo Edison)

Reference 2) WYLE Report No. 17859-02B and 02P, dated March 11, 1987
(Conducted for Commonwealth Edison)

- Reference 3) FIRL Report No. F-C4033-3 dated January, 1975
(Conducted for Raychem Corporation)
- Reference 4) Raychem Report No. EDR-6057 dated May 14, 1982
(Conducted for Florida Power Corporation)

B. The results of the SERI evaluations based on these test reports are summarized below:

- o GGNS Raychem sealed splices which were outside of the tubing usage range (high side) were found to be acceptable based on tested configurations in test reports References 1, 2, and 4. Testing showed that where the heat shrink tubing was applied on splices that were larger than that specified for the particular tubing size used, the heat shrink tubing would not have failed to perform its required sealing.
- o GGNS Raychem sealed splices which were outside of the tubing usage range (low side) were found to be acceptable based on tested configurations in test report Reference 2. Testing showed that where the heat shrink tubing was applied on splices that were smaller than that specified for the particular tubing size used, the heat shrink tubing would not have failed to perform its required sealing.
- o GGNS Raychem sealed splices with seal lengths shorter than specified were found to be acceptable based on tested tube length seals down to one eighth inch in test report References 1 and 2. Testing generally showed that as long as heat shrink tubing was applied over the cable insulation that the circuit would have remained operable.
- o The GGNS splices which did not have the Raychem cable breakout kit covered with an overall sleeve were determined to be acceptable based on testing performed in test report Reference 3 where Raychem Corporation tested specimens without an overall sleeve applied. It was determined that the breakout kit sufficiently prevents moisture intrusion without application of the sleeve. The sleeve primarily functions to provide additional physical protection to the splice.

The splices initially determined as having no breakout kits during the walkdown inspection were subsequently determined to have breakout kits underneath the overall protective sleeve.

- o The GGNS splice seals initially identified as requiring additional heating to complete the tubing seals were found to be acceptable based on 1) a nuclear grade breakout kit actually provided the proper seal underneath the overall protective sleeve as described above or 2) the tubing adhesive on in-line splices was properly bonded to at least one-eighth inch over the cable insulation. This conclusion is supported by testing conducted in test report References 2 and 3. Therefore, the affected splices were determined to be in configurations which would not have prevented circuit operation.

- C. The two MSIV Leakage Control System limit switch circuits, which were not environmentally sealed in their "as found" condition, were evaluated for potential circuit failure due to a reduction in insulation resistance of the GE terminal blocks and from possible moisture intrusion through the stranded conductor cable to the limit switch.
- o Engineering calculations were performed to determine the circuit effects from current leakage and in-rush currents as a result of reduced insulation resistance of the GE terminal blocks post-LOCA. As a result of these calculations, the limit switches would still perform their intended function when required and would not inadvertently operate.
 - o NPE conducted a comparison of the "as found" MSIV limit switch circuits to the stranded wire test reports conducted by Sandia Laboratories for the NRC as contained in SAND78-2254 (NUREG/CR-0696). Comparisons were performed on 1) the GGNS accident vs. tested pressures, 2) the GGNS crimped and enclosed terminations at the terminal blocks vs. the open wire ends tested by Sandia, and 3) the expected pressure created in the GGNS sealed limit switch compartment which would oppose moisture intrusion. Based on this evaluation, moisture intrusion into the limit switch compartments would not be expected to occur post-LOCA which would prevent operation of the switches.

These MSIV limit switch circuits have been subsequently spliced and environmentally sealed in accordance with GGNS sealing requirements.

- D. The detailed evaluations conducted on the "as found" conditions are retained in the GGNS Environmental Qualification Central Files within SERI Nuclear Plant Engineering.

IV. CONCLUSION

As a result of the SERI evaluations conducted on various GGNS Raychem splice configurations and the two unsealed circuits noted above, SERI concludes that the equipment in question would have remained operable. Therefore, SERI does not consider the "as found" condition to be reportable under 10 CFR 50.72/50.73.