GULF STATES UTILITIES COMPANY

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June 3, 1985
RBG- 21,180
File Nos. G9.5, G9.25.1.1

Mr. Robert D. Martin, Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

Dear Mr. Martin:

River Bend Station - Unit 1
Docket No. 50-458
Final Report/DR-177

On January 11, 1985, GSU provided Region IV with a 30-day written report on DR-177 concerning the design, manufacture, and installation of coaxial and instrumentation cable for the neutron monitoring system. The attachment to this letter is GSU's revised final written report pursuant to 10CFR50.55(e)(3) with regard to this deficiency.

Sincerely,

J. E. Booker

J. E. Booker
Manager-Engineering,
Nuclear Fuels & Licensing
River Bend Nuclear Group

JEB/PJD/lp

Attachment

cc: Director of Inspection & Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

NRC Resident Inspector-Site

INPO

85-436

IE-27

ATTACHMENT

May 30, 1985
RBG-21,180

DR-177/Design, Manufacture and Installation of Coaxial and Instrumentation Cable for the Neutron Monitoring System

Background and Description of the Problem

The deficiency concerns the design, manufacture and installation of coaxial and instrumentation cable for the neutron monitoring system (NMS) as identified in Nonformance and Disposition Report (N&D) Nos. 5375, 5388, 5398, 5425, 5446, 7424 and 7753.

These N&Ds relate to concerns with coaxial and instrumentation cable installed to meet, in part, the cabling requirements of the General Electric Company (GE) specified NMS. The NMS comprises a portion of the reactor protection system (RPS).

1. Cable Length Installed in excess of 500 ft. (N&D No. 5446)

   GE Specification No. 22A2736, Special Wire and Cable, defined the required installation and interconnecting wiring practices and recommended wire and cable types of GE-BWRSD-supplied instrumentation, including the NMS. Figures 1, 2 and 3 for this system indicate for the source range monitor (SRM), intermediate range monitor (IRM), and power range monitor (PRM) a maximum cable distance of 500 ft. between the SRM drawer and SRM pulse preamp, IRM drawer and IRM voltage preamp, and PRM cabinet and containment penetration, respectively. The as-designed raceway system and subsequent installation of the cables resulted in cable lengths between 600 and 700 feet. A similar discrepancy exists in the cables routed between the individual detectors and the preamps or containment penetration, as applicable, for these three monitors.

2. Deficiencies in QA Category I Rockbestos Coaxial Cable (N&D Nos. 5398 and 5425)

   One type of QA Category I procured coaxial cable, Stone and Webster Engineering Corporation (SWEC) Mark No. NGS-42, manufactured by the Rockbestos Company as Part No. RSS-6-200, was found to have various deficiencies in the as-delivered condition discovered during and subsequent to installation. Bead-shaped areas of expanded jacket diameter appear at irregular intervals on over 40 reels of this cable.

3. RPS - Pull Tension Monitoring Problem - Input Channels A and B (N&D No. 7753)

   During installation of safety-related cables for input Channels A and B of the RPS, the contractor failed to monitor the pull tension applied to the group of cables as required to ensure conformance to Rockbestos' recommendations on conductor strength

and sidewall pressure. As required by the electrical installation specification for installation in all conduits greater than 25 ft. and containing more than 90 degrees in total bends, the cables were lubricated during pulling with an approved lubricant, in this case, Slip -X-300. This lubricant was approved by the manufacturer prior to use and in accordance with both the installation specification and the nonengineered items specification by which it is procured. The electrical installation specification requires that a dynamometer or an engineer-approved monitoring device be used to monitor pulling tensions on all Category I cable pulls, except hand pulls for which the engineer has performed a calculation documenting that the expected tension is less than the maximum allowable tension. Appendix C of the specification provides generic calculation results, by cable mark number and service level, for many types of cable. Due to the inherent sidewall pressure limitations of coaxial cable and the conservatism of the calculations, generic parameters for coaxial cable were not included, thereby requiring pull tension monitoring on these installations.

4. RPS - Coaxial Cable Break - Input Channel A (N&D No. 5375)

While removing the slack in individual cables installed in a conduit in input Channel A of the RPS, a single coaxial cable, SWEC Mark No. NGS-42, Rockbestos Part No. RSS-6-200, broke at a location within the conduit. Based on conductor strength, this type of cable has a recommended-pulling tension of 25 lb.

5. RPS - Coaxial Cable Jacket Damage - Input Channel C (N&D Nos. 5388 and 7424)

N&D No. 5388 identified jacket damage sustained to six coaxial cables during the installation of input Channel C of the RPS. This damage consisted of tears in the cable jacket up to 12 in. in length, which resulted in exposure of the cable shield.

N&D No. 7424 was subsequently written to identify an additional 18 cables with jacket damage and, in some cases, shield damage. The additional damage was identified when the constructor elected to pull out the cables in this run in order to facilitate installation of replacement cables for damaged cables by repulling all cables simultaneously. The maximum pull tension applied to the cables during installation was monitored and documented to be well below the maximum allowable tension.

This raceway contained 47 cables, the largest number yet installed in a conduit at RBS. Of these, 40 were SWEC Mark No. NGS-42, which has an outside diameter of 0.20 in., the smallest cable installed at RBS. During the cable installation, the cables were precut, and as many as three cables were spooled onto one reel. However, the large number of cables resulted in many different reels that were not adequately attended during the pulling process

and, accompanied by the small cable size and the physical arrangement of the raceway entry point for this pull, resulted in the cable damage.

During the construction process, Channel C cables were the first to be installed. Physical damage to the cables was observed during this installation. During subsequent installations of Channels A, B and D no physical damage was observed. Follow-up testing (continuity and meggar) resulted in the rejection of the Channel C cable, but verified the acceptance of cables for Channel A, B, and D (Engineering and Design Coordination Report No. TC-26,406). Therefore, it is not believed that the minor jacket imperfections contributed to the rejection of the Channel C cables. The most likely cause of rejection is improper installation technique.

The underlying cause of the above numbered items is described below:

1. Cable Lengths in Excess of 500 ft.

   The design information and installation procedures did not reflect the 500-ft requirement as addressed in N&D No. 5446.

2. Deficiencies in QA Category I Rockbestos Coaxial Cable

   Engineering consultation with the manufacturer indicated that these deficiencies were caused by small accumulations of jacket material which adhered to the inner surface of the jacket during the manufacturing process. Deficiencies of this type were inspected and, following consultation with the manufacturer, were accepted by the engineers prior to installation by means of N&D No. 5398. Subsequent inspection by Field Quality Control (FQC) of various reels of this type of cable indicated minor imperfections on the surface of the jacket, which are documented on N&D No. 5425. During the manufacturing process, each continuous length of this cable was, as part of a comprehensive production test program, subjected to and passed a jacket spark test following extrustion of the jacketing material. This test would have discovered any discontinuity or hole in the jacket material, however small, and automatically interrupted the jacketing process, alerting the manufacturer to this condition.

3. Pull Tension Monitoring Problem

   As required by the specification, the engineers provided a completed cable pull tension form that specifically addressed the installation parameters for this type of coaxial cable and which indicated the maximum allowable tension against which the pull was to be monitored. This form, however (due to its limited use considering the many generic results provided in the specification and, consequently, the infrequent need for pull tension monitoring), was incorrectly interpreted by Construction personnel as the above-mentioned "calculation documenting that the expected

tension is less than the maximum allowable tension," which would have eliminated the need for pull tension monitoring. Upon discovery of the error during the cable installation, it was determined that termination of the pull and subsequent restart might subject the cable to excessive tension, and consequently, the cable installation was completed. The entire cable pull was witnessed by FQC personnel, and there were no indications of any physical damage to the cable. The existing installation procedures are adequate to ensure conformance to all necessary parameters and to provide for the correct installation of all cable to which they apply. The failure to monitor tension occurred on two different cable installations pulled on the same day. Each occurrence was the result of a misinterpretation of the requirements due to limited exposure and training in this area.

4. Coaxial Cable Break

The tension required to be applied to this individual cable (by hand, to remove the slack) was excessive and resulted in the breaking of the cable within the raceway system.

5. Coaxial Cable Jacket Damage

This damage on QA Category I safety-related cables was discovered at intermediate locations throughout the cable pull and was incorrectly repaired using an unapproved qualified products list (QPL) procured tape. The tape is listed as QA NA, with a use restriction for temporary electrical installation and a requirement for material control by the constructor listed on the QPL data sheet. FQC Inspection Criteria No. R1248000F0518, R1248000F0525, or R128000F053, depending on the type of cable ensures that FQC witnesses that the proper taping procedure is being used. The N&D was written to document this condition. The cause of the problem with the additional 18 cables was improper methods used in arranging the cable reels from which the cable was being pulled as well as a lack of care in handling the cables during the pull.

Safety Implication

The RPS is designed to cause rapid insertion of the control rods (SCRAM) to shut down the reactor to protect the fuel against high heat generation when predetermined limits are exceeded.

There are eight NMS logics associated with the RPS. Each RPS trip channel receives inputs from two NMS logics, which in turn receive signals from one IRM and from one average power range monitor (APRM). The APRM channels provide continuous indication of average reactor power by receiving and averaging signals from the local power range monitors (LPRMs), which provide localized neutron flux detection over the full power range. The current signals from the LPRM detectors are transmitted directly to the linear current amplifier through coaxial cable. The amplifier's output

voltage is proportional to its input current, and thus proportional to the magnitude of neutron flux. The output of each LPRM amplifier is isolated to prevent interference of the signal by inadvertent grounding or application of stray voltage at the signal terminal point.

Therefore, it can be concluded that the coaxial cable associated with these systems should not be subject to interference with could cause false indications of the neutron flux in the reactor.

The subject N&Ds question the integrity of one out of four RPS trip channels. During installation of safety-related coaxial cable, the majority of the RPS Channel C cables were damaged. The supporting documentation has been finalized to conclude that the installation of the remaining three RPS trip channels is acceptable.

Had this deficiency remained uncorrected, one trip channel could be subject to interference, which could cause false indications of the neutron flux in the reactor. A false indication on Channel C combined with an assumed false indication also on Channel D may have then resulted in preventing the RPS from performing its function.

Corrective Action

1. Cable Lengths in Excess of 500 ft.

   N&D No. 5466 has been dispositioned Accept-As-Is because the system's gain adjustment ranges are adequate to compensate for any potential signal loss due to the excessive cable lengths, as confirmed in GE FDDR No. LDI-1730. Review of the remaining variations between the designed or installed lengths on these systems is being conducted and will be addressed by GE on Engineering and Design Coordination Report (E&DCR) No. C-28,059.

   Future engineering and design work which has cable length constraints will identify such requirements on cable block diagrams (CBDs). In addition to maximum cable lengths shown for power cables, the CBD will also include any special requirements imposed on cable lengths by the vendors or engineers responsible for their respective systems. Implementation of the above will effectively communicate design information to the appropriate engineers and designers to preclude recurrence of the problem.

2. Discrepancies in QA Category I Rockbestos Coaxial Cable

   Engineering evaluation of all discrepancies noted in this cable has determined that the cable, as delivered, was acceptable for installation and meets all performance requirements. There is no evidence to indicate that subsequent damage incurred on this cable during installation was the result of, or propagated by, these minor jacket imperfections.

3. Pull Tension Monitoring System

The Electrical Construction Department conducted additional training in the requirements of the specification concerning pull tension monitoring to all cable installation personnel.

4. Coaxial Cable Break

Electrical Engineering has scheduled spare cables of this type in this raceway, one of which will be designated as a replacement for this broken cable. Construction personnel were reminded of the care that must be exercised when pulling individual cables of this type.

5. Coaxial Cable Jacket Damage

As corrective action to prevent recurrence, Construction personnel were instructed on the use restrictions of QPL-procured items and will be retrained in the correct methods and procedures for repairing cable damage.

The effects of this were noted by both Construction and FQC personnel at the time of cable pull, which resulted in the issuance of the N&D. N&D No. 7424 has been dispositioned to remove and replace all cable from this pull. Construction personnel were retrained in the handling of multicable pulls and in the proper setup methods of spooling as many as six precut cable lengths onto one reel to eliminate associated handling problems. These revised methods were used on this conduit repull as well as the other similar conduit which contained the associated redundant cables.