



UNITED STATES  
 NUCLEAR REGULATORY COMMISSION  
 REGION II  
 101 MARIETTA STREET, N.W.  
 ATLANTA, GEORGIA 30323

Report No.: 50-261/91-03

Licensee: Carolina Power and Light Company  
 P. O. Box 1551  
 Raleigh, NC 27602

Docket No.: 50-261

License No.: DPR-23

Facility Name: H. B. Robinson

Inspection Conducted: February 19-22, 1991

Inspector: N. Merriweather 3/21/91  
 N. Merriweather Date Signed

Approved by: Paul J. Killion for 3/21/91  
 M. Shymlock, Chief Date Signed  
 Plant Systems Section  
 Engineering Branch  
 Division of Reactor Safety

SUMMARY

Scope:

This routine, announced inspection examined the licensee's corrective action programs for previous inspection items and nonroutine licensee event reports in the area of environmental qualification of electrical equipment. The items examined were NRC Violation 50-261/87-10-04 and Unresolved Items 50-261/89-26-01, -03, and 04; and Licensee Event Reports 88-15 and 89-13.

Results:

In the areas inspected, violations or deviations were not identified. The licensee's corrective action programs were considered complete and adequate for all but one of the items examined. The licensee was very cooperative and responded to NRC requests in a timely manner. A new Unresolved Item (50-261/91-03-01) was opened to consolidate into a single item a concern remaining from the followup on Violation 50-261/87-10-04 and Licensee Event Report 89-13. The concern relates to the adequacy of the documentation used to establish qualification for Patel Conduit Seals. These seals were installed to prevent moisture from entering electrical components under design bases accident conditions. Although the licensee had performed additional testing on the seals to support qualification, the test reports were ambiguous as to whether the seals actually met the test plan acceptance criteria of no leakage during LOCA and submergence testing. This item is discussed further in paragraph 2.a.

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## REPORT DETAILS

### 1. Persons Contacted

#### Licensee Employees

- \*S. Billings, Technical Aide, Regulatory Compliance
- \*R. Crook, Senior Specialist, Regulatory Compliance
- \*W. Dorman, Manager, Nuclear Assessment Department
- \*A. McCauley, Manager, Electrical Systems
- \*M. Page, Manager, Technical Support
- \*J. Sheppard, Plant General Manager
- \*D. Stadler, Onsite Licensing Engineer, Nuclear Licensing
- \*H. Young, Manager, Quality Control
- C. Harris-Young, Environmental Qualification Coordinator

Other licensee employees contacted during this inspection included engineers, security force members, and administrative personnel.

#### Other Organizations

F. Roy, EGS Environmental Qualification Engineer

#### NRC Resident Inspectors

- \*L. Garner, Senior Resident Inspector
- \*K. Jury, Resident Inspector

\*Attended exit interview

Acronyms and initialisms used throughout this report are listed in the last paragraph.

### 2. Action on Previous Inspection Findings (92701) (92702)

- a. (Closed) Violation 50-261/87-10-04, Cable Entrance Seals for Solenoid Valves and Transmitters (Violation C in the NOV dated June 16, 1988)

The violation involved a failure to install conduit seals on ASCO solenoid valves and Rosemount 1153A transmitters. The corrective action taken by the licensee was to install Patel Conduit Seals on those EQ instruments that required a moisture seal. The corrective action was previously reviewed during NRC Inspection 50-261/89-26. The above inspection identified several concerns with the qualification documentation for Patel Conduit Seals. To resolve the concerns identified in Inspection Report 50-261/89-26 the licensee performed requalification testing on four seal configurations similar to those at Robinson. The testing program was performed from June 4, 1990, through October 8, 1990. The results are documented in Wyle

Laboratories Test Report No. 41175-1, Volumes I and II and EGS Corporation International Report No. EGS-TR-903200-04. The testing performed by Wyle Laboratories included a LOCA test followed by a 30 day submergence test. During the LOCA and submergence testing phases two of the four Robinson seals leaked (i.e. CS-1A and CS-2). After the submergence test all test specimens were pressure tested through tubing on the low pressure side of the seals. Specimens CS-1A and CS-2 leaked at the NPT pipe threads. The specimens were removed from the test chamber and provided to EGS for further evaluation of the test anomalies.

EGS tested the four Robinson seals for leakage through their wires and through the grommets. EGS pressurized the seals with nitrogen and verified leakage at the NPT threaded connection on specimens CS-1A and CS-2 at 50 psig. Specimens CS-1A and CS-2 were disassembled, resealed and then retested. No leakage was observed at a 75 psig test pressure. Specimens CS-3A and CS-4 leaked at the 75 psig test pressure. The NPT joint was resealed on both CS-3A and CS-4. A retest of CS-3A showed leakage at 60 psig. No leakage was observed on CS-4. EGS concluded that the leakage observed during the LOCA and submergence test was due to failure of the thread sealant at the NPT joints. EGS concluded that both CS-3A and CS-4 were also prone to NPT leakage.

The licensee concluded that the anomalies observed during the testing did not affect the qualification of the seals at Robinson. This was based on the EGS test data and the fact that the seals at Robinson were assembled using a different thread sealant than the one used in the test. The sealant used at Robinson was Loctite PST-580 which was LOCA and submergence tested by Rosemount. The test specimens were assembled using a EGS P-2 thread sealant.

The inspector reviewed documentation from the licensee's files that was used to establish qualification for Loctite. The inspector considered the information inconsistent and lacking as delineated below:

- (1) The licensee's Maintenance Manual Procedure MMM-025 identified the sealant as nonage sensitive when in fact test reports in their files concluded the sealant was age sensitive.
- (2) The plant installation procedure (MMM-025) for applying the Loctite sealant on conduit threads required four to seven turns or a minimum of 150 in-lb torque. However, the Rosemount Instruction Manual indicated that Loctite was used between the electronics housing and sensor threaded connection. It specified five full threads of engagement.
- (3) The submergence test performed by Rosemount was a two week test and not the 30 day Robinson Profile.

Notwithstanding the above, the inspector disagreed with the licensee that the post LOCA testing on the Patel Seals conclusively established that moisture leakage was due to the NPT threaded pipe connection. This was based on the fact that the post LOCA testing data for tubing, seal and NPT joint leakage showed that specimen CS-2 leaked nitrogen at 70 psig through the threaded NPT joint. However, during submergence testing the specimen leaked at maximum pressures of 6.4 psig. The EGS nitrogen leak testing of the seal and NPT joint showed leaks at 50 psig from the threaded joint. This did not provide an explanation for leakage at lower pressures while submerged. In addition to the above, the Wyle test included four other Patel seals that were subjected to the LOCA and submergence testing phases. Three of the four specimens leaked (CS-5A, CS-10 and CS-12). No leakage was observed post LOCA on either the tubing or the conduit seals for CS-10 and CS-12 at nitrogen pressures of 70 psig. Specimen CS-5A leaked at a flange weld at 70 psig. All of these specimens had observed leakage while submerged at pressures of eight psig.

There were also anomalies reported with two other specimens (CS-6 and 7A). Specimen CS-6 leaked after seismic testing requiring it to be removed from the test program. The cause of the leakage on CS-7A was not determined.

The inspector concluded that the reports were inconclusive in establishing qualification for the seals. The anomalies observed, whether thread or grommet leakage, were failures of the test acceptance criteria and the Post LOCA testing was insufficient to resolve those LOCA and submergence concerns.

This issue is considered an Unresolved Item (50-261/91-03-01) pending further NRC evaluation of the test reports. The violation is considered closed.

b. (Closed) Unresolved Item 50-261/89-26-01, Victoreen High Range Radiation Monitor

The installed configuration of the Victoreen High Range Radiation Monitor was not the same as the qualified tested configuration and the deviations had not been adequately addressed by the licensee. The qualified tested configuration used a sealed metal conduit configuration to protect the electrical termination at the detector from moisture intrusion. The installed configuration at Robinson used heat shrink material on stainless steel pipe to seal the cable entrance at the detector. The heat shrink materials were previously qualified for use on cable inside containment, however, adequate test data was not available to support qualification on stainless steel pipe. The licensee performed additional qualification testing on the Robinson configuration. The test specimen was assembled with heat shrink material on stainless steel pipe similar to the ones installed at Robinson. The test was conducted at LOCA temperatures and

pressures that enveloped the accident profile at Robinson. The test and results are discussed in the same Wyle and EGS reports referenced in paragraph 2.a above. The seal passed the test with no anomalies. This item is now closed.

- c. (Closed) Unresolved Item 50-261/89-26-03, Review Qualification for Raychem Penetration Seal

In LER 88-22 the licensee reported that the containment flood level was higher than what was initially analyzed. This resulted in several EQ components being subject to submergence that were not analyzed. The licensee performed an evaluation of the components that were submerged and concluded that they were acceptable. However, they made repairs on penetration "F01" to protect the penetration pigtail wires with Kapton insulation from interacting with chemical spray during a design basis event. Repairs made to penetration "F01" consisted of installing Raychem heat shrink material over the stainless steel feed through and the Kapton pigtail cables to seal the penetration from moisture. The inspector questioned the qualification of this seal design for lack of LOCA and submergence test data. The licensee conducted LOCA and submergence testing on a penetration configuration similar to that of F01. The penetration assembly successfully passed the LOCA and submergence test with no anomalies. The test results have been evaluated by the licensee and are included in EQDP 17.0. The test results are discussed in the Wyle and EGS Reports referenced in paragraph 2.a above. This item is now considered closed.

- d. (Closed) Unresolved Item 50-261/89-26-04, Dose Rate for Hydrogen Recombiner

A question was asked about the total dose the Hydrogen Recombiner Skid would see as a result of a design base accident inside containment. The master list of electrical equipment requiring environmental qualification did not include the recombiners. A sample calculation was performed using the assumed 54 and 90 day reaction chamber dose rates. The calculation showed that the total accident dose experienced by the recombiners would not exceed the EQ radiation threshold of 10,000 rads gamma for the required operating time. This was judged to be a mild environment for the recombiners. This item is considered closed.

### 3. Licensee Event Reports (LERs)

- a. (Closed) LER 88-15, Inadequate Pump Motor and Power Cable Environmental Qualification Documentation Files

The licensee reported that the SI and CS pump motors were not previously qualified for the post accident high radiation environment in which they would be exposed during a LOCA. The licensee also discovered that the room area fan coolers for the CS, SI and RHR pump

motors were not qualified for post accident radiation levels and would likely fail post accident causing elevated ambient temperatures in the SI, RHR and CS pump motor rooms. The licensee developed JCO's to allow for continued operation based on documentation which demonstrated that the motors were qualifiable. Later the licensee assembled EQ documentation for the CS pump motors and revised the qualification file for the RHR Pump motor to include the SI pump motors. The licensee evaluated the motor insulation systems to establish qualification for post accident radiation doses and service life at elevated ambient temperatures.

The qualification for the SI and RHR pump motors was addressed in EQDP 8.1. The EQDP demonstrated by analysis that the RHR and SI pump motors were qualified to perform their required safety functions after 40 years of service. The RHR pump motor was qualified to operate continuously for a minimum of 72 days post LOCA at the peak ambient temperature of 90°C. The SI pump motor was qualified to operate continuously for 52 days post LOCA at the peak ambient temperature of 102°C. This met the 30 day operating requirement.

Questions were raised about a new aging analysis performed by the licensee for the RHR pump motors at elevated temperatures. The EQDP analysis assumed operating times of 5 percent on the RHR pump motors. However, actual run time data on the RHR motors indicated use was much higher than assumed in the calculations.

The licensee has performed additional calculations using actual run time data and has reduced the motor life at elevated temperatures. The licensee has indicated that the EQDP will be revised appropriately to reflect the new calculations. Initial results indicated that the RHR pump motor life was closer to 42 days Post LOCA. This still met the 30 day operating requirement. The EQDP also showed that the RHR and SI pump motors were qualified for a total radiation dose of  $2 \times 10^8$  rads gamma. This met the accident dose  $1.3 \times 10^6$  rads gamma.

The qualification for the CS pump motor was addressed in EQDP 8.2. The analysis of the CS motor insulation system concluded that the motor was qualified for radiation environments up to a total dose of  $1 \times 10^7$  rads gamma. The calculated Post LOCA useful life for the CS pump motor at peak room temperature was 25.5 days. This fell short of the 30-day operating requirement. However, considering that the maximum ambient temperature of 213.4°F only exists for the first 24 hours and then it drops to 170°F, the licensee concluded that the motor was qualified for 30 days operation.

The above problems were identified by the EQ Assessment Program implemented as part of the corrective action in response to the NRC Notice of Violation and Proposed Imposition of Civil Penalty dated June 16, 1988. The licensee responded to the Notice in a letter to

NRC dated September 1, 1988. This meets the NRC discretionary enforcement policy in Part 2, Appendix C for no additional enforcement sanctions. This item is closed.

- b. (Closed) LER 89-13, EQ Conduit Seal Deficiency Due to Inadequate Wire Use Range Installation Instructions Qualification Concerns

Qualification concerns with Patel conduit seals were initially reported in NRC Inspection Report 50-261/89-26. During the inspection the licensee was asked about the allowable use ranges for the grommets and wire diameters. As a result of research to respond to the NRC question, it was identified that in some applications, the conduit seal grommet had an inappropriate use range for the installation, and therefore would allow moisture to enter through the seal and into safety related electrical components. The licensee inspected the seals for proper wire use range. This required some grommets to be replaced and in some cases new wire was installed or in the case of some ASCO solenoid valve configurations a low point weep hole was drilled in the conduit. The cause of the problem was attributed to inadequate installation instructions provided by the vendor. The vendor's drawings only gave a maximum wire diameter. This information was misinterpreted by the licensee. The vendor submitted a 10 CFR, Part 21 Notification on January 5, 1990 which further clarified the proper use range requirements for the Patel conduit seals. This issue will be addressed as part of the closeout for Unresolved Item 50-261/91-03-01. Thus, any enforcement action will be addressed at that time. This item is closed.

#### 4. Exit Interview

The inspection scope and results were summarized on February 22, 1991, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results listed below. Proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

(Open) Unresolved Item 50-261/91-03-01, Evaluate LOCA/Submergence Test Results for Qualification of Patel Conduit Seal, Paragraph 2.a.

#### 5. Acronyms and Initialisms

ASCO - Automatic Switch Company  
 C - Centigrade  
 CFR - Code of Federal Regulations  
 CS - Containment Spray  
 EQ - Environmental Qualification  
 EQDP - Environmental Qualification Documentation Package  
 F - Fahrenheit

JCO - Justification for Continued Operation  
LER - Licensee Event Report  
LOCA - Loss of Coolant Accident  
NPT - National Pipe Thread  
NRC - Nuclear Regulatory Commission  
PSIG - Pounds Per Square Inch Gauge  
RHR - Residual Heat Removal  
SI - Safety Injection