

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
REGION IV

Report No. 99900728/80-02

Program No. 51300

Company: Valcor Engineering Corporation
No. 2 Lawrence Road
Springfield, New Jersey 07081

Inspection Conducted: November 17-21, 1980

Inspector: I. Barnes 1/8/81
for R. E. Otter, Contractor Inspector Date
Components Section II
Vendor Inspection Branch

Approved by: I. Barnes 1/8/81
I. Barnes, Chief Date
Components Section II
Vendor Inspection Branch

Summary

Special inspection on November 17-21, 1980 (99900728/80-02)

Areas Inspected: Implementation of 10 CFR, Part 21, 10 CFR 50 Appendix B, and other NRC requirements including, assessment of cause, corrective action and generic consideration, relative to a material deficiency in coils for solenoid valves supplied by Valcor to various nuclear sites. The inspection involved 29 inspector hours on site.

Results: In the area inspected, one deviation, and no unresolved items were identified.

Deviation: Qualification of Vendors: Failure to perform an initial implant survey of Quality Coils Inc., and complete and file a survey questionnaire as required by procedure No. QCP.S 1503.10, Revision B (Notice of Deviation).

DETAILS SECTIONA. Persons Contacted*

G. Borgo, Director - QA
 M. Kreitchman, President
 A. LaMastra, Chief Project Engineer
 B. Quail, Chief Application Engineer
 P. Schkepper, Plant Manager
 J. Shieh, QA Engineer

*Also attended the exit meeting.

B. Preinspection Conference

A preinspection conference was held on November 17, 1980, with Messrs Borgo and Shieh. The NRC inspector defined the scope of the inspection as being a continuation of the inspection of the deficiency reported by Valcor in their Part 21 Reports dated 9-26-80 and 10-17-80.

C. Reported 10 CFR Part 21/50.55(e) Deficiency Concerning Valve Coil Failures Due to Latent Coil Material Incompatibility In Coils For McGuire Units 1 and 2 and Other Nuclear Power Plant Customers1. Introduction

This problem was reported by telephone to the NRC OIE Region 2 on 9-30-80 by Duke Power Company (Duke) and by Valcor Engineering Corporation (Valcor) in TWX Part 21 Reports dated 9-26-80 and 10-17-80 to the NRC OIE Director. The problem related to the failure by shorting of solenoid valve coils furnished to Omaha Public Power Company, Duke Power Company, and Stone & Webster/Northern States Power Company after a period of service in a continuously energized mode.

The failures were determined to be due to a latent material incompatibility between the polyimide insulation coating on the coil wires and the polyvinyl butyral varnish used as a self binding agent in winding the coil.

Valcor reported that the condition is applicable to valve Model No. V70900-21-1 and V70900-21-3, which are identical in design and material except for the lead wire, to those furnished to the above customers and others.

To verify the information in Valcor's Part 21 Reports, an inspection was performed on October 14-17, 1980, at the Valcor plant and

reported on (Report No. 80-01). However, it was later determined that additional information on the cause of the coil failures, the basis for the IEEE Standard 323 material qualification of the subject coils and quality of new replacement coils was needed. Consequently, this inspection was performed at the Valcor plant.

2. Objectives

The objectives of this inspection were:

- a. To identify any conditions in the implementation of either Valcor's QA Program or those of their subvendors that may have contributed to the use of incompatible materials.
- b. To identify the basis for Valcor's qualification of the subject coils to the requirements of the IEEE Standards No. 323, 344, and 382.
- c. To review information on the new replacement coils.

3. Method of Accomplishment

The preceding objectives were accomplished by:

- a. Discussions with cognizant personnel.
- b. Observations in the Valcor valve test laboratory.
- c. Review of the following applicable sections of the Valcor QA Manual:
 - (1) Customer Purchase Order Control.
 - (2) Design Drawing and Specification Control.
 - (3) Procurement Control Paragraphs:
 - 3.1 Purchasing
 - 3.3 Source Inspection
 - 3.5 Visual, Dimensional and Certification Inspection of Material
 - 3.6 Vendor Qualification
 - 3.6.1 Non-Code Vendor Qualification.
 - (4) Process Control.
 - (5) Supplemental Quality Program, Nuclear Valve Assembly.

- d. Review of the following five Valcor QC Procedures applicable to the valve coil problem:
- (1) QCP No. S1503.1, Revision C, "Quality Assurance Principals".
 - (2) QCP No. S1503.3, Revision A, "Components - Detail Part and Subassemblies."
 - (3) QCP No. S1503.4, Revision B, "Deliverable Items."
 - (4) QCP No. S.1503.4, Revision A, "Returned Material."
 - (5) QCP No. S1503.6, Revision A, "Process Control (Except Cleaning)."
 - (6) QCP No. S1503.10, Revision B, "Vendor Quality Assurance Provisions."
- e. Review of the following Valcor Customers' Purchase Orders and P.O. Specifications and related documents for the failed valves:
- (1) Duke Power P.O. No. C9773, dated 10-6-77 for 260 valves P/N V70900-21-3 and 40 valves P/N V70900-21-1.
 - (2) Duke Power Specification MCS-1210.04-00-0022, Revision 0, dated 6-30-77, "Safety Related Solenoid Valves," McGuire . . . Units 1 and 2."
 - (3) Duke P.O. No. E-97822-11, dated 2-6-80, for 70 valves P/N V70900-21-3, for McGuire Station.
 - (4) Duke P.O. No. E-52462-73, dated 11-2-78, for five valves P/N V70900-21-1 and 15 valves P/N V70900-21-3 for McGuire Station.
 - (5) Duke P.O. No. E-95188-11, dated 10-31-79, for 200 valves P/N V70900-21-3 for Catawba Station.
 - (6) Duke Catawba Nuclear Station Specification CNS-1210.04-0022, dated 11-30-78, "Safety Related Solenoid Valves."
 - (7) Stone & Webster P.O. and P.O. Specification, dated 12-27-79, for eight solenoid valves P/N V70900-21-3 for Prairie Island Units 1 and 2.
 - (8) Copes Vulcan P.O. No. 911-553, dated 10-22-79 for four solenoid valves P/N V70900-21-1.

- (9) Omaha Public Power District (OPPD) P.O. No. 43472, dated 6-25-79, for 19 solenoid valves P/N V-70900-21-3.
 - (10) OPPD letter dated 5-17-79 to Valcor.
 - (11) Anchor-Darling Valve Company P.O. No. P-827, dated 3-23-78, for 12 valves P/N V70900-21-1, and 12 valves P/N V70900-21-3.
 - (12) C. F. Braun Specification No. 400-321, Revision 4 used in purchasing the valves for Anchor Darling.
- f. Review of the following Valcor purchase orders for the solenoid coils used in the valves P/N V70900 -21-1 and -3.
- (1) P.O. dated 1-2-79, to [REDACTED] for coils P/N V70905-21-3, Revision D.
 - (2) P.O. No. 40507, dated 7-3-78 to [REDACTED] for 500 coils P/N 70905-21-3 in accordance with Drawing V 70905-21-3, Revision C.
 - (3) P.O. Change Order to P.O. No. 40507 Changing Drawing V70905-21-3, Revision D to Revision E.
 - (4) P.O. No. 44086, dated 3-14-80, to [REDACTED] for 1000 coils in accordance with Drawing V70900-21-3, Revision D.
- g. Review of specification Mil-W-583C, dated 3-6-63.
- h. Review of Federal Specification "Wire, Magnetic, Electric" No. J-W-1177/Gen., dated 9-27-76, and Federal Specification Sheet "Wire, Magnetic, Electrical, Class 220, Type M," J-W-1177/15A, dated 9-27-76, which superceded Mil-W-583C.
- i. Review of Valcor Drawings V70905-21-3, Revision D, Revision D-E, and Revision F.
- j. Review of the [REDACTED] No. 18 certifications, dated May, 1980, from five departments for coil Part Number V70905-21-3.
- k. Review of Valcor's "General Qualification Test Procedure For Class IE Nuclear Service Valves," No. S-1410, QC Approved 9-21-76.
- l. Review of Valcor's engineering test record No. QR-70900-21-1, "IEEE-323 Qualification Test Report on V70900-21-1 and V70900-21-3," QC Approved 11-23-77.
- m. Review of Valcor Drawings V52605-501, "Coil Assembly," Revision A-D, Approved 6-23-77 and Revision H, Approved 1-31-78 for the IEEE-323 test valve.

- n. Review of the [REDACTED] "QC Checkoff List" for coil Part Number V52605-501 for the IEEE-323 test valve.
- o. Review of Valcor's "Request for Engineering Change V52605-501," dated 10-17-80, covering a drawing change for the IEEE-323 test valve coil.
- p. Review of [REDACTED] "Certificate of Compliance," dated 12-3-76 for coil Part No. V52605-501, Revision C, on P.O. 36930.
- q. Review of Valcor document No. QR-52600-515, "Qualification Test Report For IEEE Class IE Solenoid Valve," P/N V52600-515, Valve Type I, St. Lucie Units 1 and 2, Ebasco Service/Florida Power and Light Company.
- r. Review of Valcor's Final Test Report for valve P/N V52600-515, Revision C.
- s. Review of Valcor's records "QA Department Vendor Evaluation Survey" for the following solenoid coil manufacturers:
 - (1) [REDACTED] dated 11-28-79.
 - (2) [REDACTED] dated 4-19-78
 - (3) [REDACTED]
- t. Review of Valcor's "Vendor Reliability Report," dated April, 1977, covering the following coil manufacturers:
 - (1) [REDACTED]
 - (2) [REDACTED]
 - (3) [REDACTED]
 - (4) [REDACTED]
- u. Review of Valcor's Drawing V70905-21-3, Revision G-J, dated 10-1-80, "Coil [REDACTED] covering the specifications for the new replacement coils.
- v. Review of Valcor's "Survey Trip Report," dated 10-9-80, for the coil manufacturer selected to manufacture the replacement coils P/N V70905-21-1 and -3.
- w. Review of Valcor's receiving inspection records for coils received on Valcor P.O. 45513.

3. Findings

a. Deviation From Commitments

Due to the problem of poor workmanship in coils manufactured by Quality Coils Inc. identified in the previous NRC inspection report on Valcor (Report 99900728/80-01), and the separate problem of material incompatibility, Valcor's control of vendors was reviewed.

To evaluate the implementation of Valcor's QA program for evaluation and approval of coil manufacturers, a review was made of the Quality Control Procedure No. QCP No. S1503.10, Revision B, and of the vendor approval records "QA Department Vendor Evaluation Report" and "Vendor Reliability Report." The review established that of the four coil manufacturers previously contracted with by Valcor, that only [REDACTED] had not been surveyed and a QC questionnaire completed and filed by QC. The Director - QA indicated Quality Coils Inc. was approved based on a good performance history identified in the "Vendor Reliability Report." The failure to have performed an initial in plant survey of [REDACTED] appears to be contrary to requirements of Valcor's QC procedure No. QCP S1503.10, Revision B. (See Notice of Deviation).

b. Unresolved Items

None.

c. Other Findings - Discussions and Comments

- (1) Review of paragraph 4. "Procurement Control" of Section 3 of the QA Manual, and of the "Supplement to Valcor's Nuclear QA Manual," established that provisions for qualification of vendors supplying "Non-Code" items, such as solenoid coils for safety related valves, was less restrictive than those for suppliers of ASME Code items. In addition, paragraph 3.6.1 of Section 3 needed editorial corrections. The supplement identified the manner in which control of Valcor's QA Manual relates to each criterion of Appendix B to 10 CFR 50 and to ANSI N45.2 standard.
- (2) Review of four purchase orders and two related specifications from Duke Power Company covering solenoid valves for McGuire Units 1 and 2, and for Catawba Units 1 and 2, showed that the specified requirements included those of IEEE-323(1971), -344(1971), -382(1972); ANSI N45.2(1971), N45.2.2(1972), N45.2.1(1973) and N45.2.9(1974), and 10 CFR 50 Appendix B. In addition, the specifications

required suitability for ambient temperatures of 150°F with 100% Relative Humidity (R.H.), and that each valve shall be qualified for a Post Accident environment of 350°F and 100% R.H. Special requirements required that Duke's specification shall apply to lower tier subcontractors and vendors. All of the P.O.s and specifications identified the valves as being safety related equipment.

- (3) Review of the balance of the four other customer purchase orders and P.O. specifications showed that the valves were also to be qualified to the previously identified IEEE standards and the Post Accident environment conditions, and were to be manufactured in accordance with 10 CFR Part 21, 10 CFR 50. Appendix B and Valcor's QA Program.
- (4) Discussions relative to Valcor's purchase of the coils for the V70900-21-1 and -3 valves, established that these coils were first purchased from [REDACTED], who supplied four valve coils for the Stone & Webster Prairie Island units. The P.O. for the coils was then transferred to [REDACTED] along with the coil molds and surplus [REDACTED] magnet wire. [REDACTED] then furnished the other four coils for Prairie Island valves and the balance of the V70905-21-1 and -3 coils for the other customers.

Valcor's initial P.O. No. 40507 to [REDACTED], referenced Valcor Drawing No. V70905-21 -3, Revision C as the specified requirements. This P.O. was subsequently modified changing the drawing to Revision D and then to Revision E and then to Revision F. Revision F of the drawing changed the specification for the magnet wire to Federal Specification J-W-1177/15A which superceded Mil-W-583C specified on the prior drawing revisions. The drawings also identified the wire to be furnished under the above specifications as Class 220, Type M, Aromatic Polyimide Coated, Round.

- (5) Review of Specification 1177/15A and 1177/Gen. established that overcoating of wire to provide self bonding of the coil was permitted in paragraph 6.1.3.2 of specification 1177/Gen. This paragraph allowed use of overcoating on film type magnet wire using resins which impart self bonding characteristics as long as the properties of the basic insulation adhere to the specification. In the Exit Interview discussions, Valcor's President indicated he had spoken with the head of [REDACTED] the wire manufacturer, and had been assured that the magnetic wire had successfully passed all of the tests required by

the specification. However, there was not any [REDACTED] test reports available at Valcor. The only records available were the Certificates of Conformance to drawing requirements, furnished by [REDACTED] to Valcor.

- (6) Valcor's IEEE qualification of the V70900-21-1 and -3 valves was reviewed. The Test Record No. QR-70900-21-1 indicated that the solenoid valves P/N V70900-21-1 and -3 were qualified to IEEE-323-344 and -382, based on similarity of materials of construction as shown in Table II of the test record by comparison to IEEE test solenoid valve P/N 52600-5291-2 and V70900-22. Valve 52600-5291-2 had successfully undergone all IE tests, while valve V70900-22 was only subjected to a LOCA test. All tests were performed in accordance with IEEE-323(1974), -344,(1975), -382(1972) and the Valcor procedure S1410. Table II of the test record, showed that the magnet wire in both the test valve P/N V52600-5291-2 and the (failed coil) valves V70900-21-1 and -3 was specified to Mil-W-583, Class 220, Type M.
- (7) A review was then made of the materials and construction of the IEEE test coil P/N V52605-501. Examination of drawings V52605-501, Revision A-D and Revision H indicated that the coil general construction included that the coil was to be wet wound with polyimide varnish and the finished coil to be impregnated with polyimide varnish, baked and cured. Discussion established that this specification was furnished to the coil manufacturer, [REDACTED]. Unknown to Valcor, the coil manufacturer had substituted a No. 996 silicone varnish in place of the polyimide varnish. The reason for this substitution, according to Valcor, was that the manufacturer indicated that the required baking -curing temperature for the polyimide varnish would have been detrimental to the coil. The change of material was detected by Valcor during the investigation of coil failures by review of [REDACTED] QC checkoff list. Valcor then issued a "Request for Engineering Change" to correct the drawing V52605 -501 to show the use of No. 996 silicone varnish. No documented request from [REDACTED] to Valcor to change the varnish material, was made available by Valcor to the NRC inspector.

Due to the above condition, it appears that the [REDACTED] Certificates of Compliance for the coil P/N V52605-501, Revision C, which certified the materials or parts to P.O. No. 36930 specification drawing, may not be valid.

- (8) Discussions with Valcor's Chief Project Engineer established that the certification of the valves P/N V70900-21-1 and -3

to IEEE Standard -323, 344, and 382 based on similarity of materials and construction to tested valves P/N 52600-5291-2 and V70900-22, was a Valcor engineering judgement based on the test methods allowed in IEEE 323. The Chief Engineer indicated that the Valcor Test Record No. QR-70900-21-1 was the documented engineering justification.

- (9) In consideration of the above conditions, it appears that the IEEE certification may be invalid for the V70900-21-1 and -3 valves, in that they were certified against a test valve containing out-of-specification material.
- (10) A review was made of documents pertaining to the replacement coils manufactured by the new coil vendor. Review of Valcor drawings, a trip survey report, and receiving inspection records provided the following information:
 - (a) The magnet wire was specified on Valcor drawing V70905-21-3, Revision G-J, "Coil [REDACTED] as No. 32 AWG in accordance with specification J-W-1177/15, Type M, 220C. The insulation system was Class H (or better) containing a D.C. 997 Silicone varnish.
 - (b) The trip report indicated that this manufacturer was acceptable and qualified to manufacture the replacement coils.
 - (c) The Valcor Receiving Inspection Report for a Lot of 48 coils received from the new coil vendor indicated that all of the coil characteristics specified on drawing V70905-21-3, Revision G-J, "Coil [REDACTED] were checked and found to be acceptable.
- (11) Discussions established that 100 new replacement coils have been shipped to Duke Power. These coils had successfully completed the accelerated thermal aging test at 600°F for 100 hrs.

D. Exit Interview

1. The inspector met with management personnel denoted in paragraph A at the conclusion of the inspection on November 21, 1980.
2. The deviation and other findings identified in this report were discussed.

3. Valcor management was requested to structure their written responses to the deviation in accordance with the three conditions identified in the report cover letter.
4. Managements questions and comments related to clarification of the findings.