<u>QDR-5437-131-01</u>

QUALIFICATION REVIEW PACKAGE

CONTINENTAL WIRE & CABLE COMPANY 600V AND 1000V CABLES

WITH SILICONE RUBBER INSULATION & HYPALON JACKET

(SPEC. NO. NUS-326)

SURRY UNIT 2

NUS CORPORATION
910 CLOPPER ROAD
GAITHERSBURG, MARYLAND 20878
(301) 258-6000

N08.1-V01-413
September 23, 1982
File 4.8

Mr. A. L. Parrish, III
Manager, Multiple Power Projects
Virginia Electric and Power Co.
P.O. Box 564
Richmond, Virginia 23204

Attention: J. E. Wroniewicz

Subject: Surry Unit 2 Transmittal of Final Rev. 1 of Qualification Review Package

Dear Mr. Parrish:

Transmitted herewith is one (1) copy of the final signed-off Revision No. 1 of the qualification document review package QDR-5437-131-01 Continental Wire & Cable Company 600V and 1000V Cables with Silicone Rubber Insulation & Hypalon Jacket dated 9/21/82 for your permanent files. All VEPCO's comments have been resolved and incorporated along with additional NUS comments in this revision. Revised sheet numbers are listed in Record of Revisions Table.

Our review for the above equipment is complete and the package is closed. The original master file with one additional copy shall be turned over to you at any time you advise.

If you have any questions, please call.

Very truly yours,

N. K. Garg

for R. C. Wilson
Project Manager

cc: N. Garg, NUS w/enc.
A. Ballav, NUS w/enc.
B. J. Reckman, NUS w/o enc.
J. L. Renehan, NUS w/o enc.
S. B. Gerges, NUS w/o enc.

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## ILLUSTRATIONS
(Section 1)



## TABLES
(Section 1)

RECORD OF REVISIONS

| Revision Number | Effective Date | Pages Affected | Description of Change |
|---|---|---|---|
| 1 | 9/21/82 | 6 | See changes as marked with revision line on right margin |
| 1 | 9/21/82 | 12 | |

CONTINENTAL WIRE & CABLE COMPANY 600V AND 1000V CABLES
WITH SILICONE RUBBER INSULATION & HYPALON JACKET
(SPEC. NO. NUS-326)
SURRY UNIT 2

QDR-5437-131-01

## SECTION #1

COMPLETE CHECKLIST,
FIGURES, & WORKSHEETS

| Rev | Date | By | App |
|---|---|---|---|
| 1 | 9/21/82 | [illegible] | NG |
| | | | |
| | | | |

Form QDR-3/01/80
Client ID: Virginia Electric & Power Company
Plant: Surry Unit 2

Sheet 1
QDR-5437-131-01

## Qualification Document Review Checklist

Review for: DOR Guidelines ☒ NUREG-0588 ☐

1. Name of the Reviewer: C. J. Endlich Date: 4/6/82
2. Equipment Covered: 600 and 1000V Cables with Silicone Rubber Insul. & Hypalon Jacket, Manufactured by Continental Co.
3. Equipment Tag No(s).: See Spec. No. NUS-326

| | | YES | NO | NA | Page Ref. |
|---|---|---|---|---|---|
| 4. | Does the report address all of the Class IE equipment in this category listed in the master IE equipment list? | | X | | See Attachment 1 |
| *5. | Is the report traceable to the plant equipment? | X | | | See Attachment 1 |
| *6. | Does the report specify an acceptance criteria for equipment performance? | X | | | See Attachment 1 |
| *7. | Was a base line test done to establish the reference basis? | X | | | See Attachment 1 |
| *8. | Do the maximum and/or accident temperature and pressure used in the test envelope those for the plant? (Table 1) | X | | | See Figures 30 & 30A (Attached) See Attachment 1 |
| 9. | Are thermal aging parameters chosen and used in the tests supported by adequate documentation or references? Note: Aging times less than 100 hrs not acceptable. | X | | | See Attachment 1 |
| *10. | Is radiation aging addressed? (Test or analysis. If analysis, is adequate documentation provided?) | X | | | Ref. Documents 61 and 63, Ref., Page 3 |
| *11. | Does the radiation dose profile, i.e., integrated dose for normal operations and accident for the plant, fall within the envelope used in qualifications? | X | | | Same as item 10 |

NOTE: Asterisk * indicates items applicable to DOR guidelines.

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Client ID: Virginia Electric & Power Company
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| | Yes | No | NA | Page Ref. |
|---|---|---|---|---|
| *12a. Does the total integrated dose include Beta radiation? | | X | | See Attachment 1 |
| b. If not is there an analysis for this? | X | | | |
| c. Is it required? | X | | | |
| 13. Was humidity aging considered? (Not required for cables.) | | | X | |
| 14. Was vibration (ambient) aging addressed? | | | X | |
| *15. Was mechanical and/or electrical cycling addressed? | | | X | |
| *16. Do the DBE test parameters meet or exceed those given in the specification? Make a copy of the temperature envelope used in the test and superimpose it on the required environmental envelope. Assure that deviations between the two are justified in the report. | X | | | See Figures 30&30A (Attached) and Attachment 1 |
| 17. Does DBE temperature envelope used in the test contain the double peak required by IEEE-323-74? | | | X | |
| *18. Does the DBE qualification include chemical spray? (Test or analysis) | | X | | See Attachment 1 |
| 19. Does the spray concentration used in tests meet or exceed those to be used for the plant? | | X | | |
| 20. Was the spray testing done while under the extremes of pressure and temperature? | | X | | |
| *21. Are the margins used in DBE test parameters defined? | | X | | See Attachment 1 |
| 22. Do the margins conform to those required by IEEE-323-1974 and any applicable daughter standard for this equipment? | X | | | |

Form QDR-3/?1/80
Client ID: Virginia Electric & Power Company
Plant: Surry Unit 2

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| | Yes | No | NA | Page Ref. |
|---|---|---|---|---|
| *23. Did the specification provide the required operating time for the equipment in the DBE or other specified harsh environment? | X | | | 90 Day Review Worksheet 6-60 |
| *24. Does the test operating time under the harsh environment equal or exceed that in the equipment specification? Assure that adequate justification is provided for deviation. | X | | | See Figures 30 & 30A and Attachment 1 |
| *25. Does the specification call out the submergence requirements if any? | | | X | |
| *26. Does the test program include submergence tests? If not assume that the justification is provided. | | | X | |
| *27. Is the accuracy demonstrated during testing equal to or better than that specified? | | | X | |
| *28. Are the mounting and installation interfaces used in the test configuration similar to those used in the plant? | | | X | |
| 29. Was the test measuring equipment (TME) calibration addressed in the report? | | X | | See Attachment 1 |
| 30. Does it specify that the calibration of the TME is traceable to NBS or other secondary standards? | | X | | See Attachment 1 |
| 31. Was the seismic testing/analysis done on aged component or equipment? | | | X | |
| 32. Did the seismic testing/analysis address effects of age? | | | X | |
| 33. Does the seismic test response and/or criteria used envelope the required response spectra for the plant? | | | X | |

Form QDR-3/01/80
Client ID: Virginia Electric & Power Company
Plant: Surry Unit 2

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QDR -5437 -131-01

| | Yes | No | NA | Page Ref. |
|---|---|---|---|---|
| *34. Was the same test specimen subject to the entire test sequence? (Including aging tests? - NUREG 0588) | X | | | See Ref. No. 63 |
| *35. Compare the block diagram for this report against the one you have prepared from your understanding of what test and procedures are required as per IEEE-323-1974 and any applicable daughter standard for this equipment. Do you believe the report meets the intent of these standards? | X | | | Figures 1 and 2 (Attached) |
| *36. Is the qualified life (QL) explicitly stated? Fill this information in the master IE equipment list. | | X | | Ref. Doc. 61, Arrhenius Plot See Attachment 1 |
| *37. Do the aging tests/analysis results support the QL conclusion and is adequate documentation provided to support this conclusion? | X | | | |
| *38. Review the test results on a relative comparison basis (i.e., performance parameters of the base line tests versus those during the various tests). Was there any major discrepancy? | | X | | |
| *39. If so, was it satisfactorily explained in the report? | | | X | |
| *40. Are maintenance requirements and component replacement intervals specified? | | | X | |
| *41. Have you compared maintenance and replacement requirements to those in the standard instruction/maintenance manuals and identified any special items in Table 2? | | | X | |

**List all the reference documents used for this review by their titles and identification no., with their revision level and date.**

1) IE Bulletin No. 79-01B, January 14, 1980.

2) VEPCO Specification No. NUS-326, Rev. 1 dated June 20, 1969.

3) VEPCO 90 day review submittal to NRC dated Aug. 24, 1981.

4) Environmental Zone description for Surry Power Plant dated Aug. 24, 1981.

5) Ref. Doc. No. 61:
   i) Letters, Anaconda Erricsson Inc. to S&W Eng. Corp., Dated 10/8/80, 10/21/80 and 12/10/80.
   ii) Data Sheet on Physical Properties of compound CC-2115, silicon rubber after conditioning simulating a LOCA condition, Rev. 1, 3/28/80.
   iii) Arrhenius Plot, Figure IV, dated 6/30/78.

6) Ref. Doc. No. 63: Continental Wire and Cable Company, Final Report F-C2935, dated October, 1970 & Addendum to final report F-C2935 (Ref. 1).

TABLE 1

Special Environmental Requirements

600V & 1000V Silicone Rubber Continental Cables

| PARAMETER | SPECIFIED | QUALIFIED | DOCUMENT REFERENCE SPECIFIED | DOCUMENT REFERENCE QUALIFIED |
|---|---|---|---|---|
| OPERATING TIME | 120 Days | >120 Days | Westinghouse Letter No. NS-SS-79287 | Ref. Doc. No. 61 and QDR Attachment 1 |
| TEMPERATURE | Max: 120°F<br>Min: 105°F<br>Accdt: 280°F | 298°F Max. | S&W Calc. 12846.44-US (B)-052-1 | Ref. Doc. No. 61 and QDR Attachment 1 |
| PRESSURE | Normal: 9.0-11 psia<br>Accdt: 58.7 psia | 0-50 psig | As Above | Ref. Document No. 61 |
| RELATIVE HUMIDITY | Oper: N.C.*<br>Accdt: 100% | 100% | As Above | Ref. Document No. 61 |
| RADIATION | Oper: $1.3 \times 10^7$ Rads<br>Accdt: $2.4 \times 10^7$ Rads | $1 \times 10^8$ Rads | S&W Calc. 12846.54-RP-038-1 | Ref. Document No. 61 & 63 |
| SUBMERGENCE | N/R** | N/R | Env. Zone Description Table RC-3A | |

* N.C. = Not Calculated

** N/R - Not Required

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Client ID: Virginia Electric & Power Company
Plant: Surry Unit 2



Table 2

Special Requirements

1. Maintenance Requirements/Intervals

   N/A

2. Replacement Requirements/Intervals

   N/A

3. Storage Requirements*

   N/A

4. Installation Requirements*

   N/A

*Applies to spare parts and replacement only for operating plants.

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Client ID: Virginia Electric & Power Company
Plant: Surry Unit 2

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QUALIFICATION REPORT REVIEW SUMMARY

1. Equipment Qualification Reviewed: Test Reports on Silicone Rubber High Temperature Cable, Manufactured by Continental Wire and Cable Company (Reference Nos. 61 & 63)

2. Status of Qualification Records:

X Records identified (Full/~~Partial~~), obtained (Full/~~Partial~~), and review (Full/~~Partial~~) summarized on QDR-3/01-80 forms.

____ The following additional documents have been requested:

1. ____ 2. ____
3. ____ 4. ____
5. ____ 6. ____

____ Following areas/documents require additional review:

1. ____ 2. ____
3. ____ 4. ____
5. ____ 6. ____

____ Other comments on status of qualification records:

3. Status of Qualification

X Equipment qualification meets the DOR guidelines. For additional comments and recommendations, see section 5.

____ Additional evaluation is needed to justify qualification status. Details of additional evaluation needs attached.

____ Qualification tests consistent with the recommendations of NUREG-0588 for Category 1 equipment should be performed on the equipment.

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Client ID: Virginia Electric & Power Company
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_____ Equipment should be relocated to an area where it will not be exposed to a harsh environment.

_____ Other recommendations:

_______________________________

_______________________________

_______________________________

5. Additional Comments/Recommendations

1) In response to the deficiencies listed in NRC's "Ten Day Letter" of April 2, 1981, N08.1-N03-002, Re. Spec. No. NUS-326, the test data show the following:

   a) QT: 120 days (Question No. 8 of Attach. #1 of this QDR).
   b) CS: 120 hrs. immersion in .5% boric acid solution (5000 ppm B) at 150°F (Ref. Doc. No. 61, data sheet on silicone rubber and Question 18 of Attachment #1 of this QDR).
   c) A : 1200 hrs. at 210°C (Ref. Doc. No. 61, Arrhenius Plot, and Question 9 of Attach. #1 of this QDR).
   d) QM: Type testing and analysis (Ref. Doc.'s 61 & 63; and Attachment #1 of this QDR).
   e) QI: Qualification Documents were obtained (Ref. Doc.'s 61 and 63).

   Conclusion: All the deficiencies have been resolved against these cables and NUS finds them qualified.

2) See Attachment #1 for additional comments.

Environmental qualification documents for the equipment identified herein have been reviewed and determined to be adequate and auditable.

| | | | |
|---|---|---|---|
| Prepared by: | C. J. Endlich | Date: | 4/6/82 |
| Certified by: | N. K. Garg N. Garg | Date: | 4/28/82, 9/20/82 |
| | A. K. Ballav | Date: | 9/1/82 |
| | | Date: | |

VEPCO's review and approval of NUS comments and recommendations

_______________ Date _______________

ATTACHMENT #1

ADDITIONAL INFORMATION/CLASSIFICATIONS/JUSTIFICATIONS

Question No. 4

NUS evaluated the test specimen cited in this report against those types of cables used in the plant and determined this report to be adequate in establishing qualification of the following 600V and 1000V cables with silicone rubber (compound CC-2100) insulation and hypalon jacket used in the Surry Plants:

| | | |
|---|---|---|
| 4/0, | Insulation Thickness .078, | Jacket thickness .060 (triplex) |
| 1C-1/0, | Insulation Thickness .078, | Jacket thickness .060 |
| 1C-#4 , | Insulation Thickness .062, | Jacket thickness .045 |
| 1C-#8 , | Insulation Thickness .062, | Jacket thickness .045 |
| 1C-#12, | Insulation Thickness .047, | Jacket thickness .030 |
| 1C-#16, | Insulation Thickness .047, | Jacket thickness .030 |
| 2C-#8 , | Insulation Thickness .062, | Jacket thickness .060 |
| 6C-#16, | Insulation Thickness .047, | Jacket thickness .060 |
| 6C-#2-6, | Insulation Thickness .078, | Jacket thickness .080 |
| 6C-#4-8, | Insulation Thickness .078, | Jacket thickness .080 |
| 7C-#12, | Insulation Thickness .062, | Jacket thickness .080 |

Question No. 5

NUS compared the insulation systems of the test specimen in the test report versus the insulation system of the cables used in the plant by document research (Ref. Report No. 61) and determined that this report is applicable for establishing qualification status of the cables, cited in Question 4, above.

Question No. 6

Satisfactory performance of cables, as specified in the report, is based on:

1. Demonstration of good physical characteristics such as elongation retention of 50% or better of the original after thermal aging per Ref. Doc. 61.

2. Acceptable tensile strength (40% of original) after being exposed to harsh environment per Ref. Doc. 61.

3. Maximum leakage current of 1.3 MA at 2 KV or 3.5 MA at 4 KV and IR value of 53 M ohm minimum (Table 1 of Reference Report #63.)

NUS finds these minimum performance criteria acceptable.

ATTACHMENT #1

Question No. 7

The following base line tests were done, as shown in Ref. Doc. No. 61.

Tensile strength and elongation

Question Nos. 8, 16 & 24

i) FIRL conducted a steam pressure test on a preconditioned (66°C, 100% RH for 6 hrs) cable sample at 340°F for 2 hrs and 160°F for 20 hrs (Section B & C of Ref. Report No. 63) with no chemical spray.

ii) Continental Company conducted a LOCA test of 240 hrs as shown in Fig. 30 & 30A. The following analysis shows that this Continental Company's LOCA test is more severe than the plant required LOCA conditions. In Figure 30, 50 psi steam (Ref. Report No. 61) is taken as equivalent to 298°F (Ref. Page A-13 of CRANE Technical Paper No. 410, 1979).

ANALYSIS:

LOCA Requirements vs. Conducted LOCA Test Calculations

The first 48 hrs of the test which envelops the peak accidental conditions are not considered in the following calculation, only last 72 hrs of test at 298°F are considered.

Using Arrhenius Equation:

$$T_x = T_L e^{-\frac{\phi}{K}\frac{(T_2 - T_1)}{T_1 x T_2}}$$

$T_x$ = LOCA test period at $T_2$ in hrs.

$T_L$ = Required time of LOCA = 118 days = 2832 hrs at 120°F

$\phi$ = Activation energy, EV (1.14 for silicone rubber per EPRI NP-1558, Final Report, September 1980, Appendix B)

K = Boltzmann's Constant $8.617 \times 10^{-5}$ EV/°K

ATTACHMENT #1

Question Nos. 8, 16 & 24 (Cont'd)

$T_2$ = Elevated Temperature to be used in °K (298°F = 148°C = 148 + 273 = 421°K)

$T_1$ = 120°F = 48°C = 48 + 273 = 321°K

Substituting the values in the above equation and solving:

$$T_x = 2832e^{\frac{-1.14(421-321)}{8.617 \times 421 \times 321 \times 10^{-5}}}$$

$T_x$ = 0.16 hr < 72 hrs.

Conclusion: Hence it is evident that the conducted LOCA test (120 hrs @ 298°F & 120 hrs @ 150°F) is much more severe than the required LOCA conditions of the plant.

Question Nos. 9, 36 & 37

Continental Wire and Cable Company developed an Arrhenius plot (Fig. IV of Ref. Report No. 61) for silicone rubber compound CC-2115, (originally no. CC-2100) with an end point criteria of 50% elongation. This plot indicates that at 125°C rating of the cable as required by Spec. NUS-326, it has an enormous life (much more than 40 yrs).

Hence we consider these cables to have a qualified life of 40 yrs.

Question No. 12

Subject cables per Question No. 4 above shows a minimum of 77 mils of insulation (47 mils silicone rubber insulation and 30 mils hypalon jacket). According to IE Bulletin No. 79-01B, dated January 14, 1980, Enclosure 4, Section 4.1 (Beta Radiation Doses) the conservative unshielded surface beta dose of $2 \times 10^8$ rads would therefore be reduced by a factor of $10^2$, leaving a conservative unshielded surface beta dose of $2 \times 10^6$ rads maximum. The specification calls for a total gamma radiation dose of $3.7 \times 10^7$ rads. The total radiation dose used for qualification (which is $1 \times 10^8$ rads) is more than one order of magnitude higher than the required dose and therefore the effect of Beta dose to sensitive internals is considered negligible.

ATTACHMENT #1

Question Nos. 18, 19 and 20

As per Ref. Doc. No. 61 the sample cable was immersed in a 0.5% (5000 ppm B) boric acid solution for 120 hrs at a temperature of 150°F as part of a LOCA incident simulation with tensile strength and elongation values as shown after different levels of radiation. NUS finds this immersion test more severe than the chemical spray test as specified in worksheet 6-60 (Spec. No. NUS-326).

Question Nos. 21 and 22

Margin is defined as the difference between the most severe specified service condition which exists in the plant and conditions used during DBE tests of specimen to account for normal variations in commercial production of equipment and reasonable errors in defining satisfactory performance. Margins for temperature and pressure (See Fig. 30 and 30A attached), chemical spray (see Question No. 18 above), radiation (see Ref. Doc. Nos. 61 & 63), and thermal aging (see Question 9 above) are adequately addressed. Therefore in accordance with IE Bulletin No. 79-01B, dated January 14, 1980, Enclosure 4, Section 6.0, the DBE test satisfies the guidelines as outlined in sections 4.0 and 5.2 of the aforementioned bulletin and no separate margin factors are required to be added.

Question Nos. 29 & 30

Test measuring equipment calibration as well as traceability to NBS are not considered critical since generally the test facilities have a quality control procedure which is recognized by the industry and which assures proper maintenance of the calibration of the TME.

CONTINENTAL CABLE AND WIRE CORPORATION (ANACONDA COMPANY)
QUALIFICATION TEST SEQUENCE BLOCK DIAGRAM

| | |
|---|---|
| EQUIPMENT COMPARISON | QUESTIONS 4 & 5 OF ATTACHMENT 1 |
| THERMAL AGING | REF. DOCUMENTS 61, FIG. IV, (QUESTION 9 OF ATTACHMENT 1) |
| RADIATION EXPOSURE | REF. DOCUMENTS 61, DATA SHEET ON CC-2115 SILICON RUBBER AND 63, REF. 1, PAGE 3 (QUESTION 12 OF ATTACHMENT 1) |
| EXPOSURE TO LOCA | REF. DOCUMENT 61, LOCA CONDITION: 120 HRS. AT 298°F/50 PSIG AND 120 HRS IMMERSION IN 0.5% BORIC ACID SOLUTION AT 160°F; RADIATION LEVELS $1x10^7$ RADS, $5x10^7$ RADS AND $1x10^8$ RADS (QUESTIONS 8 & 18 OF ATTACHMENT 1) |
| MARGINS | QUESTION 21 OF ATTACHMENT 1 |
| DOCUMENTATION | COMPILED CABLE DOCUMENTATION (SHT. 5 OF QDR-5437-47-01) |

FIGURE 1

NOTE: THE ABOVE BLOCK DIAGRAM IS COMPARED WITH FIGURE 4 (BLOCK DIAGRAM FROM DOR GUIDELINES). NUS FINDS THAT THIS MEETS THE INTENT OF FIGURE NO. 4.

DOR GUIDELINES BLOCK DIAGRAM FOR
EQUIPMENT QUALIFICATION

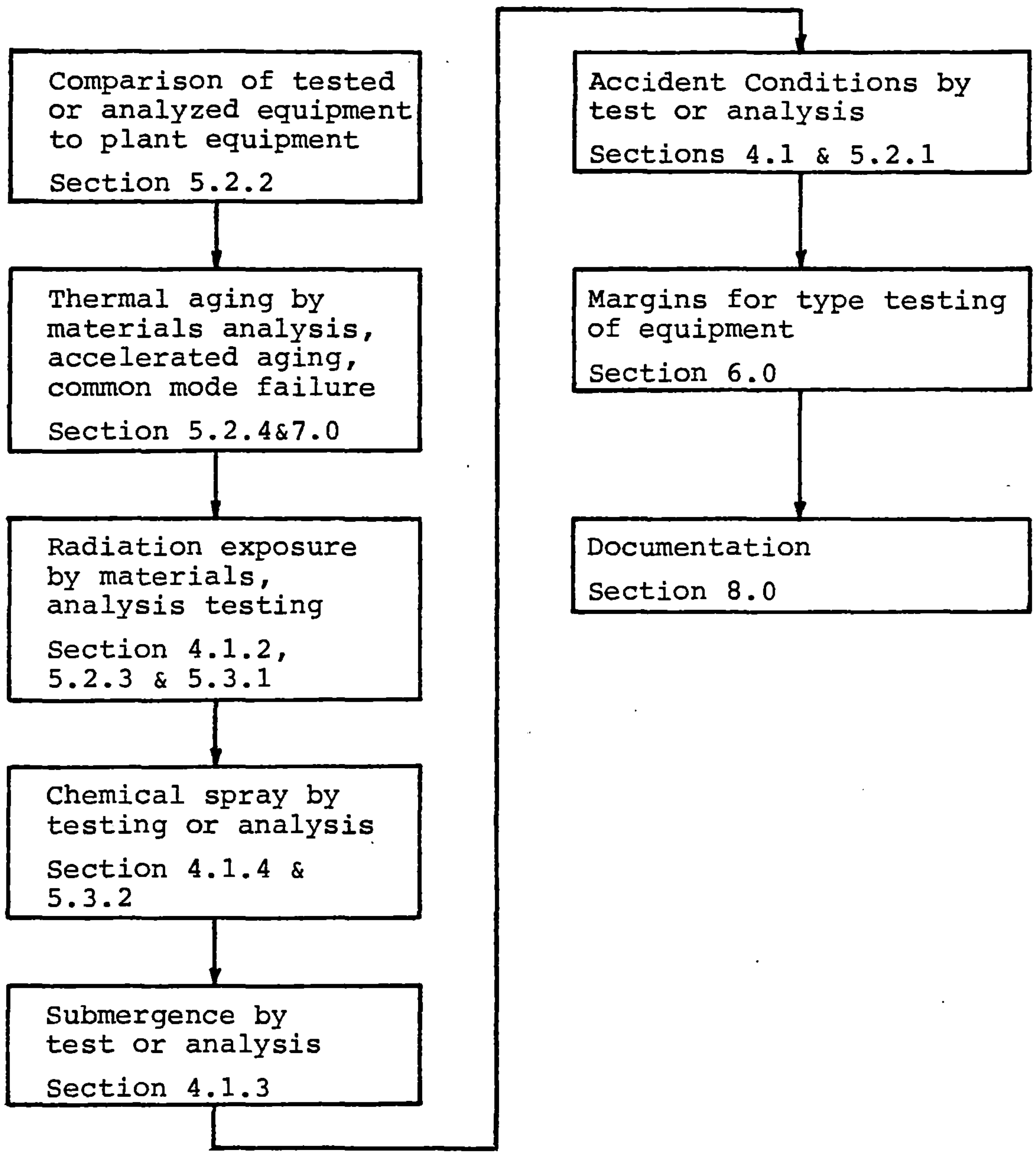
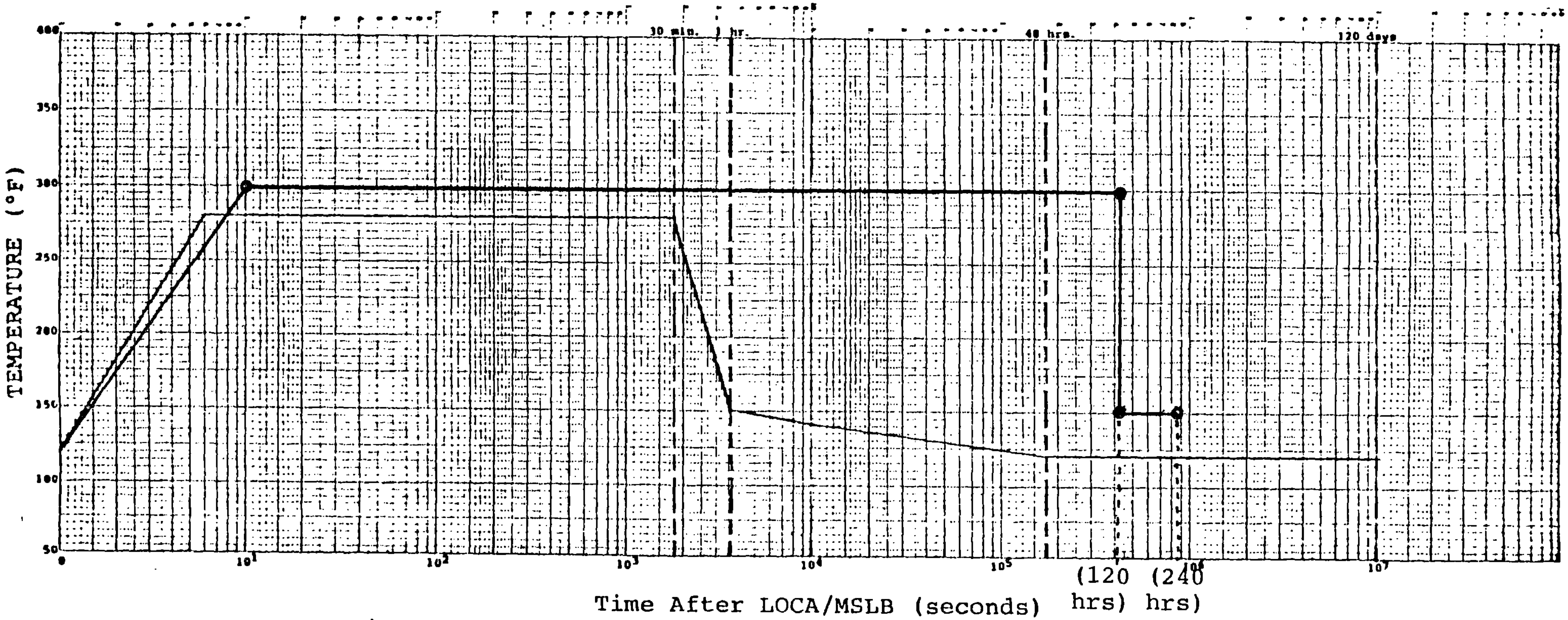



FIGURE 2




NOTE: Affect of conducted LOCA Test is more severe than the required Plant LOCA Conditions (See Question 8 in Attachment 1)

——— LOCA PROFILE [Ref.: S&W Calculation No. 12846.44-US(B)-052-1 for Zone RC-3A]

o———o ACTUAL TEST PROFILE (Ref. Report No. 61, Data Sheet on Physical Properties of CC-2115, Rev. 1, dated 3-28-80)

LOCA/MSLB TEMPERATURE TRANSIENT

FIGURE 30

Rev. 1 Dated 9/21/82
Sheet 16
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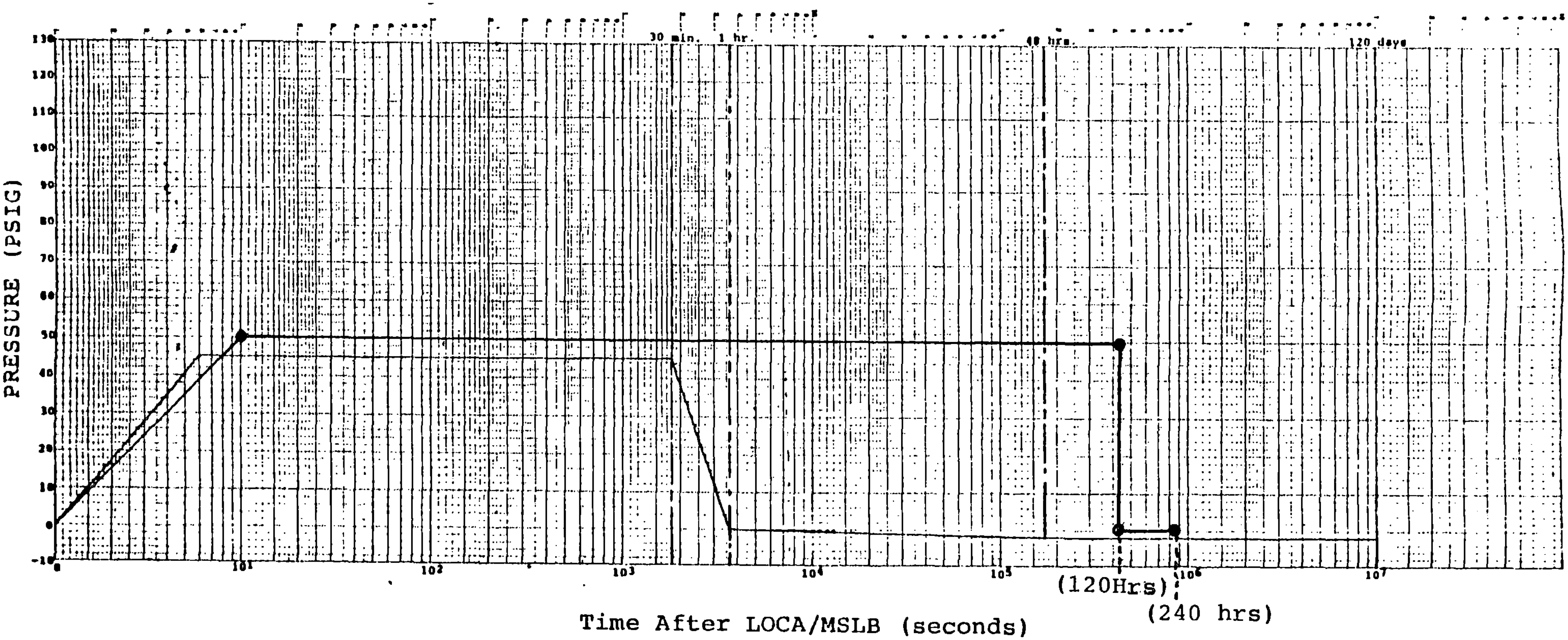
Surry Unit 2




LOCA PROFILE [Ref.: S&W Calculation No. 12846.44-US(B)-052-1 for Zone RC-3A]

ACTUAL TEST PROFILE (Report No. 61, Data Sheet on Physical Properties of CC-2115, Rev. 1, dated 3-28-80)

LOCA/MSLB PRESSURE TRANSIENT

FIGURE 30A

Rev. 1 Dated 9/21/82
Sheet 17
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Surry Unit 2

Facility: VEPCO, SURRY
Unit: 2
Docket: 50-281

# SYSTEM COMPONENT EVALUATION WORK SHEET - 90 DAY REVIEW

| SYSTEM: COMMON ELECTRICAL EQUIPMENT | Units | Environment Specification | Environment Qualification | Documentation Reference Specification | Documentation Reference Qualif. | Method | Outstanding Items |
|---|---|---|---|---|---|---|---|
| EQUIPMENT DESCRIPTION | OPER. TIME | 120 days | ~~Note 1~~ > 120 Days | Westinghouse Ref. Ltr. No. NS-SS-79287 | ~~Note 1~~ 61, 63, 150 | ~~Note 1~~ analysis + Type Test | ~~Note 1~~ None |
| PLANT ID NO. Spec. No. NUS-326 P.O. No. 330 | TEMP °F | See Fig. 30 ~~280F, 0-30 min, 280-150F, 30-60 min, 150-120F, 1-48 hr, 120F, 2-120 days~~ | See Fig. 30 ~~340F, 0-2 hr, 340-160F, 2-6 hr, 160F, 6-26 hr~~ | ~~VEPCO-NRC 11-22-77 No. NUS 382A/092477~~ S+W Calc. 12846.44-US(B)-052-1 | ~~61, 63~~ 61, 63, 150 | Type Test + analysis | ~~Note 1~~ None |
| COMPONENT: High Temperature Cable | | | | | | | |
| MANUFACTURER: Continental Wire and Cable Company | PRESS. psia | See Fig. 30A ~~58.7, 0-30 min, 58.7-12.7, 30 min-48 hr, 12.7, 2-120 days~~ | See Fig. 30A ~~114, 0-2 hr~~ | ~~VEPCO-NRC 11-22-77 No. 382A/092477~~ | ~~61, 63~~ 61, 63, 150 | Type Test + analysis | ~~Note 1~~ None |
| MODEL NUMBER: Silicon Rubber | REL. HUM. % | 100 | 100 | ~~VEPCO-NRC 6-80 No. 535~~ | ~~61, 63~~ 61, 63, 150 | Type Test | ~~Note 1~~ None |
| FUNCTION: Supply power to safety system | CHEM. SPRAY | $H_3BO_3$ (2,000-2,200 ppm B) buffered to pH of 8.5-11 NaOH, 0-4 hr | ~~Note 1~~ Immersion in 5000 ppm boric acid solution for 120 hrs at 150°F | ~~VEPCO-NRC 6-80 No. 535~~ | ~~Note 1~~ 61, 63, 150 | ~~Note 1~~ Type Test + analysis | ~~Note 1~~ None |
| ACCURACY: Spec: NR Demo: | | | | | | | |
| | RAD. | LOCA = 2.4 x 10E7 40 Yr = 1.3 x 10E7 | 1 x 10E8 | S&W Calc. 12846.54-RP-038-1 | 61, 63, 150 | Type Test | ~~Note 1~~ None |
| LOCATION: RC-3A Inside Containment Inside Cranewall SERVICE: | AGING | 40 Yrs. ~~Enclosure 4 Guidelines Section 7.0~~ | 40 yrs. | VEPCO Spec. NUS-326 | 61, 63, 150 | Analysis + Type Test ~~Refer to Report Sec. 3.1.2 (Aging)~~ | None |
| FLOOD LEVEL ELEV: -21'11" ABOVE FLOOD LEVEL: X Yes No | SUB. | ~~21'11"~~ NR | NR | Env. Zone Description ~~S&W Calc. 12846-01 -030-0~~ Table RC-3A | NR | NR | None |

NR = Not required. All numbers written in Documentation Reference Qualification column are identified in Section 8.



OK,

Rev. 1 Dated 9/21/8
Sheet 18
QDR-5437-131-01
Surry Unit 2

SECTION #2

SPECIFICATIONS, PURCHASE ORDERS,
VENDOR PROPOSAL

VEPCO SPECIFICATION NO. NUS-326
(FOR SILICONE RUBBER CABLES)
DATED JUNE 20, 1969

CENTRAL FILING DEPARTMENT
Surry Power Station
NO. 20 1.7.1PA
Cable, Conductors & Wires

J.O. Nos. 11448/11548
NUS-326

April 14, 1969
Revised June 20, 1969

# SPECIFICATION

## FOR

## SILICONE RUBBER CABLE

## FOR

## SURRY POWER STATION
## 1972 EXTENSION - SURRY POWER STATION

## VIRGINIA ELECTRIC AND POWER COMPANY

## RICHMOND, VIRGINIA

-:-

| REVISIONS | REV. 0 | REV 1 | REV. 2 | REV. 3 |
|---|---|---|---|---|
| Prepared By / Lead Engr. Approval | RWC / HVR | RWC / HVR | | |
| Project Engineer Approval | VAS | VAS | | |
| Equipment Specialist Review | G.B. | G.B. | | |
| Quality Assurance Review | G.B. | G.B. | | |

**STONE & WEBSTER ENGINEERING CORPORATION**

**BOSTON, MASSACHUSETTS**

bc: CENTRAL [illegible] DEPARTMENT
Mr. W. L. Proffitt) [illegible]
~~Mr. W. H. Wills~~
NO Station Superintendent

Cable, Conductors - Wires

June 11, 1969

J. O. Nos. 11448
11548

NUV-2267

Stone & Webster Engineering Corporation
225 Franklin Street
Boston, Massachusetts 02107

Gentlemen:

SILICONE RUBBER CABLE
SURRY POWER STATION
1972 EXTENSION - SURRY POWER STATION

We have reviewed your letter NUS-3456, dated May 20, 1969, and specification for silicone rubber cable.

The specification is approved with the following revisions:

1. Change paragraph 6 to the following:

   Cables that are specified for use in nuclear power stations must be capable of withstanding over the expected life of the cable a total radiation dose of 10[illegible] rads without any significant change in physical and electrical properties.

2. Add a shop quality control inspection sheet for the 1000 v cable.

The recommended bidders are approved with the following additions:

1. Continental Wire and Cable Company
2. Brand Rex Company
3. Essex Wire and Cable Company
4. Okonite Company

Very truly yours,

WMWJr

Stanley Ragone
Vice President

cc: Mr. O. H. Knutson
Mr. D. B. Armstrong

WCS
WCS/jpc
SPD
D. R. [illegible]

**STONE & WEBSTER ENGINEERING CORPORATION**

225 FRANKLIN STREET, BOSTON, MASSACHUSETTS 02107

NEW YORK
BOSTON
CHICAGO
GARDEN CITY
HOUSTON
LOS ANGELES
SAN FRANCISCO

AIR MAIL

DESIGN
CONSTRUCTION
REPORTS
APPRAISALS
EXAMINATIONS
CONSULTING
ENGINEERING

Mr. E. B. Crutchfield
Senior Vice President
Virginia Electric and Power Company
7th and Franklin Streets
Richmond, Virginia 23209

May 20, 1969

J.O.Nos. 11448
11548

NUS-3457

Dear Sir:

SILICONE RUBBER CABLE
SURRY POWER STATION
1972 EXTENSION - SURRY POWER STATION

We enclose for your review and comments four copies of NUS-326, Specification for Silicone Rubber Cable dated April 14, 1969.

All items in this specification are for use in high temperature ambient conditions, or for engineered safety equipment. Items 1 through 6 are to be used for electrical penetrations. Item 1 is also used for the inside recirculating spray pump motors (2 conductors per phase). Item No. 7, power cable to the pressurizer heaters, will be run from the pressurizer to a local junction box approximately 20 ft away; Item No. 8. will be used for signal cables to the position coils of the control rods; Item No. 9 describes power cable to the lift, stationary and movable gripper coils of the full length control rods; and Item No. 10 describes power cable to the part length control rods.

Items Nos. 8, 9, and 10 will be run from the control rods to a recessed floor connection box approximately 35 ft away. Items Nos. 9 and 10 specify 1,000 v insulated cable because of the possibility of d-c transients.

Paragraph 12 on page four, Inspection and Test Reports, is incorrect and will be updated in accordance with our latest instructions prior to requesting bids.

We recommend that bids be solicited from the following:

1. Anaconda Wire and Cable Company
2. Collyer Insulated Wire Company
3. General Cable Corporation
4. General Electric Company, Wire and Cable Department

5. Kaiser Aluminum and Chemical Sales, Inc.-
   Electrical Conductor Division
6. Phelps Dodge Copper Products Corporation
7. Rome Cable Division Cyrus Mines Corporation.
8. Simplex Wire and Cable Company
9. Continental Wire and Cable Co., Division of Gulton Ind.

We should appreciate receiving your comments on the enclosed specification and recommended list of bidders at your earliest convenience.

10. Brand Rex Co

Yours very truly,

V. A. Suziedelis

V. A. Suziedelis
Project Engineer

Enclosures

RWC:KK

STONE & WEBSTER ENGINEERING CORPORATION, Engineers

Boston, Massachusetts

J.O. No. 11448/11548
Order No. _____
NUS-326


Date April 14, 1969
Revised June 20, 1969

# SPECIFICATION FOR SILICONE RUBBER CABLE FOR SURRY POWER STATION

## VIRGINIA ELECTRIC AND POWER COMPANY

Seller: ________________________________

SCOPE - This specification covers the number and types of units to be supplied, conditions of service, required performance, materials and construction of each unit appearing in the schedule.

SECTIONS - In addition to this summary and schedule, the complete specification is composed of the following:

| Equipment Data | Form No. | Pages |
|---|---|---|
| Specific Requirements For Silicone Rubber Cable | | 9 |
| Schedule A - 600 V Silicone Rubber Cable | | 1 |
| Schedule B - 1,000 V Silicone Rubber Cable | | 1 |
| Quality Assurance, Nuclear Plant Machinery, Equipment and Materials | N1004-2-69 | 2 |
| Inspection Report - Shop Quality Control | QCD-101 | 2 |

NOTES - The elevation of the project site is 27.5 ft.

After receipt of order, the Seller shall submit:

4 copies of all correspondence.

\- reproducible prints of outline drawings for comments within _____ weeks after award of work.

\- reproducible prints of detail drawings for comments within _____ weeks after award of work.

\- reproducible prints of drawings as finally released by the Engineers.

See Par 13 reproducible prints of final test characteristic curves for record.

13 sets of complete installation, operating and maintenance instructions, including parts identification list, at least _____ weeks prior to initial shipment of equipment.

\- copies of quotations for spare parts, at least _____ weeks prior to initial shipment of equipment.

SCHEDULE OF EQUIPMENT TO BE FURNISHED BY SELLER

| Mark No. | Data Sheets Page No. | Data Sheets Revision | Service |
|---|---|---|---|

J.O.Nos. 11488/11548
NUS-326

# SPECIFIC REQUIREMENTS

# FOR

# SILICONE RUBBER CABLE

-:-

Unless otherwise specified the latest standard specification of ASTM and IPCEA shall apply.

## 1. GENERAL

This specification covers the requirements for single/multiple-conductor cable in sizes 16 through 4/0 AWG for use on alternating current or direct current control circuits operating in wet or dry locations at a maximum ambient temperature of 125 C. The cables shall be suitable for installation in cable trays, underground ducts, conduit or direct burial in earth. All wire and cable shall be manufactured, inspected and tested in accordance with the latest applicable IPCEA Standards Publication except as modified herein.

## 2. QUANTITY REQUIRED

The accompanying schedule gives the size, number of conductors, and length of the items required and other descriptive data. The Purchaser is to have the privilege of increasing or decreasing the quantity of any item not more than 10 percent at the unit price before manufacture is started.

## 3. DESIGN

The cables shall consist of stranded, tinned copper conductors insulated with heat, flame and moisture resistant, silicone rubber. The conductors shall be laid up with nonhygroscopic, fire resistant fillers as necessary to form a compact cable and the cables shall be covered with a flame resistant tape binder and an overall jacket of heat, moisture, oil, abrasion and flame resistant hypalon compound or equivalent.

## 4. VOLTAGE RATING

Cables shall be rated 600 v, or 1,000 v, as specified in the cable schedules covering the specific requirements.

5. CONDUCTORS

Conductors shall be of stranded, annealed, tin-coated copper wire in accordance with ASTM B33. Stranding shall be Class B, C or D as specified in the cable schedules.

6. RADIATION RESISTANCE

Cables that are specified for use in nuclear power stations must be capable of withstanding over the expected life of the cable a total radiation dose of $10^8$ rads without any significant change in physical and electrical properties.

7. CONDUCTOR IDENTIFICATION

All insulated conductors shall be identified in accordance with IPCEA Method 1, color coding, or Method 3, printed numerals and words.

8. PHYSICAL AND ELECTRICAL PROPERTIES

The physical and electrical characteristics of the insulation and jacket compounds covered by this specification are summarized below. All fill-in data are to be completed by the manufacturer. In addition to the tabulated data, the manufacturer shall submit details and results of tests that demonstrate radiation resistance of the insulation and jacket materials and the completed cables,

| Insulation Characteristics | Typical | Guaranteed |
|---|---|---|
| Type of compound | ______ | ______ |
| Insulation thickness, in. | | |
| 600 v | ______ | |
| 1,000 v | ______ | |
| Test voltage, 5 min a-c, kv | | |
| 600 v | ______ | |
| 1,000 v | ______ | |
| Insulation resistance constant, K(60 F) | ______ | ______ |
| Tensile strength, min psi | ______ | ______ |
| Elongation at rupture, min % | ______ | ______ |

| | | |
|---|---|---|
| After 7 days in air oven at 150 C | | |
| Tensile strength, min % unaged value | | |
| Elongation, min % unaged value | | |
| Heat distortion, 150 C max % | | |
| Water absorbtion, 7 days, 75 C water, Mg/sq in. | | |
| Water absorbtion, IPCEA EM-60, 75 C water | | |
| Change in SIC, 1 - 14 days, max % | | |
| Change in SIC, 7 - 14 days, max % | | |
| IPCEA Electroendosmosis, 16 wks, 50 C water, 600 v d-c neg | | |
| Change in SIC, max % | | |
| Stability factor, max | | |

<u>Jacket Characteristics</u>

| | | |
|---|---|---|
| Type of compound | | |
| Tensile strength, min psi | | |
| Elongation at rupture, min % | | |
| Tear strength, min lb/in. | | |
| Jacket thickness, mils | | |
| O.D. under jacket, in. | | |
| 0.425 or less | | |
| 0.426 - 0.700 | | |
| 0.701 - 1.500 | | |
| 1.501 - 2.500 | | |

9. INSPECTION

The Purchaser shall be permitted at any reasonable time to have his representative visit the manufacturer's plant for the purpose of examining and ascertaining whether or not the materials and processes used in the manufacture of the wire and cable conform to these specifications and whether or not work is progressing at a proper rate to meet schedule requirements.

10. REJECTION

The Purchaser shall have the right to reject any length of wire and cable which does not comply in every respect with this specification.

11. TESTS

All tests shall be made by the manufacturer. Each length of wire and cable shall be tested in accordance with the applicable IPCEA standard. Alternating current dielectric tests shall be made between each conductor and ground and between conductors of the completed cable.

Where personal inspection is called for, all tests shall be witnessed by the Purchaser or his representative, who shall have reasonable notification of the time and location of tests. Records of tests shall be furnished the Purchaser in triplicate.

12. INSPECTION AND TEST REPORTS

The original and nine copies of all written inspection and tests reports necessary to fulfill the requirements of this order/contract shall be delivered to the Purchaser's inspector if assigned, or sent to:

Stone & Webster Engineering Corporation
Inspection Department
225 Franklin Street
Boston, Massachusetts 02107

Reports shall be identified with Surry Power Station, Purchase Order Number, J.O.Nos. 11448 or 11548, and Equipment Title and/or Mark Number, as well as Seller's name and address to expedite any required communication.

Information marked with asterisks (***) is furnished by Seller. Data furnished by the Seller are included herein for Purchaser's information and use. The Seller is not relieved of responsibility for the correctness of design and details represented by the data. The Seller shall be responsible to

advise the Engineers promptly in writing of any changes in the data required to describe accurately the characteristics of the equipment as it is to be shipped or erected.

13. MARKERS

Each length of cable shall contain permanent markers in accordance with the specification under which it is manufactured. Where not covered by such specification, the manufacturer shall nevertheless provide permanent markers.

14. REELS, PACKING AND SHIPPING

The cable shall be shipped on substantial reels, suitably covered to protect the cable from injury during shipment. One length of cable shall be shipped on a reel with the cable ends sealed, secured and protected from injury. The manufacturer shall be responsible for any damage resulting from improper packing, sealing or blocking of the reels during transit.

STONE AND WEBSTER ENGINEERING CORPORATION
SCHEDULE A - 600 V SILICONE RUBBER CABLE
SURRY POWER STATION
1972 EXTENSION - SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

| Item No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Mark No. (later) | | | | | | | | |
| Quantity | 1,000 | 1,200 | 1,950 | 8,750 | 15,200 | 41,000 | 2,100 | 4,800 |
| No. of Cond. | Triplex | Single | Single | Single | Single | Single | 2/C | **6/C |
| Cond. Size, AWG | 4/0 | 1/0 | 4 | 8 | 12 | 16 | 8 | 16 |
| Type of Stranding | Class D | Class D | Class D | Class D | Class B | Class B | Class C | Class C |
| Insul. Thickness, mils | 78 | 78 | 62 | 62 | 47 | 47 | 62 | 47 |
| Jacket Thickness, mils | 45 | 45 | 30 | 30 | 15 | 15 | 30 | * |
| Net weight, lb/Mft * | | | | | | | | |
| Method proposed to identify* | | | | | | | | |
| Cable OD, in.* | | | | | | | | |

Note:

All cables shall be manufactured in accordance with the specific requirements for Insulated Wire and Cable NUS- .

* To be filled in by Seller.

** Cable Construction - 6/C (3 twisted pairs) with color coded glassbraids. The overall braid shall be tinned copper with high temp heat resistant jacket.

STONE AND WEBSTER ENGINEERING CORPORATION
SCHEDULE B - 1000 V SILICONE RUBBER CABLE
SURRY POWER STATION
1972 EXTENSION - SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

| | | |
|---|---|---|
| Item No. | 9 | 10 |
| Mark No. | | |
| Quantity | 4,800 | 500 |
| No. of Cond.** | 6 | 7 |
| Cond. Size, AWG | 2-6, 4-8 | 12 |
| Type of Stranding | Class C | Class C |
| Insul. Thickness, mils | 78 78 | 62 |
| Jacket Thickness, mils* | | |
| Net weight, lb/mft* | | |
| Method proposed to identify* | | |
| Cable OD in.* | | |

Note:

All cables shall be manufactured in accordance with the specific requirements for Insulated Wire and Cable, NUS- .

* To be filled in by Seller.

** Each conductor shall be covered with a color coded glass braid.

STONE & WEBSTER ENGINEERING CORPORATION

## QUALITY ASSURANCE
## NUCLEAR PLANT MACHINERY, EQUIPMENT, AND MATERIALS

### INTRODUCTION

Quality Assurance requirements in this specification exceed those normally acceptable for most work. Whenever these requirements are at variance with other statements in the specification, the more stringent requirements will supersede and govern.

### ACCESS FOR INSPECTION

The Seller shall afford the Stone & Webster inspector full cooperation and access to records and to the shop for inspecting equipment during fabrication and testing. The inspector will:

Make a material records check, including the chemical and physical test reports.

Check for Code compliance, including all referenced Codes and specifications.

Review the history of the equipment during fabrication and the remedy for any discovered flaws in materials or construction.

Check welding procedures and witness welding operations.

Undertake mill inspection of tube material, if any. The Seller shall arrange with his tube supplier for such inspection, including notification to Stone & Webster of readiness for inspection.

Witness of final assembly of the equipment.

Witness the running test of every item of equipment.

Witness the performance test on one item of each type of equipment.

Witness preparation for shipment.

### PROCEDURES

The manufacturer shall make readily available to the Owner's authorized representatives the written procedures of its Quality Assurance Program and a record of the inspections and tests made during manufacture of the items covered by this specification, as evidence of conformance with specified quality standards.

## RECORDS OF TESTS AND INSPECTIONS

The attached Form QCD-101 is a list of minimum test and inspection reports that shall be prepared and kept for permanent record. All such critical records, including chemical and physical test data, Code compliance and other certification reports, and radiographs* are to be turned over to the Stone & Webster inspector, who in turn will turn them over to the Owner for safekeeping for the duration of the life of the plant. This record-keeping is a requirement of the United States Atomic Energy Commission.

## COMPLIANCE WITH REFERENCED SPECIFICATIONS, CODES, AND PROCEDURES

The Seller shall state, in writing, to the Purchaser, at the conclusion of his design, procurement, and engineering phase and prior to shipment, that all referenced specifications, Codes, and procedures have been complied with, to the best of his knowledge and belief. The Seller shall obtain similar statements from his subsuppliers, as required. All statements of compliance shall be notarized.

This information is required by the plant Owner in order to conform to the requirements of the Division of Compliance, U. S. Atomic Energy Commission.

* Where the Seller is required under the ASME Boiler and Unfired Pressure Vessel Code to retain radiographs in his own file, he may do so. He shall not destroy these radiographs at the expiration of the retention period or if he closes his business, but shall forward the radiographs to the plant Owner.

NUS- 326
INSPECTION REPORT

☐ FINAL REPORT
☐ TRIP REPORT NO. ____ (SEE BACK)

# STONE & WEBSTER ENGINEERING CORPORATION
## SHOP QUALITY CONTROL

SHEET ____ OF ____

| | |
|---|---|
| CLIENT: Virginia Electric and Power Company | J.O. NO. 11448/11548 · MARK NO. |
| PROJECT: Surry Power Station | ORDER NO. · ITEM NO. |
| VENDOR | SHOP/ORDER NO |
| SUBVENDOR | SHOP NO |
| DESCRIPTION: 600 V Silicone Rubber Cable | VENDOR'S NO. |
| VENDOR'S DRAWING(S) | CODE |
| | REPORT PERIOD: FROM · TO |

| | INSPECTION AND DOCUMENT RECORD | ITEM REQ'D | FILE RECORD COPY REQ'D | APPROVED | CHECKED | WITNESSED | BY | DATE | DATE RECORD SENT TO BOSTON | DATE RECORD SENT TO JOB |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | WELDING PROCEDURE QUALIFICATION | | | | | | | | | |
| 2 | WELDER QUALIFICATIONS | | | | | | | | | |
| 3 | MILL TEST REPORTS | | | | | | | | | |
| 4 | CHARPY TEST REPORTS | | | | | | | | | |
| 5 | DROP WEIGHT TEST REPORTS | | | | | | | | | |
| 6 | DYE PENETRANT TEST REPORTS | | | | | | | | | |
| 7 | MAGNETIC PARTICLE TEST REPORTS | | | | | | | | | |
| 8 | ULTRASONIC TEST REPORTS | | | | | | | | | |
| 9 | TENSILE TEST REPORTS | | | | | | | | | |
| 10 | CHEMICAL ANALYSIS REPORT — SUBMERGED ARC WELDING WIRE | | | | | | | | | |
| 11 | CALIBRATION RECORDS — PREHEAT & STRESS RELIEF THERMOCOUPLES | | | | | | | | | |
| 12 | RADIOGRAPH FILM | | | | | | | | | |
| 13 | STRESS RELIEF FURNACE CHARTS | | | | | | | | | |
| 14 | HYDROSTATIC TEST — SHELL SIDE | | | | | | | | | |
| 15 | HYDROSTATIC TEST — TUBE SIDE | | | | | | | | | |
| 16 | HALOGEN LEAK TEST | | | | | | | | | |
| 17 | PERFORMANCE TEST | X | 8 | | | | | | | |
| 18 | DIMENSIONAL CHECK | X | 8 | | | | | | | |
| 19 | MANUFACTURER'S DATA SHEET | X | 8 | | | | | | | |
| 20 | MANUFACTURER'S STRESS REPORT | | | | | | | | | |
| 21 | MANUFACTURER'S VESSEL FABRICATION REPORT | | | | | | | | | |
| 22 | CLEANING | | | | | | | | | |
| 23 | PREPARATION FOR SHIPMENT | X | 8 | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |

REMARKS

LIST ALL DEVIATIONS FROM SPECIFICATION OR DRAWINGS, NAME OF ENGINEER GIVING APPROVAL AND DATE

| OFFICE | REPORTED BY (SIGNED IF FINAL) | DATE |
|---|---|---|
| | | |

INSPECTION REPORT
A 5040 21 (QCD-101)

☐ FINAL REPORT

☐ TRIP REPORT NO. ____ (SEE BACK)

# STONE & WEBSTER ENGINEERING CORPORATION
## SHOP QUALITY CONTROL

SHEET ____ OF ____

| | | |
|---|---|---|
| CLIENT Virginia Electric andPower Company | J O NO 11448/11548 | MARK NO |
| PROJECT Surry Power Station | ORDER NO | ITEM NO. |
| VENDOR | SHOP ORDER NO | |
| SUBVENDOR | SHOP NO | |
| DESCRIPTION 1,000 V Silicone Rubber Cable | VENDOR'S NO | |
| VENDOR'S DRAWING(S) | CODE | |
| | REPORT PERIOD FROM | TO |

| | INSPECTION AND DOCUMENT RECORD | ITEM REQ'D | FILE RECORD COPY REQ'D | APPROVED | CHECKED | WITNESSED | BY | DATE | DATE RECORD SENT TO BOSTON | DATE RECORD SENT TO JOB |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | WELDING PROCEDURE QUALIFICATION | | | | | | | | | |
| 2 | WELDER QUALIFICATIONS | | | | | | | | | |
| 3 | MILL TEST REPORTS | | | | | | | | | |
| 4 | CHARPY TEST REPORTS | | | | | | | | | |
| 5 | DROP WEIGHT TEST REPORTS | | | | | | | | | |
| 6 | DYE PENETRANT TEST REPORTS | | | | | | | | | |
| 7 | MAGNETIC PARTICLE TEST REPORTS | | | | | | | | | |
| 8 | ULTRASONIC TEST REPORTS | | | | | | | | | |
| 9 | TENSILE TEST REPORTS | | | | | | | | | |
| 10 | CHEMICAL ANALYSIS REPORT – SUBMERGED ARC WELDING WIRE | | | | | | | | | |
| 11 | CALIBRATION RECORDS – PREHEAT & STRESS RELIEF THERMOCOUPLES | | | | | | | | | |
| 12 | RADIOGRAPH FILM | | | | | | | | | |
| 13 | STRESS RELIEF FURNACE CHARTS | | | | | | | | | |
| 14 | HYDROSTATIC TEST – SHELL SIDE | | | | | | | | | |
| 15 | HYDROSTATIC TEST – TUBE SIDE | | | | | | | | | |
| 16 | HALOGEN LEAK TEST | | | | | | | | | |
| 17 | PERFORMANCE TEST | x | 8 | | | | | | | |
| 18 | DIMENSIONAL CHECK | x | 8 | | | | | | | |
| 19 | MANUFACTURER'S DATA SHEET | x | 8 | | | | | | | |
| 20 | MANUFACTURER'S STRESS REPORT | | | | | | | | | |
| 21 | MANUFACTURER'S VESSEL FABRICATION REPORT | | | | | | | | | |
| 22 | CLEANING | | | | | | | | | |
| 23 | PREPARATION FOR SHIPMENT | x | 8 | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |

REMARKS

LIST ALL DEVIATIONS FROM SPECIFICATION OR DRAWINGS, NAME OF ENGINEER GIVING APPROVAL AND DATE

| OFFICE | REPORTED BY (SIGNED IF FINAL) | DATE |
|---|---|---|
| | | |

CONTINENTAL WIRE & CABLE COMPANY
QUOTATIONS & CORRESPONDENCE

CONTINENTAL WIRE & CABLE
division of GULTON INDUSTRIES, INC.
BOX 1863 YORK, PA 17405 · TWX (510) 657-4748 PHONE (717) 792-2644
TELEX 84-0437

WHEN ORDERING PLEASE REFER TO
# QUOTATION
☐ ORIGINAL
☐ CONFIRMING
NO. 17748

CUSTOMER
REFERENCE
DATE
F.O.B. YORK, PA.
TERMS 2% 10 DAYS NET 30 DAYS
QUOTATION FIRM FOR 30 DAYS

TO
STINE & WEBSTER ENG. C).
225 FRANKLIN ST.
BOSTON,MASS 02170

ATTN MR. H.J.O'LEARY

Gentlemen:
Thank you for your inquiry — we are pleased to quote on your requirements.

| ITEM | QUANTITY | DESCRIPTION | | | | UNIT PRICE M/FT. | TOTAL |
|---|---|---|---|---|---|---|---|
| | | | SRH-X600 | SS-X600 | SRPF-X600 | | |
| 1 | 1000 ft. | #4/0 triplex CWC type | $4,500.00 | $5,000.00 | $5775.00 | | |
| 2 | 1200 ft. | #1/0 single " " | $ 870.00 | $1,155.00 | $1,240.00 | | |
| 3 | 1900 ft. | #4 single " " | $ 405.00 | $ 570.00 | $ 615.00 | | |
| 4 | 2750 ft. | #8 single " " | $ 235.00 | $ 330.00 | $ 355.00 | | |
| 5 | 15200 ft. | #12 single " " | $ 66.00 | $ 75.80 | $ 106.00 | | |
| 6 | 41000 ft. | #16 single " " | $ 40.50 | $ 46.80 | $ 67.00 | | |
| 7 | 2100 ft. | 2/#8 cable " " | $ 560.00 | $ 795.00 | $ 850.00 | | |
| 8 | 4800 ft. | 6/#16 cable " " | $ 645.00 | $ 905.00 | $ 895.00 | | |
| 9 | 4800 ft. | 2/#6-4/#8 (NO QUOTE) | | | | | |
| 10 | 500 ft. | 7/#12 cable " " | $1,145.00 | $1,600.00 | $1,580.00 | | |
| 9A | 4800 ft. | 2/#6 cable " " | $ 830.00 | $1,175.00 | $1,260.00 | | |
| 9B | 4800 ft. | 4/#8 cable " " | $ 998.00 | $1,420.00 | $1,530.00 | | |

Your consideration of this quotation will be appreciated.

OUR LOCAL REPRESENTATIVE R.MEBER
WILL BE PLEASED TO CALL ON YOU.

PLEASE RETURN ONE COPY OF THIS FORM WITH YOUR ORDER TO ASSURE YOU OF PROMPT AND ACCURATE PROCESSING.

SHIPMENT
8-12 weeks

NOTE;
SRHis SILICONE RUBBER with HYPALON JACKET
SS IS " " " SILICONE RUBBER JACKET
SRPF is " " " FEP TEFLON JACKET

CONTINENTAL WIRE & CABLE
Div. of Gulton Industries, Inc.
BY H.L.GOODWIN
TITLE SALES MANAGER

TRANSPORTATION: PREPAID AND ALLOWED ON 300 POUNDS OR MORE VIA ROUTING OF OUR CHOICE.

PAGE 1 OF 1

ALL DELIVERIES ARE QUOTED FROM DATE OF RECEIPT OF ORDER

CONDITIONS ON THE BACK OF THIS FORM ARE AN INTEGRAL PART OF THE QUOTATION

THIS COPY TO: DEPT. AUDITG DIV. ACCTANT PURCH AGENT DEPT. DIV. DEPT.

Cables

| PARTIALLY / [X] COMPLETELY FILLS REQ. NO. 9725 OF R.W.Clark | TO BE USED FOR 600 V Silicone Rubber Cable | ACCOUNT NO. 24.123 |
|---|---|---|

VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION, AGENT

P. O. BOX 2325, BOSTON, MASSACHUSETTS 02107

# MEMO OF CHANGES

4540.29

P.O. NO. SN-330-3

PAGE 1 OF 2

J.O. NO. 11448/11548

DATE April 6, 1971

THE ABOVE PURCHASE ORDER AND JOB ORDER NUMBERS MUST APPEAR ON ALL INVOICES AND CORRESPONDENCE.

TO

Continental Wire & Cable Corporation
Division of Culton Industries, Inc.
P.O. Box 6759
Towson, Maryland

**INSTRUCTIONS**

*These instructions supersede all prior agreements insofar as they affect changes herein specified.*

*Manufacturers and contractors will acknowledge these instructions without reservation or modification.*

THE SELLER MUST SIGN AND RETURN AT ONCE TO THE ABOVE ADDRESS THE ACCEPTANCE COPY OF THIS MEMORANDUM OF CHANGES

THIS CONFIRMS VERBAL AWARD TO SELLER'S MR. W.L. DRUCK BY ENGINEERS' MR. R.D. ANGLAND ON APRIL 6, 1971. DO NOT DUPLICATE.

Please refer to Purchase Order No. SN-330 dated January 27 , 1970, and to subsequent Memo. of Changes covering silicone rubber cable for the Surry Power Station and 1971 Extension - Surry Power Station of Virginia Electric and Power Company, and note the following:

ADD the following items:

| Item No. | Quantity, Ft | Description | Unit Price | Amount |
|---|---|---|---|---|
| 13 | 700 | 1/C No.4/0,untinned copper, silicone rubber insulated cable with overall impregnated glass braid jacket, Class M stranding (8,512 strands) a mylar tape shall be applied between the bare copper and the silicone insulation | $2,520/M ft | $1,764 |
| 14 | 1,200 | 1/C No.1/0, untinned copper, silicone rubber insulated cable with overall impregnated glass braid jacket, Class M stranding (4,214 strands) a mylar tape shall be applied between the bare copper and the silicone insulation | 1,462/M ft | 1,754 |

NOTE - The silicone rubber shall be of methyl phenyl base good for $1.41 \times 10^8$ rads over a 40 year life.

Virginia Electric and Power Company

:EM

STONE & WEBSTER ENGINEERING CORPORATION Agent

J.P. Cooper

GENERAL PURCHASING AGENT

P. O. NO. SN-330-3

CONTINUATION F. ORDER
14538.16

VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION,
P. O. BOX 2325, BOSTON, MASSACHUSETTS 02107
AGENT

| P.O. NO. SN-330-3 | PAGE 2 OF 2 | J.O. NO. 11448/11548 |
|---|---|---|
| DATE April 6, 1971 | | THE ABOVE PURCHASE ORDER AND JOB ORDER NUMBERS MUST APPEAR ON ALL INVOICES AND CORRESPONDENCE. |

IMPORTANT: NOTE INSTRUCTIONS ON FIRST SHEET

(2)

TO

Continental Wire & Cable Corporation
Division of Gulton Industries, Inc.

| | | |
|---|---|---|
| Previous Total Price of Order | - | $30,662.76 |
| Increase by this Memo. of Changes | - | 3,518.40 |
| Revised Total Price of Order | - | $34,181.16 |

All other terms and conditions remain unchanged.

CONFIRMATORY

COPIES

1. Client authorization verbal from Mr. G. Flowers to Mr. R.W. Clark on April 6, 1971.

2. Charge 50% to J.O. No. 11448 and 50% to J.O. No. 11548.

Virginia Electric and Power Company

RDA:EM

STONE & WEBSTER ENGINEERING CORPORATION, Agent

J.P. Cooper

GENERAL PURCHASING AGENT

P. O. NO.
SN-330-3

CONTINENTAL WIRE & CABLE
division of GULTON INDUSTRIES, INC.
BOX 1363 YORK, PA. 17405 · TWX (510) 657-4745 PHONE (717) 792-2644
TELEX 84-0437

# QUOTATION

☐ ORIGINAL
☐ CONFIRMING

NO. 18599

CUSTOMER Stone & Webster

REFERENCE Inq. Nos. 11449/ 11548

DATE December 2, 1969

F.O.B. YORK, PA.

TERMS 2% 10 DAYS NET 30 DAYS

QUOTATION FIRM FOR 30 DAYS

TO

Stone & Webster Engineering Corporation
225 Franklin Street
Boston, Massachusetts 02107

Attn: Mr. H. J. O'Leary

Gentlemen:

Thank you for your inquiry — we are pleased to quote on your requirements.

| ITEM | QUANTITY | DESCRIPTION | UNIT PRICE M/FT. | TOTAL |
|---|---|---|---|---|
| 1 | 1000' | #4/0 Triplex SRG-X600 O.D. 1.760" 350' maximum length | $3300.00 | $3300.00 |
| 2 | 1200' | #1/0 SRG-X600 O.D. 0.631" | 880.00 | 1056.00 |
| 3 | 1950' | #4 SRG-X600 O.D. 0.417" | 392.00 | 764.40 |
| 4 | 8,750' | #8 SRG-X600 O.D. 0.316" | 218.00 | 1907.50 |
| 5 | 15,200' | #12 SRG-X600 O.D. 0.180" | 78.50 | 1193.20 |
| 6 | 41,000' | #16 SRG-X600 O.D. 0.140" | 49.70 | 2037.70 |
| 7 | 2,100' | 2/8 SRG-X600 with treated glass braid overall O.D. 0.682" | 537.00 | 1127.70 |
| 8 | 4,800' | 6/16 SRG-X600 " " " " " O.D. 0.470" | 398.00 | 1910.40 |
| 9 | 4,800' | 2/6 - 4/8 SRG-X600 X1000 ~~with~~ treated glass braid overall O.D. ~~1.030~~ 1.150" 2000' maximum length | 1,745.00 ~~1655.00~~ | 8376.00 ~~7944.00~~ |
| 10 | 500' | 7/12 SRG-X1000 O.D. 0.690" with treated glass braid overall | 760.00 | 380.00 |
| | | | | ~~$21620.90~~ 22,272.90 |

NOTES: Para 1. Question complete suitability of this construction for Direct Burial
Para.3. All jackets are treated glass braids.

Your consideration of this quotation will be appreciated.

OUR LOCAL REPRESENTATIVE ______________________
WILL BE PLEASED TO CALL ON YOU.

SHIPMENT

NOR DEC 4 1969 R.B.A.

TRANSPORTATION: PREPAID AND ALLOWED ON 300 POUNDS OR MORE VIA ROUTING OF OUR CHOICE

PLEASE RETURN ONE COPY OF THIS FORM WITH YOUR ORDER TO ASSURE YOU OF PROMPT AND ACCURATE PROCESSING.

CONTINENTAL WIRE & CABLE
Div. of Gulton Industries, Inc.

BY ______________________

TITLE ______________________



ALL DELIVERIES ARE QUOTED FROM DATE OF RECEIPT OF ORDER

CONDITIONS ON THE BACK OF THIS FORM ARE AN INTEGRAL PART OF THE QUOTATION

ORIGINAL

CONTINENTAL WIRE & CABLE

division of GULTON INDUSTRIES, INC.

BOX 1863 YORK, PA 17405 · TWX (510) 657-4748 PHONE (717) 792-2644
TELEX 84-0437

WHEN ORDERING PLEASE REFER TO

QUOTATION

☐ ORIGINAL

☐ CONFIRMING

NO. 18599 599

TO

CUSTOMER

REFERENCE

DATE

F.O.B. YORK, PA.

TERMS 2% 10 DAYS NET 30 DAYS

QUOTATION FIRM FOR ______ DAYS

Gentlemen:

Thank you for your inquiry — we are pleased to quote on your requirements.

| ITEM | QUANTITY | DESCRIPTION | UNIT PRICE M/FT. | TOTAL |
|---|---|---|---|---|
| | | Para 6. Radiation resistance 5 x $10^8$ rads. | | |
| | | NOTE 1: Items 1 - 4 Class H stranding | | |
| | | NOTE 2: Meets IPCEA Spec. S19-81 Para. 3.17 | | |
| | | We accept the warranties and remedies which are a part of this bid. Based on 52¢ copper and subject to escalation per published market price. | | |
| | | Your consideration of this quotation will be appreciated. | | |

OUR LOCAL REPRESENTATIVE Russ Meyer/G. Nace
WILL BE PLEASED TO CALL ON YOU.

SHIPMENT 12-14 Weeks

NOTED DEC 4 1969 R.D.A.

TRANSPORTATION: PREPAID AND ALLOWED ON ~~300~~ 500 POUNDS OR MORE VIA ROUTING OF OUR CHOICE.

PLEASE RETURN ONE COPY OF THIS FORM WITH YOUR ORDER TO ASSURE YOU OF PROMPT AND ACCURATE PROCESSING.

CONTINENTAL WIRE & CABLE
Div. of Gulton Industries, Inc.

BY H.L. Goodwin H.L. Goodwin

TITLE Sales Manager



ALL DELIVERIES ARE QUOTED FROM DATE OF RECEIPT OF ORDER

CONDITIONS ON THE BACK OF THIS FORM ARE AN INTEGRAL PART OF THE QUOTATION

THIS COPY TO: ☐ PURCH. DEPT. ☐ BOSTON AUDIT'G DIV. ☐ CLIENT ☐ FIELD ACCOUNTANT ☐ LOCAL PURCH. AGENT ☐ MATERIAL DEPT. ☐ COST DIV. ☐ ENGINEER DEPT. ☐ INSPECTOR ☐

Cables

| PARTIALLY ☐ COMPLETELY ☒ FILLS REQ. NO. 78977 OF C.E. Houk | TO BE USED FOR 600 V Silicone Rubber Cable | ACCOUNT NO. 24.123 |
|---|---|---|

VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION, AGENT

P. O. BOX 2325, BOSTON, MASSACHUSETTS 02107

# MEMO OF CHANGES

S 4540.29

P.O. NO. SN-330-4A

PAGE 1 OF 2

J.O. NO. 11448/11548

DATE September 9, 1971

THE ABOVE PURCHASE ORDER AND JOB ORDER NUMBERS MUST APPEAR ON ALL INVOICES AND CORRESPONDENCE.

TO

Continental Wire & Cable
Division of Gulton Industries, Inc.
P.O. Box 6759
Towson, Maryland

INSTRUCTIONS

*These instructions supersede all prior agreements insofar as they affect changes herein specified.*

*Manufacturers and contractors will acknowledge these instructions without reservation or modification.*

~~THE SELLER MUST SIGN AND RETURN AT ONCE TO THE ABOVE ADDRESS THE ACCEPTANCE COPY OF THIS MEMORANDUM OF CHANGES~~

ISSUED FOR ACCOUNTING PURPOSES ONLY. ORIGINAL AND ACCEPTANCE COPY DESTROYED.

Please refer to Purchase Order No. SN-330 dated January 27, 1970, and to subsequent Memo. of Changes covering silicone rubber cable for the Surry Power Station and 1972 Extension - Surry Power Station of Virginia Electric and Power Company and note the following:

Record difference in actual quantities ordered and quantities received as follows:

| Item No. | Quantity Ordered in Feet | Quantity Received | Quantity Difference | Original Item Price Total | Revised Total Price |
|---|---|---|---|---|---|
| 13 | 700 | 702 | 2 | $1,764.00 | $1,769.04 |
| 14 | 1,200 | 1,200 | — | 1,754.40 | 1,754.40 |

Record Price Adjustment Increase in the Amount of $23.97 in accordance with the price adjustment clause of the purchase order as follows:

| Item No. | Quantity, Ft. | Date Shipped | Unit Price Increase Per M Ft | Total Change |
|---|---|---|---|---|
| 13 | 702 | April 30, 1971 | $18.43 | $12.94 |
| 14 | 1,200 | April 30, 1971 | 9.19 | 11.03 |

Above prices taken from Seller's Certified Invoice No. 96305-A dated April 30, 1971.

Shipment of silicone ribber cable to D.G. O'Brien, Inc., has been authorized to be shipped via Air Freight as per Teletype No.94-6271 dated April 23, 1971 by Mr. H.J. O'Leary.

| | |
|---|---|
| Shipment of April 30, 1971 - 1,188 lb | |
| Emery Air Bill No. PHL 08220 | $241.63 |
| Normal Freight Allowance | 38.85 |
| Additional Charges due for Purchaser's Account | $202.78 |

Above breakdown taken from Seller's Invoice No. 96305-B dated April 30, 1971.

Virginia Electric and Power Company

AAB:EM

STONE & WEBSTER ENGINEERING CORPORATION, Agent

J.P. Cooper

GENERAL PURCHASING AGENT

P. O. NO. SN-330-4A

CONTINENTAL WIRE & CABLE

XXXXXXXXXXXXXXXXXX

BOX 1863 YORK, PA. 17405 • TWX (510) 657-4847 PHONE (717) 792-2644

TELEX 84-0437

QUOTATION

June 18, 1970

☐ ORIGINAL ☒ CONFIRMING

CUSTOMER

REFERENCE Inq. #11448-060 Ademdem

DATE June 18, 1970

F.O.B. YORK, PA.

TERMS 2% 10 Days, Net 30

QUOTATION FIRM FOR 30 DAYS

TO

Stone & Webster Engineering Corp.
P.O. Box 2325
Boston, Mass. 02107
Attention: Mr. Robert Anglen

Gentlemen:

Thank you for your inquiry — we are pleased to quote on your requirements.

| ITEM | QUANTITY | DESCRIPTION | UNIT PRICE M/FT. | TOTAL |
|---|---|---|---|---|
| NRA | 4,800' | 6/C #16 (19) tinned copper, .047" insulated silicone rubber, .012" glass braid, Cable construction, three twisted pairs with color coded (black-white) glass braids, the overall braid shall be tinned copper, mylar tape, asbestos braid, high temperature finish. | $576.00 NET | |
| NRA | 1,500' | 3/C 4/0 stranded, triplex cable, 78 mils silicone insulation, 12 mils glass braid | $3,300.00 NET | |

The Copper base used in computing the above price is 60 ¢/lb., as currently reported. Adjustment of our price at time of shipment will be made on this basis if necessary.

NOTED JUN 22 1970 R.A.A.

Your consideration of this quotation will be appreciated.

OUR LOCAL REPRESENTATIVE R. Meyer, G. Nace WILL BE PLEASED TO CALL ON YOU.

SHIPMENT

10 - 11 weeks

PLEASE RETURN ONE COPY OF THIS FORM WITH YOUR ORDER TO ASSURE YOU OF PROMPT AND ACCURATE PROCESSING.

CONTINENTAL WIRE & CABLE

XXXXXXXXXXXXXXXX

BY Preston Shultz

Preston Shultz

TITLE

TRANSPORTATION: PREPAID AND ALLOWED ON 500 POUNDS OR MORE VIA ROUTING OF OUR CHOICE.

PRICES SUBJECT TO ADJUSTMENT FOR PRICE OF CONDUCTOR MATERIAL IN EFFECT AT TIME OF SHIPMENT
ALL DELIVERIES ARE QUOTED FROM DATE OF RECEIPT OF ORDER

PAGE 1 OF 1

CONDITIONS ON THE BACK OF THIS FORM ARE AN INTEGRAL PART OF THE QUOTATION

ORIGINAL

J.O.No. 11448 January 9, 1969

## SCHEDULE OF SILICONE RUBBER INSULATED POWER CABLE FOR SURRY POWER STATION

## VIRGINIA ELECTRIC AND POWER COMPANY RICHMOND, VIRGINIA

| Item No. | Mark No. | Quantity | Description |
| --- | --- | --- | --- |
| 1 | | 2,100 ft | 600 volt, two conductor (twisted pair) No. 8 AWG (19 strand) copper, 62 mil silicone rubber insulated with 31 mil moisture, abrasion and high temperature heat resistant jacket on each conductor, no further covering. This cable shall be suitable for operation at ambient temperatures up to 125 C. Diameter each insulated and jacketed conductor (.332 in.) |
| 2 | | 2,100 ft | 1,000 v, 6 conductor cable, 2 conductors No. 6 AWG (19 strand) copper and 4 conductors No. 8 AWG (19 strand) copper. Each conductor to have 78 mil silicone rubber insulation and color coded glass braid. Cable to have overall moisture, abrasion, and high temperature heat resistant jacket. Jacket thickness, *________mil. This cable shall be suitable for operation at ambient temperatures up to 125 C. Overall diam *________. |
| 3 | | 4,800 ft | 600 v, 4 conductor (two twisted pairs), No. 16 AWG (19 strand) copper, silicone rubber insulated overall jacketed control cable. Each conductor to have 47 mil silicone rubber insulation and color coded glass braid. The conductors shall have an overall tinned copper braided shield and moisture, abrasion, and high temperature heat resistant jacket. Jacket thickness *_______mil. Cable shall be suitable for operation at ambient |

| Item No. | Mark No. | Quantity | Description (Cont'd) |
|---|---|---|---|
| | | | temperatures up to 125 C. Overall diam *________. |
| 4 | | 400 ft | 1,000 v, 7 conductor, No. 12 AWG (19 strand) copper cable. Each conductor to have 62 mil silicone rubber insulation and color coded glass braid. Cable to have overall moisture, abrasion, and high temperature heat resistant jacket. Jacket thickness, *________mil. This cable shall be suitable for operation at ambient temperatures up to 125 C. Overall diam *________. |

*By Bidder

Note: All jacket thicknesses shall be in accordance with current IPCEA-NEMA Standards.

COPY TO: PUBLIC DEPT. AUDIT & DIV. ✓ ACCOUNTANT PURCH AGENT DEPT. DIV. DEPT.

Cables

COMPLETELY [X]

REG. NO. 91545

E. Spurell

TO BE USED FOR: Pressurizer Heater 50% Control Cable 50%

ACCOUNT NO.: 24.124 J.O.11448 / 24.124 J.O.11448

# PURCHASE ORDER

**STONE & WEBSTER ENGINEERING CORPORATION**
AGENT FOR VIRGINIA ELECTRIC AND POWER COMPANY
P. O. BOX 375, SURRY, VIRGINIA 23883

P.O. NO. SN-21,887

PAGE 1 OF 2

J.O. NO. 11548/11448

THE ABOVE PURCHASE ORDER AND JOB ORDER NUMBERS MUST APPEAR ON ALL INVOICES AND CORRESPONDENCE.

TO

Continental Wire & Cable Company
P. O. Box 1863
York, Pennsylvania 17405

Attn: Mr. Clair Leber

DATE: June 9, 1972

TERMS: 2% 10 days, Net 30 days

PRICE FOB: Job Site — PREPAY CHARGES IF PURCHASED F.O.B. DESTINATION

SHIPMENT DUE: 7 - 8 weeks from date of order - sooner if possible

SHIP TO

STONE & WEBSTER ENGINEERING CORPORATION
AGENT FOR VIRGINIA ELECTRIC AND POWER COMPANY
C/O SURRY POWER STATION
near Hog Island (Surry County)
Virginia

ADDRESS ALL CORRESPONDENCE TO THE ABOVE ADDRESS.

[redacted]

SEND INVOICE IN DUPLICATE TO:

VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION, AGENT
P. O. BOX 375
SURRY, VIRGINIA 23883

VIA Mtr. Frt. - Richmond, Va. - transfer Blue & Gray Trans. Co.

| ITEM NO. | QUANTITY | DESCRIPTION OF MATERIAL | UNIT PRICE | AMOUNT |
|---|---|---|---|---|

THE SELLER, BY ACCEPTING THIS ORDER, AGREES TO THE SEVERAL CONDITIONS PRINTED ON THE REVERSE SIDE HEREOF AND MUST SIGN THE ACCEPTANCE COPY OF THIS ORDER AND RETURN AT ONCE TO THE ABOVE ADDRESS.

Confirming verbal order placed with Seller's Mr. Clair Leber by Engineer's Mr. A. C. Orr June 6, 1972.

| Item | Quantity | Mark | Description | Unit Price | Amount |
|---|---|---|---|---|---|
| 1. | 2500 ft. | NRF | 2/cond. #8 - 19 strand code #SRG-X-600 600V silicone rubber covered electric cable meeting Specification NUS-326 dated April 19, 1969 and latest revision with mill certification data same as purchased on previous order SN-330 Item #7, dated January 27, 1970. Cable to be furnished in approximately 1000 ft. lengths if possible furnished on non-returnable reels | $565.00 mft | $1,412.50 |

TOTAL PRICE OF ORDER - $1,412.50

The above prices are FIRM.

PRICE ADJUSTMENT - Prices are FIRM except for copper. Prices based on copper cost of $0.525/lb.;prices shall be adjusted to reflect the cost of copper at time of shipment.

Invoices shall be rendered for the amount covered by the Purchase Order or less. Separate invoices are required for price increases. Prior to payment the Seller will be required to furnish one additional copy of each invoice, and to certify on each invoice that the prices

OUT OF STATE

BJ

VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION, AGENT

A. C. Orr
A. C. Orr — LOCAL PURCHASING AGENT

P. O. NO SN-21,887

STONE & WEBSTER ENGINEERING CORPORATION
AGENT FOR VIRGINIA ELECTRIC AND POWER COMPANY
P. O. BOX 375, SURRY VIRGINIA 23883

P.O. NO. SN- 21,887

PAGE 2 OF 2

J.O. NO. 11548/11448

DATE June 9, 1972

THE ABOVE PURCHASE ORDER AND JOB ORDER NUMBERS MUST APPEAR ON ALL INVOICES AND CORRESPONDENCE

Continental Wire & Cable Company

IMPORTANT: NOTE INSTRUCTIONS ON FIRST SHEET

illed are in accordance with the price adjustment clause.

o NOT BILL VIRGINIA SALES/USE TAX
SALES AND/OR USE TAX - RESPONSIBILITY OF PURCHASER. See Commonwealth of Virginia Direct Payment Permit No. 998106-3, attached.

Invoices covering materials and/or equipment supplied under this order shall include as a separate item the actual amount of freight paid supported by copy of paid freight bill.

All invoices for materials must contain the following certification statement:

"Seller warrants that the prices (including any price increases) reflected in this invoice are consistent with, and permissible under, the Economic Stabilization Act of 1970 and the decrees and regulations thereunder."

CONFIRMATORY - DO NOT DUPLICATE

VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION, AGENT

R. C. Orr
LOCAL PURCHASING AGENT

P. O. NO.
SN-21,887

DIV. AGENT

| PARTIALLY ☐ COMPLETELY ☒ FILLS P.O. NO. 18109 OF E. Spurrell | TO BE USED FOR Inside Recirculation Spray Pump Power Cable | ACCOUNT NO. 22.123 |
|---|---|---|

PURCHASE ORDER

**STONE & WEBSTER ENGINEERING CORPORATION**
AGENT FOR VIRGINIA ELECTRIC AND POWER COMPANY
P. O. BOX 375, SURRY, VIRGINIA 23883

P.O. NO. SN-22,062

PAGE 1 OF 2

J.O. NO. 11548

THE ABOVE PURCHASE ORDER AND JOB ORDER NUMBERS MUST APPEAR ON ALL INVOICES AND CORRESPONDENCE

TO

Continental Wire and Cable Company
P. O. Box 1863
York, Pennsylvania 17405

Attn: Mr. Leber

DATE July 14, 1972

TERMS ½ of 1% 10 days, Net 30 days

PRICE FOB S/P Frt. All. on 500 lbs. or more

PREPAY CHARGES IF PURCHASED F.O.B. DESTINATION

SHIPMENT DUE 2 weeks from date of order

SHIP TO

STONE & WEBSTER ENGINEERING CORPORATION
AGENT FOR VIRGINIA ELECTRIC AND POWER COMPANY
C/O SURRY POWER STATION
near Hog Island (Surry County)
Virginia

ADDRESS ALL CORRESPONDENCE TO THE ABOVE ADDRESS.

[redacted]

SEND INVOICE IN DUPLICATE TO:

VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION, AGENT
P. O. BOX 375
SURRY, VIRGINIA 23883

SHIP VIA Mfr. Frt. Richmond, Va. transfer Blue & Gray Trans. Co.

THE SELLER, BY ACCEPTING THIS ORDER, AGREES TO THE SEVERAL CONDITIONS PRINTED ON THE REVERSE SIDE HEREOF AND MUST SIGN THE ACCEPTANCE COPY OF THIS ORDER AND RETURN AT ONCE TO THE ABOVE ADDRESS.

Confirming verbal order placed with Seller's Mr. Leber by Engineer's Mr. A. C. Orr July 13, 1972.

| ITEM NO. | QUANTITY | DESCRIPTION OF MATERIAL | UNIT PRICE | AMOUNT |
|---|---|---|---|---|
| 1. | 480 ft. | 4/0 1 conductor triplexed 600V code #SRG-X600 copper power cable with silicone rubber, glass braid insulation with same construction as cable purchased on previous order SN-330 Item #1 meeting Specification NUS-326 dated April 19, 1969 and latest revisions with mill certification data in accordance with specification for the 1972 Extension-Surry Power Station of the Virginia Electric and Power Company located near Hog Island (Surry County) Surry, Virginia | $3,584.00 mft | $1,648.64 |

TOTAL PRICE OF ORDER - $1,648.64

Price Adjustment: Prices are <u>firm</u> except for copper. Price based on copper cost of $0.5050/lb. Prices shall be adjusted to reflect cost of copper at time of shipment.

Reels: Unless shipped on non-returnable reels, reels will be charged for extra net 30 days. Full credit will be allowed upon return of reels to Seller's mill, freight collect within 12 months from date of shipment.

OUT OF STATE

BJ

VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION, AGENT

A. C. Orr

A. C. Orr LOCAL PURCHASING AGENT

P. O. NO. SN-22,062

CONFIRMATION OF ORDER

# STONE & WEBSTER ENGINEERING CORPORATION
AGENT FOR VIRGINIA ELECTRIC AND POWER COMPANY
P. O. BOX 375, SURRY VIRGINIA 23883

SN- 22,062

PAGE 2 OF 2

J.O. NO. 11548

DATE July 14, 1972

THE ABOVE PURCHASE ORDER AND JOB ORDER NUMBERS MUST APPEAR ON ALL INVOICES AND CORRESPONDENCE.

TO

Continental Wire and Cable Company

IMPORTANT, NOTE INSTRUCTIONS ON FIRST SHEET

DO NOT BILL VIRGINIA SALES/USE TAX
SALES AND/OR USE TAX - RESPONSIBILITY OF PURCHASER. See Commonwealth of Virginia Direct Payment Permit No. 998106-3, attached.

Invoices covering materials and/or equipment supplied under this order shall include as a separate item the actual amount of freight paid supported by copy of paid freight bill.

All invoices for materials must contain the following certification statement:

"Seller warrants that the prices (including any price increases) reflected in this invoice are consistent with, and permissible under, the Economic Stabilization Act of 1970 and the decrees and regulations thereunder."

CONFIRMATORY - DO NOT DUPLICATE

BJ

VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION, AGENT

A. C. Orr
A. C. Orr
LOCAL PURCHASING AGENT

P. O. NO.
SN- 22,062

# STONE & WEBSTER ENGINEERING CORPORATION

225 FRANKLIN STREET, BOSTON, MASSACHUSETTS 02107

**AIR MAIL**

NEW YORK
BOSTON
CHICAGO
GARDEN CITY
HOUSTON
LOS ANGELES
SAN FRANCISCO

DESIGN
CONSTRUCTION
REPORTS
APPRAISALS
EXAMINATIONS
CONSULTING
ENGINEERING

3

Mr. E. B. Crutchfield
Senior Vice President
Virginia Electric and Power Company
7th and Franklin Streets
Richmond, Virginia 23209

January 5, 1969
J.O.Nos. 11448/
11548
NUS-4374

TELECOPIED
DAT 1-7-69 TIME 12.15

Dear Sir:

SILICONE RUBBER CABLE
SURRY POWER STATION
1972 EXTENSION - SURRY POWER STATION

We urgently require the silicone rubber cables for the reactor penetrations and since an order has been placed with General Electric Company, it is doubtful that the strike will be settled in a short time.

We therefore have requested an alternate proposal for the silicone cable from Continental Wire and Cable Co. who were the only other bidder to quote on silicone rubber cable. In their original proposal, they offered three types of constructions which were not suitable for our application. Their new construction is silicone insulation with treated glass braid overall which is similar to General Electric's cable construction.

We enclose for your review two copies of Continental Wire and Cable Co. proposal dated December 2, 1969, and their letter of December 5, 1969, clarifying their proposal.

Continental Wire quote terms of two per cent, 10 days net cash 30 days and delivery of 12 to 14 weeks, prices subject to adjustment depending on the material cost of copper at the time of shipment. Continental Wire quote shipment fob factory, freight allowed to destination and accept the VEPCO warranty clause.

Continental Wire take exception to the radiation requirements of $1 \times 10^8$ rads and state that the cable will withstand $0.5 \times 10^8$ rads without any significant change in physical and electrical properties. Continental advised that radiational tests are being performed on this type cable at $1 \times 10^8$ rads and higher and will forward information to us as soon as it is available.

We estimate that the exposure to radiation over the expected 40 year life of the plant will be $3 \times 10^7$ rads and the maximum dose during the postulated maximum accident condition will be $1 \times 10^8$ rads.

We therefore recommend that an order be placed with Continental Wire and Cable Co. in the amount of $22,556.40 for furnishing the silicone wire cable for the Surry Power Station. We further recommend canceling our existing order, SN-254, with General Electric Company.

We should appreciate receiving your authorization to purchase the silicone cable as recommended.

Yours very truly,

V. A. Suziedelis

V. A. Suziedelis
Project Engineer

Enclosures

RWC:SAT

CONTINENTAL WIRE & CABLE
division of GULTON INDUSTRIES, INC.
BOX 1863 YORK, PA. 17405 • TWX (510) 657-4748 PHONE (717) 792-2544

December 15, 1969

Stone & Webster
Engineering Corp.
225 Franklin St.
Boston, Mass. 02107

NOTED DEC 18 1969 R.D.A.

Attention: Mr. Bob Anglend

Referance: Inquiry 11448/11548 for Virginia Elec. Power Co.

Dear Bob:

This letter is to confirm the information given to you today during our telephone conversation.

Firstly, item No. 8 of our quotation No. 18599, should read, 4,800 ft. 6/16 SRG-X600 with tinned copper shield braid overall, and treated glass braid over all - $453.00 per M ft. net, total price $2,174.40.

Secondly, it has been our test experience, that small gauge copper conductors do not have sufficent strength when heated to support the cable, when subjected to the vertical tray flame test. We have also found that breakdown of small gauge conductors occurs from three minutes to ten minutes after application of the flame. We therefore must take an exception to the electrical requirement section of paragraph 8.0 flame resistance. Please be advised that we are conducting tests at the present time to determine the exact time of conductor breakdown under controlled flame tests. We unfortunately have no conclusive results at the present time, however, when these results are avaliable please be advise that we will pass them on to you.

We greatly appreciate your time and efforts in correcting the error on item No. 8 of the subject quotation, and are very sorry for any inconvience that error may have caused you.

Very truly yours,

CONTINENTAL WIRE & CABLE

Gary W. Nace

G. Nace
Regional Sales Mgr.

GN/ar

# CONTINENTAL WIRE & CABLE

division of GULTON INDUSTRIES, INC.

BOX 1863 YORK, PA. 17405 • TWX (510) 657-4748 PHONE (717) 792-2644

December 5, 1969

Stone and Webster Engineering Co., Inc.
225 Franklin St.
Boston, Mass. 02170

NOTED DEC 8 1969 H.O.A.

Attention: Mr. Bob Angland

Dear Bob:

In referance to our telcon this date concerning your inquiry No. T-11448-0714- Silicone Rubber Cable - Surrey Power Station 1972 Ext., for Virginia Elec. and Power Co., this is to confirm that our quotation no . 18599, Item #9 should read 4800 ft. 2/6 - 4/8 SRG-X1000 with treated glass braid overall, O.D. 1.150", 2000' Max. length, unit price$1795.00 per M', total item price $8,616.00

We are very sorry for any inconvience our error may caused you and greatly appreciate your time and efforts in correcting that error.

Very truly yours,

CONTINENTAL WIRE & CABLE

Gary W. Nace

Gary Nace
Regional Sales Mgr.

GN/sr
cc: Russ Meyer
D. Amelia
H. Goodwin

CONTINENTAL WIRE & CABLE
division of GULTON INDUSTRIES, INC.
BOX 1863 YORK, PA. 17405 • TWX (510) 657-4743 PHONE (717) 792-2644

August 19, 1969

Stone and Webster
225 Franklin Street
Boston, Massachusetts 02107

Attention: Mr. Roger W. Clark,
17th Floor, Engineering

Dear Mr. Clark:

It was a pleasure talking with you on radiation resistance of various materials for possible use in nuclear generating stations. Pursuant to this telephone call, I am including the information you requested.

The following is a table showing radiation levels (Rads) where physical properties (tensile and elongation) begin to deteriorate significantly. Since these materials are to be used as cable jackets, these properties seem most relevant.

| | |
|---|---|
| FEP Teflon | $10^5$ to $3 \times 10^5$ Rads |
| Silicone Rubber | $10^7$ to $10^8$ Rads |
| Hypalon (Chlorosulfonated PE) | $10^7$ to $10^8$ Rads |

We hope the above is of some value to you. It must be remembered that silicone rubber and "Hypalon" are compounds, or a mixture of variable ingredients, and as such will exhibit somewhat different properties.

If you desire any further information, please contact us, and we will endeavor to provide it.

Very truly yours,

CONTINENTAL WIRE AND CABLE
Division of Gulton Industries, Inc.

Paul S. Cardello

P. S. Cardello,
Assistant Manager, Engineering

PSC/sw

# SECTION #3

## QUALIFICATION REPORTS

"ANACONDA LETTER WITH ENCLOSURE"
DATED OCTOBER 8, 1980
(REFERENCE NO. 61)

Ref. # 61

October 8, 1980

Stone & Webster Eng. Corp.
P.O. Box 2325
Boston, MA 02107

Attn: John Bonner

Re: VEPCO/SURRY Qualification Data, your letter of Oct. 2, 1980.

Dear Mr. Bonner:

Per the referenced letter and in accordance with telecons with your Messrs. Steve Miller (9/17/80) and Ira MacFarlane (10/8/80) we offer the following:

1. Stone & Webster will study the existing LOCA qualification data conducted for VEPCO by Conax on Anaconda Instrument cable insulated with CC-2210 FR-XLP - and determine its' applicability to control and thermocouple items also supplied by us on this project. (Anaconda-Continental does not have a copy of this report.)

   Since CC-2210 has not been used by us for several years, we have nothing further to offer.

2. For items insulated with silicone rubber (i.e. NUS-326/SN-330) the following data is available:

   a) FIRL Report F-C2935
   b) Addendum to F-C2935. (Extends radiation exposure from $10^7$ to $10^8$ rads.)
   c) Data sheet on physical properties of CC-2115.
   d) Arrhenius Plot. (For Thermal Age characteristics only.)

Please note that the CC-2100 designation used for silicone rubber in these applications, when these contracts were awarded several years ago, has been replaced by our designations CC-2115 and/or CC-2216.

We hope this information is of some value to you and your client.

Very truly yours,

ANACONDA ERICSSON INC.
CONTINENTAL WIRE & CABLE

Paul S Cardello

Paul S. Cardello
Chief Engineer

PSC:ts
cc: W. Schneider
F. Flood
T. Ling
CF: S&W/VEPCO

PHYSICAL PROPERTIES OF CC-2115 SILICONE RUBBER AFTER CONDITIONING SIMULATING A L.O.C.A. CONDITION.

| CONDITIONING | TENSILE | ELONGATION |
|---|---|---|
| ---- | (PSI) | (%) |
| NONE | 1040 | 300 |
| STEAM/BORIC ACID (1) | 640 | 187 |
| RADIATION ONLY | | |
| $1 \times 10^7$ RADS (2) | 1000 | 110 |
| $5 \times 10^7$ RADS | 825 | 40 |
| $1 \times 10^8$ RADS | 520 | 19 |
| RADIATION AFTER STEAM/BORIC ACID (1) | | |
| $1 \times 10^7$ RADS | 570 | 87 |
| $5 \times 10^7$ RADS | 450 | 28 |
| $1 \times 10^8$ RADS | 380 | 15 |

WIRE SAMPLE, TUBE SPECIMENS TAKEN FROM #12 AWG .030" WALL CC-2115.

NOTES:

(1) 120 HRS. 50 PSI STEAM, FOLLOWED BY 120 HRS. .5% BORIC ACID SOLUTION @ 150°F. (CONDITIONING PERFORMED BY CWC LABORATORIES.)

(2) COBALT 60 SOURCE (GAMMA RADIATION).

PAGE 1 OF 1

| REVISIONS | | | |
|---|---|---|---|
| 1 | RE-TYPE, NEW FORMAT | 3/28/80 | [illegible] |
| | | | |
| | | | |

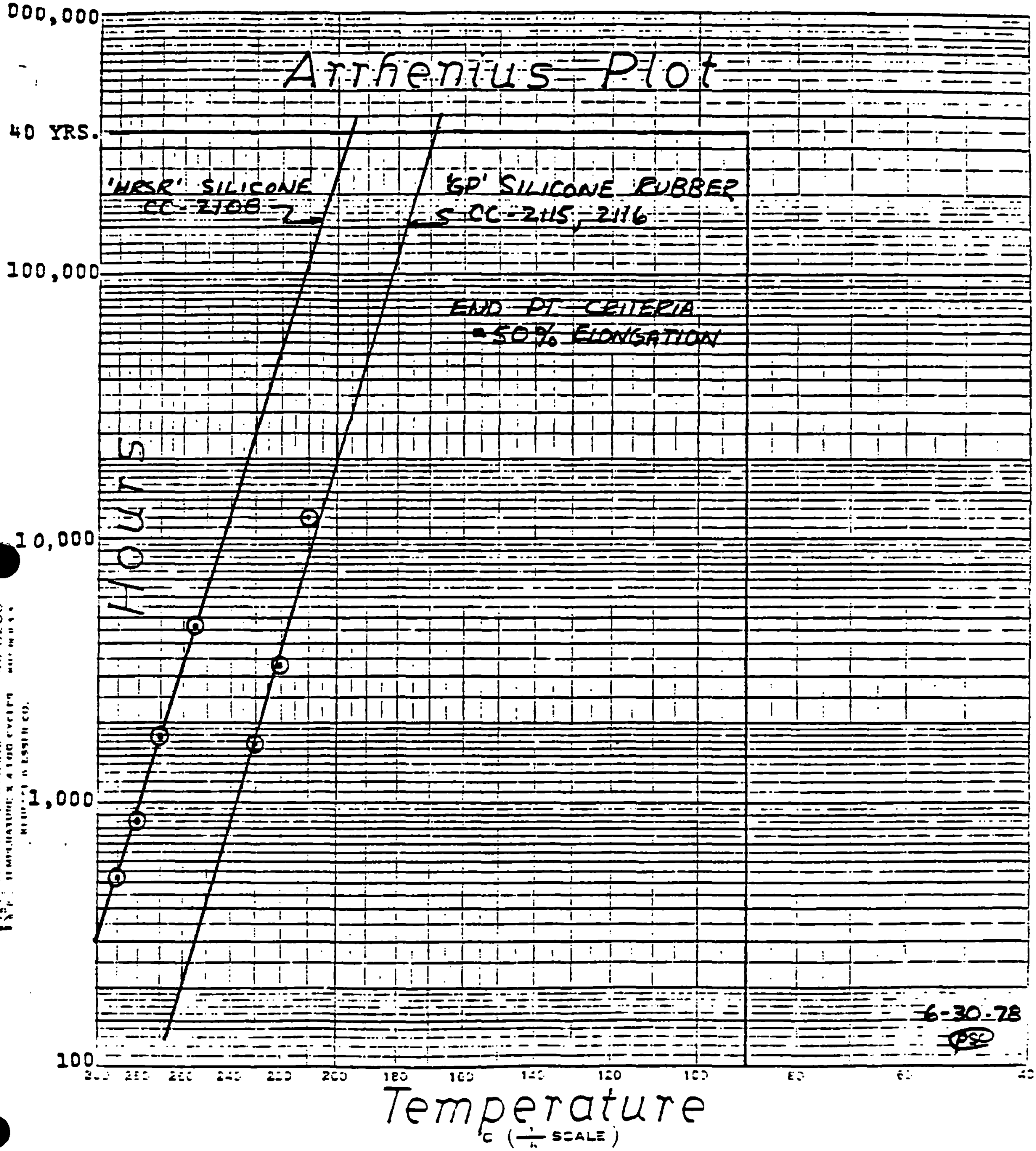
ANACONDA Wire and Cable Division

Continental Wire & Cable Wire and Cable Division
P. O. Box 1863 York, Pennsylvania 17405 717/792-2644

DRN. N. H. DATE 1/70
CKD. DATE
APP. [illegible] DATE

AC-806

FIGURE IV


Arrhenius Plot
000,000
40 YRS.
100,000
10,000
1,000
100
HOURS
'HRSR' SILICONE
CC-2108
'GP' SILICONE RUBBER
CC-2115, 2116
END PT CRITERIA
= 50% ELONGATION
6-30-78
PSC
180
120
Temperature
°C ($\frac{1}{K}$ SCALE)

(FIRL REPORT NO. F-C2935 on Continental SI Cables)
DATED OCTOBER 1970
(REFERENCE NO. 63)

Ref. #

Reference # 63

PROPRIETARY INFORMATION

Technical

Report

Final Report
F-C2935

# TEST OF ELECTRICAL CABLES UNDER SIMULATED POST-ACCIDENT REACTOR CONTAINMENT SERVICE

by

S. P. Carfagno
L. E. Witcher

October 1970

Prepared for

Continental Wire and Cable Company
York, Penna.

PROPRIETARY INFORMATION

THE FRANKLIN INSTITUTE RESEARCH LABORATORIES
BENJAMIN FRANKLIN PARKWAY • PHILADELPHIA, PENNA. 19103

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## LIST OF FIGURES



## LIST OF TABLES

# 1. INTRODUCTION

Samples of a seven-conductor and a two-conductor cable manufactured by the Continental Wire and Cable Co. were subjected to qualification tests to determine their ability to withstand conditions that may be encountered within the containment of a nuclear power plant, including those which follow a loss-of-coolant accident (Design Basis Event).

The tests included irradiation of the cables and exposure to a steam environment at temperatures up to 340°F, while electrically energized, in accordance with the schedule given in Section 3 of this report.

# 2. SAMPLES

The samples tested were identified as follows:

A. 7 Conductor #12 (7) copper, CC-2115 silicone rubber insulation, glass braid over silicone, glass finished with a flame and abrasion resistant finish CC-1233, 7 conductors cabled, mylar binder tape, overall asbestos braid, asbestos finished with CC-1120 flame and abrasion resistant finish.

B. 2 Conductor #16 (7) copper, CC-2115 silicone rubber insulation, glass braid over silicone, glass braid finished with a flame and abrasion resistant finish CC-1233, 2 conductors cabled with impregnated asbestos fillers, mylar binder tape, overall asbestos braid, asbestos finished with CC-1120 flame and heat resistant finish.

# 3. TESTS PERFORMED

A. Irradiation

The samples were irradiated using a cobalt-60 gamma source to a dose level of at least 10 megarad, at a rate of about 0.45 megarad per hour.*

*A copy of a letter from Industrial Reactor Laboratories, Inc., confirming the irradiation performed is presented in the Appendix to this report.

B. Preconditioning at 66°C (151°F) and 100% R.H.

The samples were installed in a test chamber, as shown in Figure 1, and connected to the external electrical circuits in the manner shown in Figures 2 and 3.

Steam was injected into the tank to raise the temperature to approximately 151°F and create an environment of 100% relative humidity. At the same time, the cables were energized electrically: 600 V ac was applied between adjacent conductors; a current of 14 A was passed through all conductors in Samples A-1 and A-2; and a current of 12 A was passed through all conductors in Samples B-1 and B-2.

The oxygen concentration within the test tank was monitored and maintained at approximately 4% by bleeding nitrogen into the tank. 151°F, 100% RH 6 HRS

The above conditions were maintained for a period of six hours. The temperature varied slightly during this time, ranging within plus and minus six degrees. The pressure varied between 0.5 and 1.3 psig.

C. Steam Exposure

Subsequent to the 6-hr period at 151°F, the steam pressure was increased to approximately 100 psig, increasing the temperature to approximately 340°F (171°C) in about 12 sec. Electrical loading was continued as in B, above. 2 HRS AT 340°F. 100 PSIG

These conditions were maintained for 2 hours, with the temperature being held constant within a band of only a few degrees.

At the end of the 2-hr period at 340°F, the steam admission valve was closed, and the temperature allowed to decrease. After approximately 4 hr, the temperature reached 160°F (71°C), where it was maintained for a period of 20 hours. Electrical loading was continued, as described under B, throughout the test period, except for an interruption starting approximately 3 hr after the steam admission valve was closed, when the dielectric measurements described in par. D were initiated. 4 HRS 160°F 20 HRS AT 160°F (PRESSURE ?

Fig. 1. Photograph of Cables Mounted in Test Tank

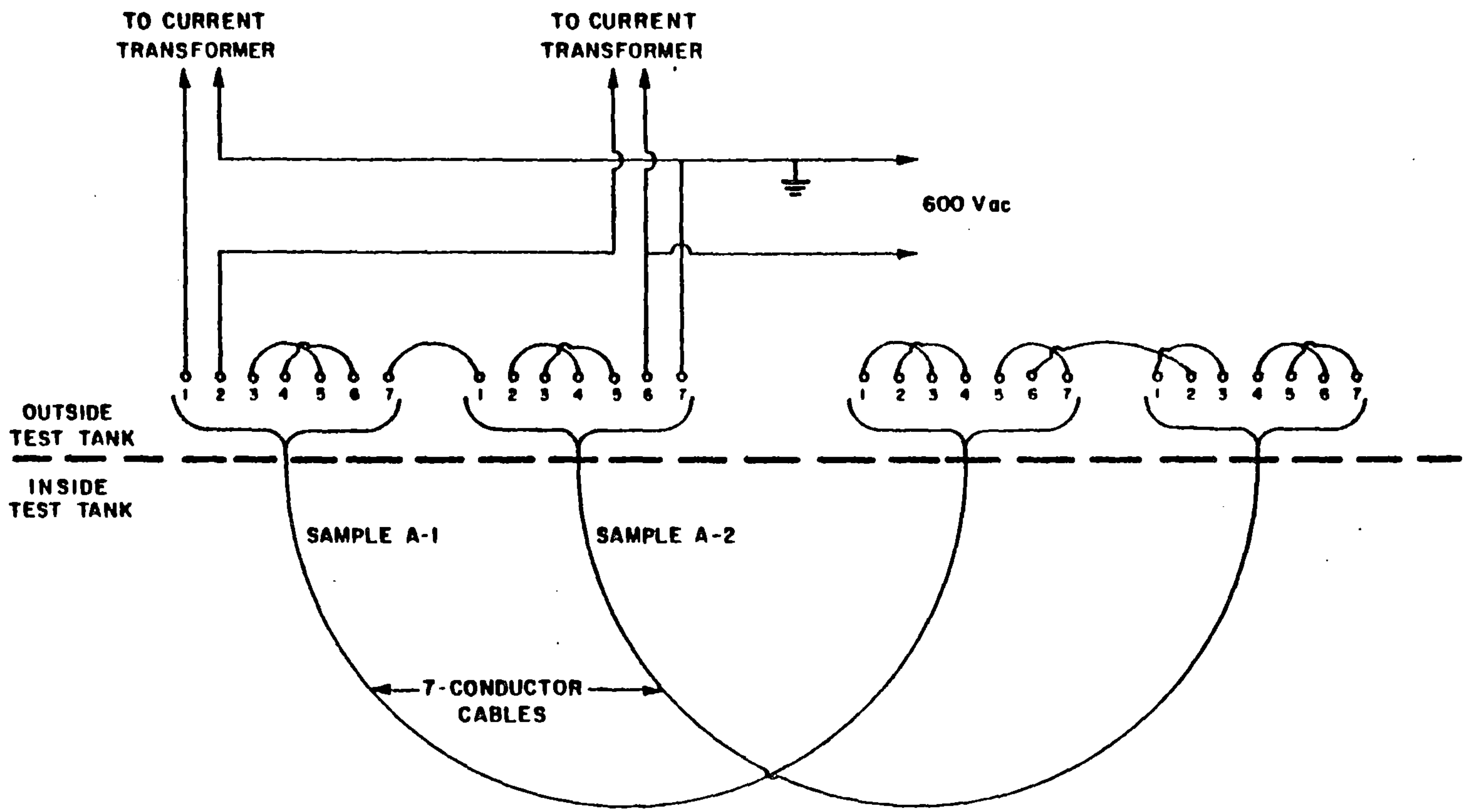


Fig. 2. Electrical Loading Circuit for Samples A-1 and A-2.

Numbers refer to conductors in the cables.
Both ends of each cable were passed through the wall of the test tank, permitting connection to external terminal strips, and leaving a continuous loop of cable inside the tank.

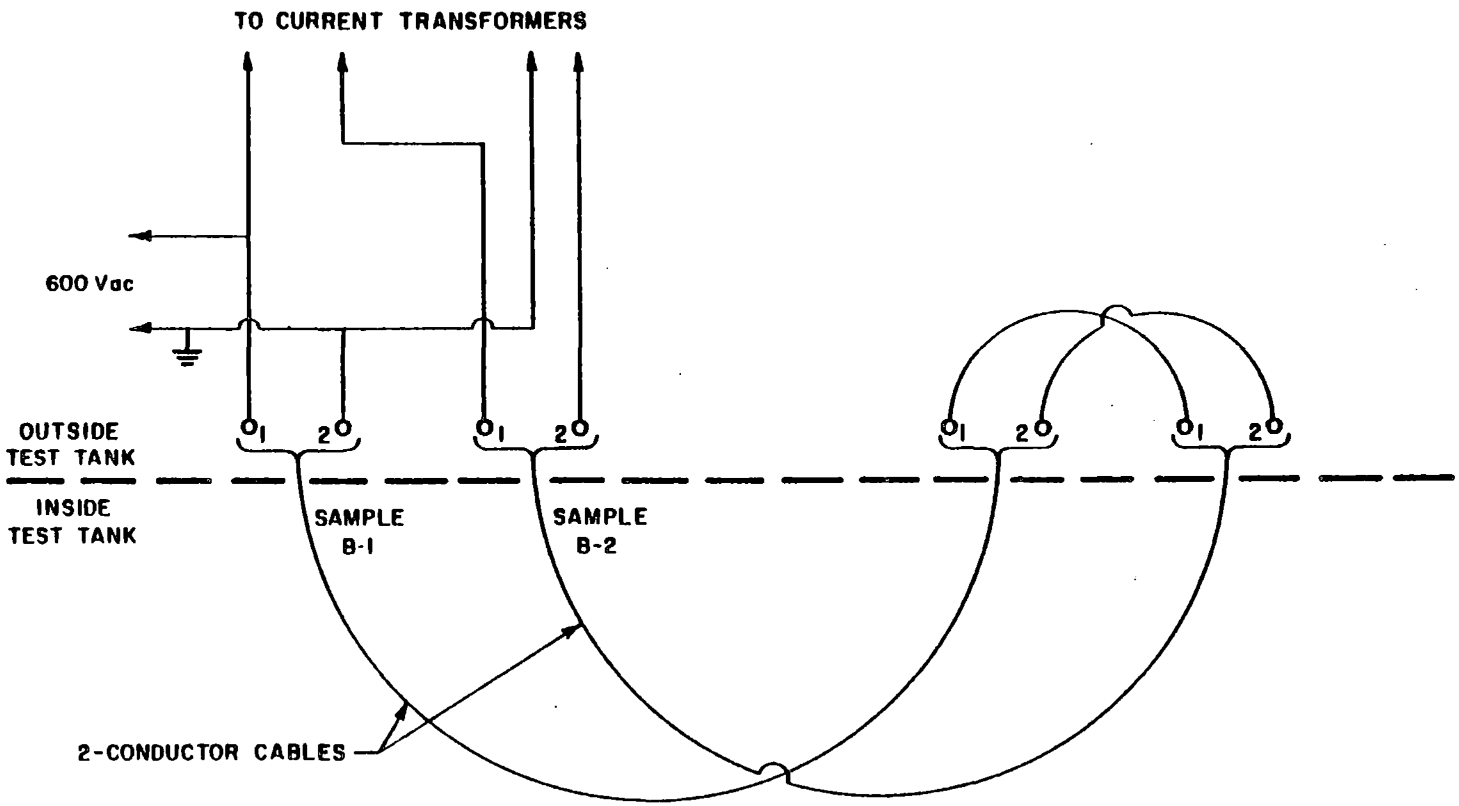


Fig. 3. Electrical Loading Circuit for Samples B-1 and B-2.

Numbers refer to conductors in the cables.
Both ends of each cable were passed through the wall of the test tank, permitting connection to external terminal strips, and leaving a continuous loop of cable inside the tank.

D. Dielectric Measurements

At the end of the steam exposure (2-hr exposure at 340°F) and at the conclusion of the tests, the insulation resistance at 500 V dc and the leakage current under the application of 2 kV ac and 4 kV ac for 5 min were measured. The results are given in Table 1.

## 4. CONCLUSIONS

Two samples of electrical cable were subjected to a test program which simulated conditions which could be encountered in nuclear power plant service should a loss-of-coolant accident (Design Basis Event) occur. No difficulties were encountered, and there was no visually apparent change in the samples as a result of undergoing the tests. Insulation resistance and leakage current measurements did not reveal any breakdown of the insulation.

It is concluded that the cables will perform satisfactorily under the conditions simulated.

Sworn to and subscribed before me
this 12th day of October 1970
Margaret E. Tramellin
Notary Public, Philadelphia, Philadelphia Co.
My Commission Expires April 17, 1972

S P Carfagno
S. P. Carfagno
Project Manager

## TABLE 1. Dielectric Measurements

| Sample | Terminal Connections[1] I | Terminal Connections[1] II (ground) | Measured Following the 2-Hour Exposure to Steam at 340°F[4]: Insulation Resistance[2] (MΩ) | Leakage Current[3] Potential (kVac) | Leakage Current[3] Current (mA) | Measured at Conclusion of All Tests: Insulation Resistance[2] (MΩ) | Leakage Current[3] Potential (kVac) | Leakage Current[3] Current (mA) |
|---|---|---|---|---|---|---|---|---|
| A-1 | 1,2,3,4,5,6,7 | ground | — | 2 | 3.3 | — | 2 | 3.3 |
| A-2 | 1,2,3,4,5,6,7 | ground | — | 2 | 3.6 | — | 2 | 3.5 |
| B-1 | 1,2 | ground | — | 2 | <1 | — | 2 | 1.3 |
| B-2 | 1,2 | ground | — | 2 | <1 | — | 2 | 1.0 |
| A-1 | 1 | all others | 680 | 4 | 1.4 | 40,000 | 4 | 1.2 |
| A-1 | 2 | all others | 590 | 4 | 1.3 | 40,000 | 4 | 1.3 |
| A-1 | 3 | all others | 850 | 4 | 1.2 | 40,000 | 4 | 1.2 |
| A-1 | 4 | all others | 780 | 4 | 1.3 | 40,000 | 4 | 1.3 |
| A-1 | 5 | all others | 900 | 4 | 1.4 | 40,000 | 4 | 1.3 |
| A-1 | 6 | all others | 860 | 4 | 1.4 | 40,000 | 4 | 1.2 |
| A-1 | 7 | all others | 500 | 4 | 1.3 | 17,000 | 4 | 1.3 |
| A-2 | 1 | all others | 1150 | 4 | 1.4 | 45,000 | 4 | 1.3 |
| A-2 | 2 | all others | 80 | 4 | 1.4 | 45,000 | 4 | 1.2 |
| A-2 | 3 | all others | 1000 | 4 | 1.4 | 40,000 | 4 | 1.2 |
| A-2 | 4 | all others | 550 | 4 | 1.3 | 40,000 | 4 | 1.2 |
| A-2 | 5 | all others | 820 | 4 | 1.4 | 30,000 | 4 | 1.2 |
| A-2 | 6 | all others | 1350 | 4 | 1.3 | 40,000 | 4 | 1.2 |
| A-2 | 7 | all others | 1450 | 4 | 1.4 | 50,000 | 4 | 1.3 |
| B-1 | 1 | 2 | 54 | 4 | <1 | 620 | 4 | 1.0 |
| B-1 | 2 | 1 | 53 | 4 | <1 | 605 | 4 | 1.0 |
| B-2 | 1 | 2 | 65 | 4 | <1 | 700 | 4 | 1.0 |
| B-2 | 2 | 1 | 66 | 4 | <1 | 710 | 4 | 1.0 |

Notes:

1. The numbers in these columns indicate which conductors were connected to the instrument terminals.
2. Measured after application of 500 V dc for 1 min, using a Biddle Megger, Insulation Tester, Model No. 610815.
3. These measurements were made with a Beckman Breakdown Test Set, Model 1000-AC/DC - ITS 2 M. The indicated potential was applied for 5 min.
4. The temperature in the test tank decreased from approximately 200°F to about 155°F while the measurements were being made.

# Appendix

IRRADIATION REPORT

INDUSTRIAL REACTOR LABORATORIES, INC.
A RESEARCH FACILITY OF RUTGERS • THE STATE UNIVERSITY
PLAINSBORO, NEW JERSEY 085:
609-799-1800

October 7, 1970

Mr. William Steigelmann
Franklin Institute Research Laboratory
Benjamin Franklin Parkway
Philadelphia, Pennsylvania 19103

Re: Your P. O. No. 12948

Dear Bill:

The three groups of cables delivered to IRL on October 6, 1970, were exposed to cobalt-60 irradiation for a period of 22 hours, accumulating a minimum dose of 10 Megarads, as determined by dose rate measurements made with a calibrated ionization chamber.

Very truly yours,

R. T. Canfield
R. T. Canfield

RTC/bc

" ADDENDUM "

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## 1. INTRODUCTION

This report is an addendum to Final Report F-C2935 (Ref. 1), covering the testing of cable and insulation samples under conditions partly identical to tests described in the earlier report. While referring to the earlier report for a description of the tests, this addendum identifies the samples and the test program, and presents the data obtained.

## 2. SAMPLES

The samples tested were identified as follows:

A-1. 7 Conductor #12 (7) copper, CC-2115 silicone rubber insulation, glass braid over silicone, glass finished with a flame and abrasion resistant finish CC-1233, 7 conductors cabled, mylar binder tape, overall asbestos braid, asbestos finished with CC-1120 flame and abrasion resistant finish.

B-1. 2 Conductor #16 (7) copper, CC-2115 silicone rubber insulation, glass braid over silicone, glass braid finished with a flame and abrasion resistant finish CC-1233, 2 conductors cabled with impregnated asbestos fillers, mylar binder tape, overall asbestos braid, asbestos finished with CC-1120 flame and heat resistant finish.

C. 4 Conductor #12 (19) tinned copper, CC-2200 Crosslene insulation, cabled, mylar binder tape, pvc jacket CC-2021 overall.

D. 6 Conductor #14 (19) tinned copper, CC-2210 flame retardant Crosslene insulation, cabled, mylar binder tape, pvc jacket CC-2024 overall.

E. 2 Conductor #16 solid iron/constantan, CC-2193 silicone insulation, glass braid over silicone, CC-1250 silicone finish, 2 conductors twisted, mylar tape, tinned copper drain wire, aluminum/mylar shield tape, CC-2193 silicone rubber jacket overall.

| | |
|---|---|
| F-1 and F-2 | Insulation samples of compound CC-2193. |
| F-3 and F-4 | Insulation samples of compound CC-2193-1. |
| G-1(a) | Insulation samples of compound CC-2210. |
| G-1(b and c) | Insulation samples of compound UC-4730. |
| G-2(a) | Same as G-1(a). |
| G-2(b and c) | Same as G-1(b and c). |

## 3. TEST PROGRAM

The test sequence for samples A through F-2 consisted of an initial irradiation, a preconditioning at 66°C*, a steam exposure**, and a final irradiation. Samples F-3 through G-2 underwent irradiation only.

The test program is summarized in Table 1.

Sample C underwent the preconditioning at 66°C, but the cable jacket evidently became softened due to additional heating a few minutes after the steam exposure at 100 psig was initiated. Consequently, most of the sample was forced out of the test chamber through the compression fitting used to seal the cable where it passed through the chamber wall. The portion of Sample C which came out was cut off, leaving a length approximately 1 ft long inside the test chamber; this short piece underwent the steam exposure, but it was not electrically loaded. Only this 1-ft piece was exposed to the final irradiation. At the same time that Sample C was forced out of the chamber, it was noticed that liquid from inside the test chamber was slowly oozing out of Sample D. Therefore, to avoid the possibility of its being shot out of the test chamber, Sample D was cut near the ends — leaving most of it inside the test chamber. Thus it was not energized during the remainder of the steam test.

*In accordance with par. B, Section 3 of Ref. 1.
**In accordance with par. C, Section 3 of Ref. 1.

Table 1. TEST PROGRAM

| Sample | Dose Level of Initial Irradiation* (Mrad) | Preconditioning and Steam Exposure ** | Dose Level of Final Irradiation† (Mrad) |
|---|---|---|---|
| A-1 | 10 | - | 90 |
| B-1 | 10 | - | 90 |
| C | 10 | (see accompanying text) | 90Δ |
| D | 10 | (see accompanying text) | 90 |
| E | 10 | - | 90 |
| F-1, F-2 | 10 | - | 90 |
| F-3 | None | None | 10 |
| F-4 | None | None | 100 |
| G-1 | None | None | 10 |
| G-2 | None | None | 100 |

* Irradiated at a rate of about 0.45 Mrad/hr, using a cobalt-60 gamma source.
** In accordance with pars. B and C of Section 3, Ref. 1.
Δ Only a 1-ft section which remained in the test chamber throughout the steam test was subjected to the final irradiation.
† See Irradiation Report in the Appendix.

## 4. DIELECTRIC MEASUREMENTS

Measurements of insulation resistance and leakage current made at the conclusion of the steam exposure test and following the final irradiation are presented in Table 2.

## Table 2. DIELECTRIC MEASUREMENTS

| Sample | Terminal Connections(1) | | Measured at Ambient Conditions Following Conclusion of Steam Exposure Test | | | Measured After Final Irradiation | | |
|---|---|---|---|---|---|---|---|---|
| | I | II (ground) | Insulation Resistance(2) ($10^9 \Omega$) | Leakage Current(3) Potential (kV ac) | Leakage Current(3) Current (mA) | Insulation Resistance(2) ($10^9 \Omega$) | Leakage Current(3) Potential (kV ac) | Leakage Current(3) Current (mA) |
| A-1 | 1,2,3,4,5,6,7 | ground | -- | 2 | 3.3 | -- | 2 | 4.9 |
| B-1 | 1,2 | ground | -- | 2 | 1.3 | -- | 2 | 1.2 |
| C(4) | 2,3,4(5) | ground | -- | 2 | 1.2 | -- | -- | -- |
| D | 1,2,3,4,5,6 | ground | -- | 2 | 1.6 | -- | 2 | 7.3 |
| A-1 | 1 | all others | 40 | 4 | 1.2 | 100 | 4 | 1.5 |
| A-1 | 2 | all others | 40 | 4 | 1.3 | 0.2 | -- | (Note 7) |
| A-1 | 3 | all others | 40 | 4 | 1.2 | 900 | 4 | 1.4 |
| A-1 | 4 | all others | 40 | 4 | 1.3 | 100 | 4 | 1.5 |
| A-1 | 5 | all others | 40 | 4 | 1.3 | 70 | 4 | 1.6 |
| A-1 | 6 | all others | 40 | 4 | 1.2 | 85 | 4 | 1.6 |
| A-1 | 7 | all others | 17 | 4 | 1.3 | 95 | 4 | 1.5 |
| B-1 | 1 | 2 | 0.620 | 4 | 1.0 | 20 | 4 | 1.1 |
| B-1 | 2 | 1 | 0.605 | 4 | 1.0 | 25 | 4 | 1.2 |
| C(4,6) | 2 (black) | all others | 2000 | 4 | 1.0 | -- | -- | -- |
| C(4) | 3 (red) | all others | 2000 | 4 | <1 | -- | -- | -- |
| C(4) | 4 (green) | all others | 2000 | 4 | 1.0 | -- | -- | -- |
| D | 1 (white) | all others | 5 | 4 | 1.8 | 0.15 | 3.4 | > 10(8) |
| D | 2 (black) | all others | 90 | 4 | 1.8 | 0.7 | 4 | 6.2 |
| D | 3 (red) | all others | 13 | 4 | 1.5 | 1.5 | 4 | 3.7 |
| D | 4 (orange) | all others | 8 | 4 | 1.5 | 1.3 | 4 | 2.8 |
| D | 5 (green) | all others | 5 | 4 | 1.6 | 1.0 | 4 | 3.3 |
| D | 6 (blue) | all others | 2 | 4 | 1.6 | 0.9 | 4 | 3.5 |

Notes:

(1) The numbers in these columns indicate which conductors were connected to the instrument terminals.

(2) Measured after application of 500 V dc for 1 min, using a General Radio Megohmmeter 1862B.

(3) These measurements were made with a Beckman Breakdown Test Set, Model 1000-AC/DC - ITS 2 M. The indicated potential was applied for 5 min.

(4) In this table, Sample C refers to the portion which was subjected to the 6-hr preconditioning at 66°C, and was shot out of the test chamber soon after the steam pressure was raised to 100 psig.

(5) Conductor No. 1 (white) was not connected to Terminal I because of a cut in the insulation.

(6) No measurements were made on the white conductor because of a cut in the insulation.

(7) Arcing was observed between the conductor and the metal tube in which one of the ends of the cable had been potted. As this was on the side that had been outside the test chamber, the cut was evidently caused by handling.

(8) Sample was noticeably heated at conclusion of measurement.

## REFERENCE

1. S. P. Carfagno and L. E. Witcher, *Test of Electrical Cables under Simulated Post-Accident Reactor Containment Service*, Franklin Institute Final Report F-C2935, October 1970.

# APPENDIX

## IRRADIATION REPORT

INDUSTRIAL REACTOR LABORATORIES, INC.
A RESEARCH FACILITY OF RUTGERS • THE STATE UNIVERSITY
PLAINSBORO, NEW JERSEY 0853
609-799-1800

November 16, 1970

Mr. William Steigelmann
Franklin Institute Research Laboratory
Benjamin Franklin Parkway
Philadelphia, Pennsylvania 19103

Ref: Your P. O. 13311

Dear Bill:

The cobalt 60 irradiation of three groups of cables was completed on November 13, 1970.

The cables were stacked inside the FIRL pressure vessel and were irradiated in an IRL Hot Cell. The variation of dose rate along the height of the stacked cables was ±10%.

One group of cables was irradiated to an average exposure of 90 Megarads. This group had previously been irradiated to an exposure of 10 Megarads. The second group of cables was irradiated to a total dose of 100 Megarads, and the third group was exposed to a 10 Megarad dose. The cables in each group of irradiations were as identified on the detailed instruction sheet from FIRL dated October 26, 1970.

Very truly yours,

Richard T. Canfield
Manager, Operations

## SECTION #4

CONCLUSION SECTION, REFERENCE SECTION &
RESPONSE TO 10 DAY LETTER

Source B - Cable obtained from North Anna Units 1 & 2 stock.

Source C - Cable originally purchased for use on North Anna 3 & 4.

1) Collyer Insulated Wire Company type, cross-linked polyethylene with neoprene jacket.

All deficiencies identified in VEPCO's November, 1980 submittal, and the NRC's SER Appendix B have been resolved. Details are provided in the updated Component Evaluation Worksheets. Complete qualification documentation has been, or will be assembled and available in the central file.

2) General Electric Wire & Cable; type, cross-linked polyethylene with neoprene jacket.

SEE SECTION 7.3.10

3) Kaiser Aluminum and Chemical Sales Inc.; type, cross-linked polyethylene with neoprene jacket.

SEE SECTION 7.3.11

4) Continental Wire and Cable Co.

(a) Type, high temperature silicone rubber cable.

All deficiencies identified in VEPCO's November, 1980 submittal, and the NRC's SER Appendix B have been resolved. Details are provided in the updated Component Evaluation Worksheets. Complete qualification document has been or will be assembled and available in the central file.

(b) Type, cross-linked polyethylene with neoprene jacket.

All deficiencies identified in VEPCO's November, 1980 submittal, and the NRC's SER Appendix B have been resolved. Details are provided in the updated Component Evaluation Worksheets. Complete qualification documentation has been, or will be assembled and available in the central file.

REFERENCE SECTION 8


54. Lewicki, R.G., Reliance Electric Company, to Barnhart, J.H., Stone & Webster Engineering Corporation, subject: VEPCO/Surry Power Station Units 1 & 2, Motor Bearing Lubricant, Reliance Part No. 4824-15-A, November 14, 1980.

55. Reliance Electric Company, Nuclear Power Motor Systems, Type Test Support Analysis, Random Wound Motors, Summary Report NUC-9, July 1, 1978. Includes Appendix: Seismic Report 78-R-33, Justification for Omission of Routine "End Turn Stress Analysis" for Random Wound Motors, July 10, 1978.

56. Electric Power Research Institute, Evaluation and Test of Improved Fire-Resistant Fluid Lubricants for Water Reactor Coolant Pump Motors, Volume 1: Fluid Evaluation, Bearing Model Tests, Motor Tests, and Fire Tests, Interim Report NP-1447, July 1980.

Rev. 4] 57. Deleted

58. Kuster, J., Raychem Corporation, to MacFarlane, I.S., Stone & Webster Engineering Corporation, subject: IE Bulletin 79-01B, Environmental Qualification of Equipment, Surry Power Station Units 1 & 2, Additional Qualification of Raychem Flamtrol Wire and Cable, Spec. No. NAS-3190, December 2, 1980.

59. McGowan, E.J., Raychem Corporation, to LaPetra, F.E., Raychem Corporation, Memo - Subject: Raychem-Flamtrol, Continuation of LOCA Test for Qualification to IEEE Standard 383, Test Report EM #1237, June 21, 1976. Possible attachments include: Kuster, J., Raychem Corporation, to MacFarlane, I.S., Stone & Webster Engineering Corporation, January 27, 1981.

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VEPCO

SURRY UNIT 2
APPENDIX B TO NRC-SER
AUGUST 24, 1981

LEGEND

DESIGNATION FOR DEFICIENCY

R - Radiation
T - Temperature
QT - Qualification time
RT - Required time
P - Pressure
H - Humidity
CS - Chemical spray
A - Material aging evaluation, replacement schedule, ongoing equipment surveillance
S - Submergence
M - Margin
I - HELB evaluation outside containment not completed
QM - Qualification method
RPN - Equipment relocation or replacement, adequate schedule not provided
EXN - Exempted equipment justification inadequate
SEN - Separate effects qualification justification inadequate
QI - Qualification information being developed
RPS - Equipment relocation or replacement schedule provided

RESOLUTION OF DEFICIENCY

1. Components deleted from the master list

2. Components requiring replacement or modification

3. Components determine to be qualified

4. Components determined to be qualified except for aging

| NUM | KEY# | EQUIPMENT | MANUFACTURER | COMPONENT NUMBER | DEFICIENCY | RES | REF | COMMENTS | STA |
|---|---|---|---|---|---|---|---|---|---|
| 321 | 0814 | 600V INSTRUMENT CABLE | CONTINENTAL WIRE AND CABLE | SPEC. NO. NUS-411 | R,QT,P,H,CS,A,QI | 3 | 6-59 | | |
| 322 | 0814 | 600V INSTRUMENT CABLE | CONTINENTAL WIRE AND CABLE | NUS-341A | R,QT,P,H,CS,A,QI | 3 | 6-59A | | |
| 323 | 0814 | HIGH TEMPERATURE CABLE | CONTINENTAL WIRE AND CABLE | NUS-326 | QT,CS,A,QM,QI | 3 | 6-60 | QDR-5437-131-01 | |
| 324 | 0815 | 5000V POWER CABLE | COLLYER | NUS-364 | R,T,QT,P,H,A,QI | 3 | 6-60A | REF QDR-5437-143-01 | |
| 325 | 0836 | 5000V POWER CABLE | OKONITE | NUS-364A | R,T,QT,P,H,A,QI | 3 | 6-60B | REF QDR-5437-133-01 | |
| 326 | 0829 | 5000V POWER CABLE | KAISER | NUS-217 | R,T,QT,P,H,A,QI | 1 | 6-60C | | |
| 327 | 0325 | PUMP MOTOR | GE | 2-CC-P-2A | R,T,QT,P,H,A,RPN | 2 | 6-61 | | |
| 328 | 0325 | PUMP MOTOR | GE | 2-CC-P-2B | R,T,QT,P,H,A,RPN | 2 | 6-62 | | |
| 329 | 0401 | SOLENOID VALVE | ASCO | SOV-CC-205A | R,QT,A,RPN | 2 | 6-63 | REF QDR-5437-SOV-02 | |
| 330 | 0401 | SOLENOID VALVE | ASCO | SOV-CC-205B | R,QT,A,RPN | 2 | 6-64 | REF QDR-5437-SOV-02 | |
| 331 | 0401 | SOLENOID VALVE | ASCO | SOV-CC-205C | R,QT,A,RPN | 2 | 6-65 | REF QDR-5437-SOV-02 | |
| 332 | 0401 | SOLENOID VALVE | ASCO | SOV-CC-207 | R,QT,A,RPN | 2 | 6-66 | REF QDR-5437-SOV-02 | |
| 333 | 0401 | SOLENOID VALVE | ASCO | SOV-CC-209A | R,QT,A,RPN | 2 | 6-67 | REF QDR-5437-SOV-02 | |
| 334 | 0401 | SOLENOID VALVE | ASCO | SOV-CC-209B | QT,A | 2 | 6-68 | REF QDR-5437-SOV-02 | |
| 335 | 0401 | SOLENOID VALVE | ASCO | SOV-CC-210A | QT,A,RPN | 2 | 6-69 | REF QDR-5437-SOV-02 | |
| 336 | 0401 | SOLENOID VALVE | ASCO | SOV-CC-210B | R,QT,A,RPN | 2 | 6-70 | REF QDR-5437-SOV-02 | |
| 337 | 0401 | SOLENOID VALVE | ASCO | SOV-CC-210C | R,QT,A,RPN | 2 | 6-71 | REF QDR-5437-SOV-02 | |
| 338 | 0531 | MOTOR OPERATED VALVE | LIMITORQUE | MOV-CS-201A | QT,A | 3 | 6-72 | QDR 5437-MOV-2-01 BASED ON SURRY 1 INSP. WILL BE VERIFIED DURING OUTAGE | |