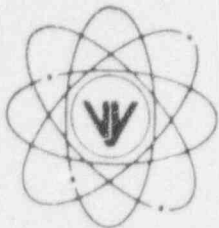


# VERMONT YANKEE NUCLEAR POWER CORPORATION



Ferry Road, Brattleboro, VT 05301-7002

REPLY TO  
ENGINEERING OFFICE  
580 MAIN STREET  
BOLTON, MA 01740  
(508) 779-6711

November 15, 1996  
BVY 96-145

United States Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555

- References: (a) License No. DPR-28 (Docket No. 50-271)  
(b) Letter, VYNPC to USNRC, BVY 96-58, dated May 28, 1996  
(c) Letter, USNRC to VYNPC, NVY 96-117, dated June 28, 1996  
(d) Letter, VYNPC to USNRC, BVY 96-94, dated July 26, 1996  
(e) Telecon, USNRC to VYNPC, November 8, 1996  
(f) Underwriter's Laboratory Test Report, File R10925-1, dated April 10, 1984

**Subject: Response to Request for Additional Information Regarding Vermont Yankee Request for Exemption from 10 CFR Part 50, Appendix R**

In Reference (b), Vermont Yankee requested exemption from the requirements of 10CFR50, Appendix R, Section III.G, "Fire protection of safe shutdown capability," to permit use of Rockbestos Firezone®R fireproof cable in plant areas that require enclosing cables in a fire barrier having a 1-hour fire rating. The plant areas identified in the exemption request were the Cable Vault and the 280 foot elevation of the Reactor Building.

In Reference (c), the NRC requested additional information needed to complete review of our exemption request. In Reference (d) Vermont Yankee submitted the requested information and revised the exemption request so that it now applies to the use of Rockbestos Firezone®R cable only in the Cable Vault.

In Reference (e), the NRC requested further information regarding our request. The information requested is attached.

We trust that the information provided is acceptable; however, should you have any questions, please contact this office.

Sincerely,

VERMONT YANKEE NUCLEAR POWER CORPORATION

James J. Duffy  
Licensing Engineer

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Attachment 1: Response to Request for Additional Information  
Attachment 2: Rockbestos Firezone®R cable Vendor Information

c: USNRC Region I Administrator  
USNRC Resident Inspector - VYNPS  
USNRC Project Manager - VYNPS

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Attachment 1  
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Request for Additional Information  
Vermont Yankee Nuclear Power Station

**Request for Additional Information #1**

Describe and justify the differences between the tested [Reference (f)] and installed Firezone®R cable configurations. Describe why and how the tested configurations bound the installed configurations. In addition, state the maximum temperature attained during the test and provide the limiting temperature for cable damage.

**Response to Request for Additional Information #1**

The cable which is the subject of Vermont Yankee's exemption request, installed in the Cable Vault, is a two-conductor (2/C) #14 AWG Firezone®R cable with a stainless steel sheath (see Attachment 2). The cables tested in Reference (f) included a 3/C #14 AWG cable. As demonstrated below, the 2/C cable is identical to the 3/C cable in all critical fire protection attributes except for having one less conductor. Also, as demonstrated below, the test configurations exposed the Firezone®R cable to conditions more severe than the installed configuration. Based on these facts, the tested configurations bound the installed configuration and therefore the use of the 2/C Firezone®R cable requested in Reference (b) is considered acceptable.

**Cable Construction**

As described in Attachment 2, all Firezone®R cables have the same cable jacket construction including: flame retardant binder tape, glass braid covering and a continuously welded, corrugated stainless steel sheath. Additionally, each individual conductor in a #14 AWG Firezone®R cable has the same conductor construction including: conductor size, composite inorganic layer fire barrier, silicone rubber insulation, mica tape and glass braid conductor covering with high temperature finish. Finally, conductor to conductor spacing and conductor to cable jacket spacing are the same for the installed 2/C cable as for the tested 3/C cable. The critical electrical insulation properties of the cable when exposed to the fire are therefore the same.

**Fire Test Configuration**

The configuration of the 2/C cable installed at Vermont Yankee is less severe than the test configuration of the 3/C cable in Reference (f). The installed 2/C cable is routed outside of cable trays, away from non-fire-resistant electrical cables [see description of 2/C cable routing provided in Reference (d)]. As described in Reference (f), the tested 3/C cable was placed in a cable tray assembly among non-fire-resistant electrical cables to simulate the fuel loading of an actual installation. Despite the additional exposure of ignited non-fire-resistant cables, a configuration more severe than Vermont Yankee's configuration, the Firezone®R cable remained functional throughout the test.

Also, the installed 2/C cable is used in a 120Vac circuit and the cable insulation is rated for 600Vac. The tested cable was subjected to a 78 minute fire exposure with the furnace temperatures controlled in accordance with the Standard for Fire Tests of Building Construction

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and Materials, ASTM E119. During the fire endurance test, the 3/C cable was connected to three phase Y voltages of 480/277V and 960/555 Vac [Reference (f), p. 32]. This test configuration is clearly more severe than the installed configuration. The temperatures measured on the stainless steel sheath of the tested cable are contained in Appendix D of Reference (f). The maximum ambient temperature attained was 1740°F and the maximum 3/C cable temperature attained was 1671.9°F. Although the limiting temperature for cable damage was not determined during the test, the test results demonstrate that the limiting temperature for cable damage is in excess of that required to achieve a one-hour fire rating.

Therefore, because the 2/C Firezone®R cable installed at Vermont Yankee is essentially the same in construction and fire protection features as the tested 3/C Firezone®R cable and because the 3/C cable passed an ASTM E119 fire test whose configuration and test conditions were more severe than the 2/C cable installation at Vermont Yankee, use of the 2/C Firezone®R cable is bounded by the tested configuration and its use as a 1-hour fire barrier is therefore acceptable.

#### **Request for Additional Information #2**

Describe the conditions and functionality of the Firezone®R cables throughout the test. Indicate whether the cables were energized and carrying load or de-energized, as well as whether the cables were capable of performing their function. Discuss the criteria used to determine functionality of the cable such as insulation resistance, physical damage, or others.

#### **Response to Request for Additional Information #2**

"The fire endurance test was conducted with the furnace temperatures controlled in accordance with the Standard for Fire Tests of Building Construction and Materials, ASTM E119."

- Reference (f), p. 15

"Immediately before the fire endurance test, the fire resistant cables were energized with predetermined steady-state ac electrical currents. The cables remained energized throughout the fire exposure except for a 10 s period immediately preceding an inrush current test on each fire resistant cable. Following the fire endurance test, the cables were deenergized for the water hose stream test. Following the water hose stream test, the cables were again energized with predetermined steady state ac electrical currents. The cables remained energized throughout a 93 h cooldown period except for a 10 s period just prior to the application of four supplemental inrush current tests. Following the 93 h extended cooldown period the cables were again deenergized for a second hose stream test. Immediately following the second hose stream test the cables were subject to a final inrush current test."

- Reference (f), p. 1

"In addition to the low voltage ac electrical current applied to each conductor of the nine fire resistant cable configurations, each fire resistant cable was energized with a dc voltage and monitored continuously for electrical faults. The electrical fault monitor panel was connected to

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an automatic data logger which scanned each circuit and provided a printed record to show electrical faults."

- Reference (f), p. 17

The test results indicated that no "electrical faults occurred in any of the nine fire resistant cable configurations." To "substantiate the determination that no electrical faults were present in the nine fire resistant cable configurations, insulation resistance and dielectric voltage-withstand tests were conducted on each conductor of the nine cables. The results of the insulation resistance and dielectric voltage-withstand tests are contained in Appendices B and C, respectively," of Reference (f).

- Reference (f), p. 23

"As evidenced from the tables in Appendices A, B and C, (electrical current, insulation resistance and dielectric voltage-withstand measurements) each of the nine fire resistant cable configurations in the full-scale test assembly remained electrically functional during the fire endurance test and during the extended cool-down period."

- Reference (f), pp. 31-32

### **Request for Additional Information #3**

Describe the magnitude of current loading during the testing in Reference (f).

### **Response to Request for Additional Information #3**

The following table provides a comparison of loads carried by the tested and installed cables:

Cable Type	Steady State Current	Inrush Current
Tested: 3/C #14 AWG	~ 4 A *	~ 17 A (for 30 sec)*
Installed: 2/C #14 AWG	0.2 A	1.3 A (for 8.3 msec)

\* See Appendix A, p. A3, of Reference (f) for exact values for each conductor

The latest vendor catalog establishes conduction ampacity at 1700°F (based on an 1800°F conductor temperature) as follows:

Cable Type	Ampacity at 1700°F ambient
3/C #14 AWG	14.9 A
2/C #14 AWG	14.9 A

The significantly higher current loading of the tested cable and the manufacturer's published ampacity provide further evidence that the use of the 2/C Firezone<sup>®</sup>R cable at Vermont Yankee is bounded by the tested configuration and is therefore acceptable.

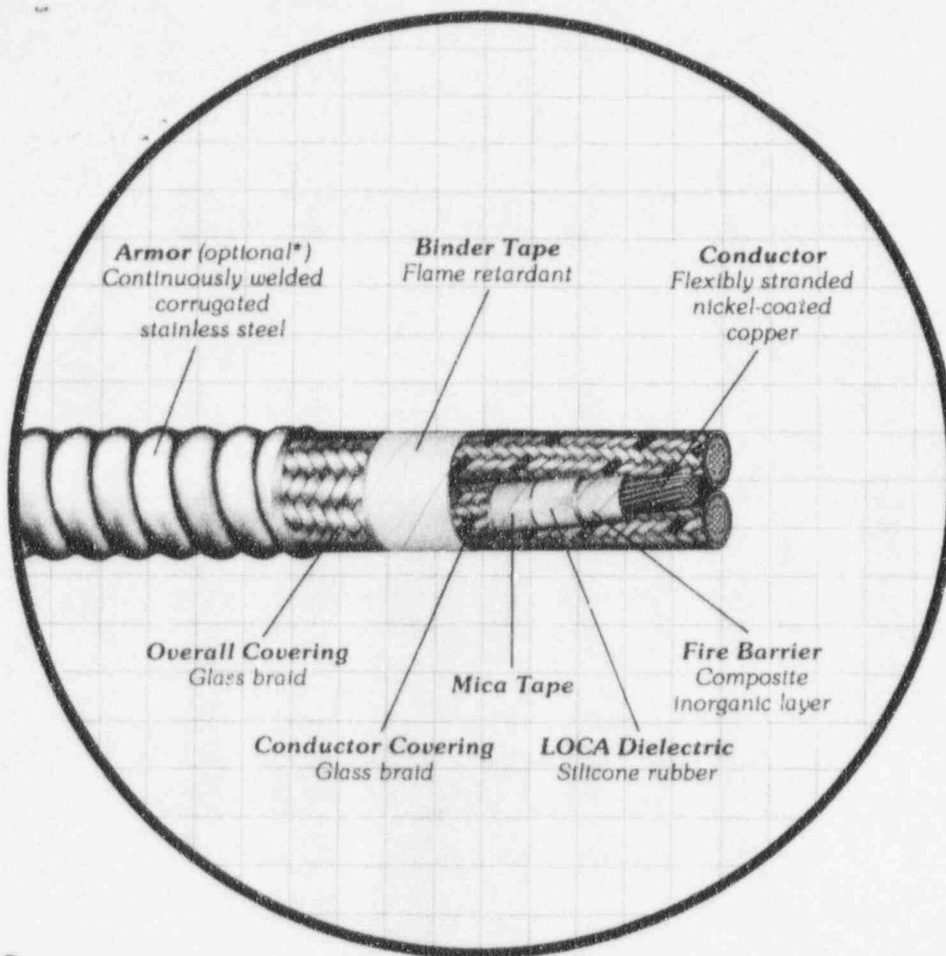


# Firezone® R Appendix "R" Fireproof Cable

(Inorganic Layers)

90°C\*\*, 600 Volt  
Class 1E Nuclear

Spec. RSS-5-144



## Scope

Firezone® R is a fireproof cable specifically designed to address redundant safety circuit requirements within nuclear generating stations. This unique Class 1E nuclear qualified cable system insures safety-related circuit integrity in the event of a fire as required by Appendix "R". (Code of Federal Regulations: Title 10, Part 50.48). It is intended for use on low voltage control, power and instrumentation circuits and can be supplied in either armored or unarmored\* versions.

## Features

- Cost-efficient alternative to thermal wrapping of cable trays or cable re-routing
- Can be installed within trays containing typical plant cables
- Other cables within tray do not have to be derated (as is necessary with ampacities for cables inside thermally wrapped trays)
- Additional circuits can be easily added
- Does not require costly inspection, maintenance and record keeping associated with tray wrapping
- Full traceability provided
- Radiation resistant
- Flame retardant
- Nuclear qualified with a minimum 40-year thermal life expectancy at 90°C\*\*

## Performance Standards

- Minimum one hour fire rating at 1700°F as defined by the ASTM standard E-119
- Greater than three hour fire survival at 1500°F
- Class 1E qualified in accordance with IEEE-383 and IEEE-323. (Rockbestos Report QR-9801)
- Full ASTM E-119 fire test report available under UL report file #R10925-1, project #84NK2320 (Note: this is not a UL listed cable)
- Cable passed the IEEE-383 70,000 BTU/hr vertical tray flame test
- Silicone rubber insulation layer is in accordance with ICEA standard S-19-81
- Quality Assurance program in accordance with 10 CFR Appendix B

## Construction

### Conductor:

Flexible strand, high temperature, nickel-coated copper conductor

### Fire Barrier:

Composite inorganic layer

### LOCA Dielectric:

Silicone rubber insulation layer

### Conductor Covering:

Mica tape and glass braid with high temperature finish

### Circuit Identification:

White braids with colored tracers

### Cabling:

Required number of conductors cabled

### Binder Tape:

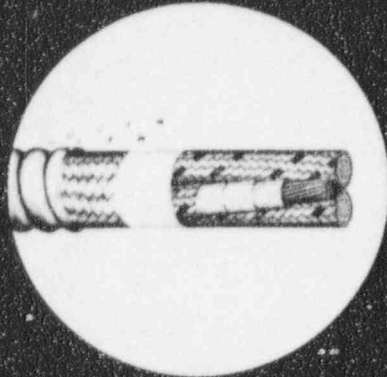
Flame retardant binder tape

### Armor: (optional\*)

Continuously welded, corrugated, stainless steel sheath

\*Unarmored cable must be installed in steel conduit

\*\*Silicone rubber insulation has an inherent 125°C 40-year thermal life.



# Firezone® R

## Appendix "R"

### Fireproof Cable

(Inorganic Layers)

90°C, 600 Volt  
Class 1E Nuclear

Spec. RSS-5-144

## Stainless Steel Armored

Product Code	Number of Conductors	Conductor Size	Number of Strands	Single Conductor Diameter (In)	Nominal Overall Diameter (In)	Approximate Net Weight (lbs/M')
F54-3017	2	14 AWG	19	.27	.78	260
F54-3041	3	14 AWG	19	.27	.92	320
F54-3045	4	14 AWG	19	.27	.96	390
F54-3053	7	14 AWG	19	.27	1.00	540
F54-3004	2	12 AWG	19	.29	.84	290
F54-3042	3	12 AWG	19	.29	.96	370
F54-3046	4	12 AWG	19	.29	1.00	450
F54-3054	7	12 AWG	19	.29	1.13	650
F54-3040	2	10 AWG	49	.33	.96	360
F54-3005	3	10 AWG	49	.33	1.00	430
F54-3047	4	10 AWG	49	.33	1.00	530
F54-3055	7	10 AWG	49	.33	1.33	820
F54-3043	3	5 AWG	133	.39	1.26	600
F54-3048	4	8 AWG	133	.39	1.26	740
F54-3044	3	6 AWG	133	.44	1.26	730
F54-3049	4	6 AWG	133	.44	1.46	930
F54-3014	3	4 AWG	133	.54	1.50	1150
F54-3050	4	4 AWG	133	.54	1.56	1220
F54-3016	3	2 AWG	665	.60	1.61	1470
F54-3051	4	2 AWG	665	.60	1.71	1650
F54-3057	3	1 AWG	817	.67	1.80	1630
F54-3052	4	1 AWG	817	.67	2.02	2100

## Unarmored (Must be installed in conduit)

F54-3019	2	14 AWG	19	.27	.62	150
F54-3025	3	14 AWG	19	.27	.66	200
F54-3030	4	14 AWG	19	.27	.73	250
F54-3021	7	14 AWG	19	.27	.88	400
F54-3010	2	12 AWG	19	.29	.66	170
F54-3020	3	12 AWG	19	.29	.70	240
F54-3031	4	12 AWG	19	.29	.78	300
F54-3009	7	12 AWG	19	.29	.94	480
F54-3024	2	10 AWG	49	.33	.73	220
F54-3011	3	10 AWG	49	.33	.78	290
F54-3032	4	10 AWG	49	.33	.87	380
F54-3038	7	10 AWG	49	.33	1.05	620
F54-3026	3	8 AWG	133	.39	.93	430
F54-3033	4	8 AWG	133	.39	1.03	560
F54-3027	3	6 AWG	133	.44	1.02	550
F54-3034	4	6 AWG	133	.44	1.14	720
F54-3028	3	4 AWG	133	.54	1.15	760
F54-3055	4	4 AWG	133	.54	1.29	990
F54-3029	3	2 AWG	665	.60	1.29	1070
F54-3036	4	2 AWG	665	.60	1.44	1400
F54-3058	3	1 AWG	817	.67	1.51	1380
F54-3037	4	1 AWG	817	.67	1.68	1800