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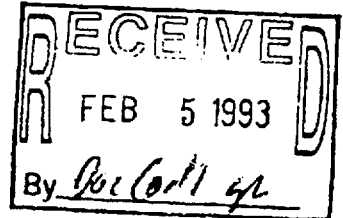
INTEROFFICE CORRESPONDENCE

December 23, 1992
RVR-92-11R, Rev 1

TO: Tom Klein White Plains

FROM: R V Rebbapragada 86/2 WTC

SUBJECT: **EVALUATION OF THE FLAME RETARDANT
CHARACTERISTICS OF CABLES INSTALLED
AT JAMES A FITZPATRICK NUCLEAR POWER PLANT**



In response to your 11/12/92 request and further clarifications resulting from our 11/16/92 meeting, a review of the twelve cable purchase orders available at NYPA's White Plains Office was completed. The objective of this review was to assess the specific requirements to which the cables were designed and tested with respect to their flame resistant capabilities. The summary of this review is presented in exhibit 1.

The following paragraphs describe in detail our assessment along with a comparison of the various flame/fire tests performed on these cables to the ones stipulated in IEEE 383-1974:

1. All the purchase orders indicated that the most predominant cable insulation used in the JAF Nuclear Power Plant was Cross-Linked Polyethylene (XLPE), which was enclosed in a Neoprene jacket. Cables covered in the purchase order excepting APO-55 are provided with insulation and jackets of the Thermal Set Type. In addition, purchase order numbers APO-76 and APO-88 have also used Flame Resistant Ethylene Propylene Rubber (EPR) as an insulation material with a Neoprene jacket. Purchase order APO-101 is a special coaxial instrument cable, which is built to MIL Standards and has two levels of insulation, the first level is Alkane-Imide Polymer, and the second level is XLPE. Specifics regarding the cable manufacturer, purchase order date, applicable Standards, and Insulation/Jacket materials for all the Purchase Orders are summarized in Exhibit 1.
2. Purchase orders APO-76 through APO-174 have imposed the requirement that all the cables be flame resistant and self-extinguishing. The flow chart in Exhibit 2 details the Standards and Flame Tests used to meet these cable requirements. Purchase order APO-55 is the only exception, as it contains lighting cables, which are single conductor and

Attachment

are routed from panel boards to fixtures in individual conduits. Since these cables are run in separate conduits, they are not involved in circuit separation problems and are therefore not held to the above mentioned criteria.

3. LV and MV power cables covered in Purchase Order numbers APO-76 and APO-77 are constructed with Thermosetting XLPE and EPR insulation, with a Neoprene jacket. All of these cables have been subjected to, and passed a Horizontal Flame Test in accordance with IPCEA S-19-81, Section 6.13.2 (see Attachment M for details). Furthermore, these power cables are wrapped in flame resistant and self-extinguishing filler material and binding tape prior to being enclosed in a galvanized steel armor, which does not support combustion. Based on these factors, it is the writer's opinion that these cables would pass the requirements of IEEE 383-1974.
4. With the exception of Purchase Order numbers APO-55, APO-76, and APO-77, all the cables have passed a Vertical Flame Test in accordance with ASTM D2633, Section 34 (see Attachments D through L for details). In addition, these cables were also subjected to, and passed a Cable Tray Fire Propagation Test. This fire test was incorporated into the individual purchase orders, as part of their Technical Provisions section. In the writer's opinion, the combination of these two tests, as well as the flame resistant and self-extinguishing characteristics of the cable materials will provide adequate flame resistance to meet the requirements of IEEE 383-1974. The engineering and technical basis for this judgement is based on the following comparison the characteristics of Burlap/Oil Cable Tray Fire Propagation Test described in S&W Specifications and the IEEE 383 Standard:

<u>Requirements</u>	<u>Specification Test</u>	<u>IEEE 383</u>
Test Conduct in Draft-Free Room	Yes	Yes
Tray Size	6" Wide, 8' High, No Depth Specified	12" Wide, 8' High, 3" Deep
Tray Orientation	Vertical	Vertical
Test Sample Arrangement	One Level of Test Cable	One Level of Multiple Lengths of Test Cable on Center 6" of tray

<u>Requirements</u>	<u>Specification Test</u>	<u>IEEE 383</u>
Number of Tests	Not Specified	At Least 3
Separation of	1/2 of cable Diameter Between Cables	1/2 of cable Diameter Between Cables
Size of Burlap	24" X 24", 9 oz. per square yard	24" X 24", 9 oz. per square yard
Folding Method	Fold all corners inward	Fold all corners inward according to IEEE Fig. 2 until reduced to 4" X 6" and wrap with wire to keep shape
Type of oil for Immersion	Similar to transil 10C	Similar to Mobilect 33
Duration of Immersion	5 minutes	5 minutes
Duration of Drawing	15 minutes	15 minutes
Weight of Burlap/Oil	160 ± 5 g.	160 ± 5 g.
Placement of Ignitor	Above lower cable ends	In front and 2 ft. above lower cable ends.
Attachment to tray with	Metal Bands	Metal Bands
Testing	Ignite and Burn-out Naturally	Ignite and Burn-out Naturally

<u>Requirements</u>	<u>Specification Test</u>	<u>IEEE 383</u>
Failure Conditions	1) If self-sustaining or Propagating Fire Results 2) Excessive smoke appears from cable during fire or after ignitor is consumed. 3) Hot drippings are produced from the cable that may ignite fire in lower areas 4) One electrical circuit breaks down in less than 5 minutes after ignition.	1) Propagate flame and burn the total height of the tray above the flame source.

The General Requirements, as listed in the left-hand column, are procedurally consistent with the criteria for both the Specifications Cable Tray Fire Propagation Test and IEEE 383-1974. In general, the only differences between the two tests center around the details provided for each requirement. The IEEE 383-1974 test includes more specific instructions, such as a depth for the cable tray, a diagram showing the folding pattern, and a wire wrap around the burlap. In fact, the Specification Test actually provides a more stringent pass/fail requirement than IEEE 383. However, it is the writer's opinion that these minor differences are not significant enough to dismiss the Specification Test as below IEEE 383-1974 standards. Furthermore, the insulation and jacket material that comprise the cables is inherently flame resistant and self-extinguishing. These cable characteristics, as well as the documents verifying that the cables passed both the Vertical Flame Test and Cable Tray Fire Propagation Test (see Attachments D through L) lead the writer to conclude the following:

Purchase Orders APO-88 through APO-174 have successfully met the criteria of the specification, which calls for both a Vertical Flame Test and Cable Tray Fire Propagation Test. Due to the nature of these tests and their similarity with the requirements of IEEE 383-1974, the writer believes that the cables would successfully pass all the requirements of IEEE 383-1974. Therefore, with the exception of APO-55 cables, which are not involved in cable separation problems, all the Purchase Order Cables would pass the criteria of IEEE 383-1974.

cc: R Weronick
G C Pan
N Kundu
D Woods

APPENDICES

Appendix A	PURCHASE ORDER APO-55
Appendix B	PURCHASE ORDER APO-76
Appendix C	PURCHASE ORDER APO-77
Appendix D	PURCHASE ORDER APO-88
Appendix E	PURCHASE ORDER APO-88B
Appendix F	PURCHASE ORDER APO-88C
Appendix G	PURCHASE ORDER APO-88D
Appendix H	PURCHASE ORDER APO-89
Appendix I	PURCHASE ORDER APO-98
Appendix J	PURCHASE ORDER APO-101
Appendix K	PURCHASE ORDER APO-172
Appendix L	PURCHASE ORDER APO-174
Appendix M	ICEA SPECIFICATION S-19-81
Appendix N	ICEA SPECIFICATION S-66-524
Appendix O	ICEA SPECIFICATION S-68-516
Appendix P	ASTM SPECIFICATION D2633

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

CABLE SUMMARY CHART

Exhibit 1

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FILE JACKET1.WK3

Purchase Order No.	Manuf. & P.O. Date	Title of Specification	Standards Invoked	Insulation Material	Jacket Material	Remarks
APO-55	Collyer Insulated Wire Co. 8/13/70	600 V Lighting Wire	IPCEA S-66-524 and the latest ASTM Standards shall apply.	Dual Purpose, Cross-Linked, Polyethylene	N/A	These cables are 1/C Lgt cables that are routed in their own raceway system and should not have any separation problem (need verification). No information regarding specific flame/fire test
APO-76	The Okonite Company 11/4/70	600 V Power Cable	Latest applicable IEEE, NEMA, ASTM, ANSI, AEIC and IPCEA S-66-524, S-68-516 Standards shall apply.	1) Flame Resistant and Self-Extinguishing XLPE 2) Ethylene Propylene Rubber	1) Okoprene (Neoprene) 2) Neoprene	Armour cables (Galvanized Steel) These cables passed the Horizontal Flame Test specified by IPCEA S-19-81, Section 6.13.2
APO-77	The Okonite Company 10/10/70	5,000 V Power Cable	Latest applicable IEEE, NEMA, ASTM, ANSI, AEIC and IPCEA S-66-524, S-68-516 Standards shall apply.	Flame Resistant and Self-Extinguishing XLPE	None	Armour cables (Galvanized Steel) These cables passed the Horizontal Flame Test specified by IPCEA S-19-81, Section 6.13.2
APO-88	General Cable Corp. 5/3/71	600 V and 1,000 V Control Cable	Latest IPCEA, IEEE, NEMA, AEIC, ANSI, ASTM D2633, and Fire Propagation tests of the Specification shall apply	1) 600 V, Flame Resistant XLPE 2) 600 V Flame Resistant EPR 3) 1000 V Flame Resistant XLPE 4) 1000 V Flame Resistant EPR	Flame Resistant Neoprene Flame Resistant Neoprene Flame Resistant Neoprene Flame Resistant Neoprene	All these cables passed ASTM D2633 Tests and the Cable Tray Fire Propagation Test of the Specification
APO-88B	Cerro Wire and Cable Co. 3/10/72	600 V and 1,000 V Control Cable	Latest IPCEA, IEEE, NEMA, AEIC, ANSI, ASTM D2633, and Fire Propagation Test of the Specification shall apply	Flame Retardant, Cross-Linked Polyethylene	Flame Retardant Neoprene	All these cables passed ASTM D2633 Tests and the Cable Tray Fire Propagation Test of the Specification.
APO-88C	General Electric Company 11/18/70	600V and 1,000 V Control Cable	ASTM D-2633, IPCEA S-19-81 Cable Tray Fire Propagation Test of the Specification shall apply	Vulkene Geoprene	Neoprene	These cables passed IPCEA S-19-81 Vertical Flame Test and the Cable Tray Fire Propagation Test of the Specification.

* Note: Item # 6-G-4, 1/C Conductor 12, has a Vulkene jacket, not Neoprene.

JAMES A. FITZPATRICK NUCLEAR POWER PLANT CABLE SUMMARY CHART

Exhibit 1

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FILE: JACKET2.WK3

Purchase Order No.	Manuf. & P.O. Date	Title of Specification	Standards Invoked	Insulation Material	Jacket Material	Remarks
APO-88D	Cerro Wire and Cable Co. 6/30/72	1000 V Shielded Control Cable	Latest applicable, NEMA, AEIC, ANSI, ASTM D2633, and Fire Propagation tests in the Specification shall apply	Flame Retardant, Cross-Linked Polyethylene	Flame Retardant Neoprene	All these cables passed ASTM D2633 Tests and the Cable Tray Fire Propagation Test of the Specification.
APO-89	Cerro Wire and Cable Co. 3/9/71	Instrument Cables	Latest applicable, NEMA, AEIC, ANSI, ASTM D2633, and Fire Propagation tests in the Specification shall apply	Cross-Linked Polyethylene	Flame Retardant Neoprene	All these cables passed ASTM D2633 Tests and the Cable Tray Fire Propagation Test of the Specification.
APO-98	Cerro Wire and Cable Co. 9/27/71	Thermocouple Extension Wire	ASTM D-2633	Cross-Linked Polyethylene	Flame Retarded Neoprene	All these cables passed ASTM D2633 Tests and the Cable Tray Fire Propagation Test of the Specification.
APO-101	Core Raychem Corp. 6/21/72	Coaxial Instrument Cable	ASTM D470, Sections 2 thru 21, IPCEA S-66-524, and IPCEA S-19-81, Paragraph 6.19.6	1st Level: Alkane-Imide Polymer * 2nd Level: Cross-linked Radiation Resistant Polyolefin *	Flame Retarded, Noncorrosive, Cross-Linked, Polyolefin *	These cables passed IPCEA S-19-81 Vertical Flame Test and the Cable Tray Fire Propagation Test of the Specification.
APO-172	Rockbestos Firewall III 1/19/77	300 V Instrument Cable	IEEE 323, IEEE 383, IPCEA S-19-81, IPCEA S-66-524, IPCEA S-68-516,	Flame retardant XLPE	Neoprene	APO packet includes "Qualification of Firewall III Class 1E Electrical Cables" and related test reports. All tests are qualified for IEEE 383-74.
APO-174	Rockbestos Firewall III 1/26/77	1,000 V Fire Resistant Control Cable	IEEE 323, IEEE 383, IPCEA S-19-81, IPCEA S-66-524, IPCEA S-68-516,	Flame retardant XLPE	Neoprene	APO packet includes "Qualification of Firewall III Class 1E Electrical Cables" and related test reports. All tests are qualified for IEEE 383-74.

* Note: 1) Mark # NFG-52 has Rayolin F insulation and a Flamtrol jacket.

2) Mark # NFG-53 has Flamtrol insulation and a Radiation, Cross-Linked Flamtrol jacket.

3) Mark # NFG-54 has a Flame Retarded, Noncorrosive, Cross-Linked, Low Noise Polyolefin Jacket.

4) Mark # NFG-95 has a Flame Retarded, Noncorrosive, Cross-Linked, Cellular, Polyolefin Jacket.

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
New York Power Authority
IEEE 383 Fire Test Compliance Flow Chart

EXHIBIT 4

