Progress Energy

FEB 1 5 2006

Serial: HNP-06-004
10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT NO. 1
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI)
REGARDING THE REQUEST FOR A LICENSE AMENDMENT TO USE
FIRE-RESISTIVE ELECTRICAL CABLE AT THE HARRIS NUCLEAR PLANT

Ladies and Gentlemen:

On November 7, 2005 and December 6, 2005, the NRC requested additional information to facilitate the review of the proposed request (HNP-05-063 dated August 18, 2005) for a license amendment to use fire-resistive electrical cable at the Harris Nuclear Plant (HNP).

Attachment 1 provides the requested additional information from the first RAI (November 7, 2005).

Attachment 2 provides the requested additional information from the second RAI (December 6, 2005).

Attachment 3 provides the specifications of the fire-resistive cable as additional information to facilitate the review of the proposed request.

Attachment 4 provides the applicable electrical evaluation portion and design drawings of the HNP modification for the Volume Control Tank (VCT) outlet valves.

The additional information provided by this submittal does not change the intent of or the justification for the requested license amendment. HNP has determined that this submittal did not result in any change to the No Significant Hazards Consideration contained in the original letter. Therefore, the 10 CFR 50.92 Evaluation provided in the August 18, 2005 submittal and published in the Federal Register (i.e., 70 FR 67746 dated November 8, 2005) remains valid.

HNP requests that the proposed license amendment be issued by May 13, 2006 to support startup from HNP Refueling Outage (RFO)-13.

This document contains no new Regulatory Commitment.

Progress Energy Carolinas, Inc.
Harris Nuclear Plant
P.O. Box 165
New Hill, NC 27562

A001

Please refer any question regarding this submittal to Mr. Dave Corlett at (919) 362-3137.

I declare, under penalty of perjury, that the attached information is true and correct (Executed on FEB 1 5 2006).

Sincerely,

C.S. Kamilaris

C. S. Kamilaris
Manager, Support Services
Harris Nuclear Plant

CSK/jpy

Attachments:

1. Response to the First Request for Additional Information (RAI) Regarding the Request for a License Amendment to Use Fire-Resistive Cable at Harris Nuclear Plant (HNP)

2. Response to the Second Request for Additional Information (RAI) Regarding the Request for a License Amendment to Use Fire-Resistive Cable at Harris Nuclear Plant (HNP)

3. Specifications for Meggitt Fire-Resistive Cable

4. Applicable Electrical Evaluation portion and Design Drawings of the Harris Nuclear Plant (HNP) modification for the Volume Control Tank (VCT) outlet valves, Engineering Change (EC) 52769 titled, "1CS-165 and 1CS-166 Cable Protection for 1-A-EPA, 1-A-EPB, 1-A-BAL-B"

c:
Mr. R. A. Musser, NRC Senior Resident Inspector
Ms. B. O. Hall, N.C. DENR Section Chief
Mr. C. P. Patel, NRC Project Manager
Dr. W. D. Travers, NRC Regional Administrator

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RESPONSE TO THE FIRST REQUEST FOR ADDITIONAL INFORMATION (RAI)
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FIRE-RESISTIVE CABLE AT HARRIS NUCLEAR PLANT (HNP)

From the First Request for Additional Information (RAI) dated November 7, 2005:
Request 1:

Meggitt Safety Systems, Inc., Fire Test Report, Project No.14980-121039, dated February 23, 2005 (Attachment 4 to SERIAL: HNP-05-063, dated August 18, 2005): on page 27 in the Conclusions Section, it is stated that "Omega Point Laboratories, Inc., has not been requested to analyze the Megger, Conductor Resistance nor Current Leakage data. These data have, therefore, been presented as collected for review and analysis by authorized, qualified persons." Please provide the document where this review and analysis has been performed. Also, provide the acceptance criteria for the megger, conductor resistance, and current leakage testing of the cables, and the justification for meeting (or not meeting) the acceptance criteria.

Response 1:

The megger, conductor resistance and current leakage data, which was collected during fire testing performed under Fire Test Report Project No. 14980-121039, provides baseline cable performance data during a three-hour fire. To take credit for the fire rated capability of the cable, an application specific analysis (controlled under the plant modification process) is required. This analysis must demonstrate that the cable selected is acceptable for the specific application.

The electrical evaluation portion of the Harris Nuclear Plant (HNP) modification for the Volume Control Tank (VCT) outlet valves, Engineering Change (EC) 52769 titled, "1CS-165 and 1CS-166 Cable Protection for 1-A-EPA, 1-A-EPB, 1-A-BAL-B," provides the requested information. Attachment 4 provides this section of the EC package.

Request 2:

Meggitt Safety Systems, Inc. Fire Test Report, Project No. 14980-117047, dated July 7, 2004 (Attachment 5 to SERIAL; HNP-05-063 dated August 18, 2005): on page 24 in the Conclusions Section, it is stated that "Omega Point Laboratories, Inc., has not been requested to analyze the Megger, Conductor Resistance nor Current Leakage data. These data have, therefore, been presented as collected, for review and analysis by authorized, qualified persons." Please provide the document where this review and analysis has been performed. Also provide the acceptance criteria for the megger, conductor resistance and current leakage testing of the cables, and the justification for meeting (or not meeting) the acceptance criteria.

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REGARDING THE REQUEST FOR A LICENSE AMENDMENT TO USE
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From the First Request for Additional Information (RAI) dated November 7, 2005:
Response 2:

The cable performance data collected under Fire Test Report Project No. 14980-117047 provides additional assurance of and demonstrates the acceptability of the cable supports and consistency in cable performance at high temperature, but it was not evaluated in any design or plant modification document. Therefore, no specific review or analysis is provided for this test.

Request 3:

Please explain why the acceptance criteria in the CP&L Meggitt Cable Test Plan -Test 3 (Document Number 51-5060368-01, page 31 of Attachment 4) is only for cable supports and does not include cable functionality.

Response 3:

The acceptance criteria for the cable supports is not application dependant. Electrical performance characteristic acceptance criteria is dependant on application specific design constraints. HNP EC 52769 contains the analysis based on the baseline cable performance data collected under Fire Test Report Project No. 14980-121039. The evaluation contained in EC 52769 demonstrates that Meggitt Safety System fire-resistive cable is acceptable for use in the Volume Control Tank outlet valve application as set forth within the EC.

Request 4:

Please explain why the acceptance criteria in the CP&L Meggitt Cable Test Plan (Document Number 51-5038146-02, page 29 of Attachment 5) is only for cable supports and does not include cable functionality.

Response 4:

The acceptance criteria for the cable supports is not application dependant. Electrical performance characteristic acceptance criteria is dependant on application specific design constraints as stated in Response 3 of this RAI.

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From the First Request for Additional Information (RAI) dated November 7, 2005:
Request 5:

On Drawing No. 02-5050103A-01, there appears to be four cables in the area of the section cut C-C. On Drawing No. 02-5050106A-00, Section C-C, five cables are shown. Please explain this apparent discrepancy.

Response 5:

As indicated on drawing 02-5050103A-01, there are four cables in the area of Section C-C. On drawing 02-5050106A-00, Section C-C indicates four cables and one dead weight. This dead weight was included to demonstrate the acceptability of an alternate type of cable clamp. This alternate clamp type was included in the fire test in both the horizontal and vertical positions.

Request 6:

Meggitt Safety Systems, Inc., Fire Test Report, Project No.14980-121039,dated February 23, 2005 (Attachment 4 to SERIAL: HNP-05-063 dated August 18, 2005): page 60 - Please confirm that the Megger test was performed on the 4/C #8 cable at 1000 volts direct current (VDC).

Response 6:

In Fire Test Report Project No. 14980-121039, the Megger readings for the 4/C #8 cable shown on page 60 were taken at 1000 volts direct current (VDC) as directed by the test plan (page 39 of the test report).

Request 7:

Meggitt Safety Systems, Inc., Fire Test Report, Project No. 14980-121039, dated February 23, 2005 (Attachment 4 to SERIAL: HNP-05-063 dated August 18, 2005): page 63 - At the top of the spreadsheet the test voltage is written as 500 VDC. At the right of the first three rows, the voltage is written at 1000 VDC. Below the table there is a note that reads "Resistance measurement @ 500 VDC is the first reading in Megohms for Cond. #1 Red to Black and Red to blue. All other readings @ 1000 VDC." Please confirm what voltage was used for this test.

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From the First Request for Additional Information (RAI) dated November 7, 2005:
Response 7:

In Fire Test Report 14980-121039, the Megger readings for the 4/C #8 cable shown on page 63 were taken as follows: The technician attempted to take Megger readings at 1500 VDC during the fire test. With the cable at an elevated temperature, the test equipment was not capable of taking Megger readings at 1500 VDC. The technician reduced the voltage and took the Megger readings at 500 VDC. After taking the first two Megger readings at 500 VDC, the technician was directed to start over and take the Megger readings at 1000 VDC as directed by the test plan (page 39 of the test report). The report shows that the first two Megger readings were taken at 500 VDC (values on the left). Also shown for the first two Megger readings are the values taken at 1000 VDC (values on the right). The remaining readings on page 63 of the test report were all taken at 1000 VDC as directed by the test plan.

Request 8:

Meggitt Safety Systems, Inc., Fire Test Report, Project No. 14980-121039, dated February 23, 2005 (Attachment 4 to SERIAL: HNP-05-063 dated August 18, 2005): pages 68 and 69 - Please confirm that the Megger testing performed on 8/C #12 - Cable #2 was at 500 VDC.

Response 8:

In Fire Test Report 14980-121039, the Megger readings for the 8/C #12 - Cable #2 shown on pages 68 and 69 were taken at 500 VDC as directed by the test plan (page 39 of the test report).

Request 9:

Meggitt Safety Systems, Inc., Fire Test Report, Project No. 14980-121039, dated February 23, 2005 (Attachment 4 to SERIAL: HNP-05-063 dated August 18, 2005): page 78 - Please confirm that the Megger testing performed on 7/C #14 - Cable #3 was at 500 VDC.

Response 9:

In Fire Test Report 14980-121039, the Megger readings for the 7/C #14 - Cable #3 shown on page 78 were taken at 500 VDC as directed by the test plan (page 39 of the test report).

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From the First Request for Additional Information (RAI) dated November 7, 2005:
Request 13:

Meggitt Safety Systems, Inc., Fire Test Report, Project No. 14980-121039, dated February 23, 2005 (Attachment 4 to SERIAL: HNP-05-063 dated August 18, 2005): page 92 - This page is titled "Certificate of Calibration for Carolina Power & Light." At the bottom of the page it is written "Page 1 of 2." There is no page 2 of 2 provided. Please provide page 2 of 2.

Response 13:

Page 93 of Fire Test Report Project No. 14980-121039 is the second page (page 2 of 2) of the "Certificate of Calibration for Carolina Power & Light" (the first page is shown on Page 92 of the test report).

Request 14:

"Proposed [final safety analysis report (FSAR)] Changes" - Attachment 3 to SERIAL: HNP-05-063: Please explain why the proposed FSAR changes are written in general terms and not specifically for the circuits associated with volume control tank outlet valves 1CS-165 and 1CS-166.

Response 14:

The proposed FSAR change is worded in such a manner as to be consistent with the level of detail currently contained within the Harris Nuclear Power Plant final safety analysis report (FSAR) for electrical cables. The proposed use of fire-resistive cable is discussed in the second paragraph of the Description for the proposed License Amendment (page 1 of Attachment 1), which states:

> "HNP proposes to use fire-resistive electrical cable to address the specific circuits associated with the volume control tank (VCT) outlet valves to the charging/safety injection pumps (CSIPs) and may use fire-resistive electrical cable in other applications conditioned upon an evaluation to demonstrate that the cable is acceptable for the specific application."

Per discussions with the NRC on January 12, 2006, approval of this proposed License Amendment may be conditioned upon specific approval to address the circuits associated with the VCT outlet valves rather than generic approval for use of fire-resistive electrical cable. If conditionally approved, then use of fire-resistive electrical cable in other applications would require prior NRC approval.

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From the Second Request for Additional Information (RAI) dated December 6, 2005:
Request 1:

In the license amendment request (LAR), the licensee stated that two independent, three-hour fire qualification tests specific to the Harris Nuclear Plant (HNP) applications were performed, and both of these tests will be used to bound the HNP applications of stainless steel jacketed fire resistive cables by Meggitt Safety Systems Inc. (Meggitt cables). The licensee further stated that the installation requirements for the cable and supports will be bounded by the tested configurations. These installation requirements will include such details as: minimum bend radius, clamp torque force, maximum support span, minimum seismic clearance, minimum electrical separation, routing to protect against mechanical damage from other equipment, restrictions on contact with galvanized material, grounding of cable, and application-specific evaluations to demonstrate that the cable is acceptable for its tested insulation resistance values.

Please provide the specifics of the above mentioned installation requirements which will be bounded by the fire test configurations providing references to the pertinent pages from the Meggitt cable test reports.

Response 1:

Fire test Project Report No. 14980-117047 referred to in the HNP proposed License Amendment is applicable since it provides additional assurance of and demonstrates the acceptability of the cable supports and consistency in cable performance at high temperature, but its cable performance data was not evaluated in any design or plant modification document. Therefore, the test report referred to in this response (Response 1 of this RAI) is Fire Test Report Project No. 14980-121039.

Minimum bend radius: The minimum bend radius is six (6) inches as specified by Meggitt Safety Systems Inc., Appendix R Cable Specifications, dated April 12, 2004 (Attachment 3 of this response). General Notes 1.b) on Page 55 of the fire test report states, "Minimum bend radius is 6 inches. At least one bend shall be installed with a minimum bend radius as indicated on Drawing No. 02-5050103A." This specific installation requirement will be incorporated into HNP drawings 6-B-060 Sheet 0007J and 6-B-060 Sheet 0028E by plant modification EC 52769, specifically, the Fire Rated Cable Installation Notes and Details, Note 1, on 6-B-060 Sheet 0007J, and line items 7-10 on 6-B-060 Sheet 0028E. The mark-ups for these drawings are included in Attachment 4.

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From the Second Request for Additional Information (RAI) dated December 6, 2005:
Response 1 (continued):

Clamp torque force: The fire test included two different types of B-Line cable clamps, B2000 SS4 and B2088 SS4. The clamping force to be applied to the tested configuration is discussed in General Note 5.d) on Page 56 of the test report for B-Line B2000 SS4 model clamps and General Note 6.c) on Page 56 of the test report for B-Line B2088 SS4 model clamps. HNP modification EC 52769 evaluated the use of the B2000 SS4 clamp, and the specific installation requirement will be incorporated into HNP drawing 6-B-060 Sheet 0007J, specifically the Fire Rated Cable Installation Notes and Details, Note 2. The mark-up for this drawing is included in Attachment 4.

Maximum support span: The maximum support span included in the fire test is 81 inches. Page 49 of the fire test report represents fire test specimen construction drawing 02-5050103A. The drawing includes detail which shows that the distance between supports A-A and B-B is 81 inches. Eighty-one inches is the maximum distance between any two supports within the fire test. This specific installation requirement will be incorporated into HNP drawing 6-B-060 Sheet 0007J by plant modification EC 52769, specifically the Fire Rated Cable Installation Notes and Details, Note 3. The mark-up for this drawing is included in Attachment 4.

Minimum seismic clearance: This design requirement was not derived from the fire test. Seismic cable separation was selected to be ½" between the outside of cable jacket to the outside of the neighboring cable jacket. Seismic functionality of the cable was demonstrated through seismic testing. A representative sample of cable types, were seismically tested by Trentec, Inc., under the SQURTS Program and is documented under Trentec Inc., Test Report No. 4S002.0. During the seismic testing, the sample cables were installed with ½" of cable jacket to cable jacket separation at the support locations. During the seismic testing, cable electrical functionality was successfully demonstrated. This specific installation requirement will be incorporated into HNP drawings 6-B-060 Sheet 0007J and CPL-2168-S-9459 by plant modification EC 52769, specifically, the Fire Rated Cable Installation Notes and Details, Note 9, on 6-B-060 Sheet 0007J, and the Seismic Clearance Dimensions, Table 1, Note 7, on CPL-2168-S-9459. The mark-ups for these drawings are included in Attachment 4.

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From the Second Request for Additional Information (RAI) dated December 6, 2005:
Response 1 (continued):

Minimum electrical separation: During the fire test, the cable samples were installed with two (2) inches of separation between cables centerline to centerline (slightly less than 1½" between cable jackets). This separation is shown on Pages 49-52 of the fire test report, which represents fire test specimen construction drawings. The results of the fire test demonstrate that the cables flex and move during exposure to the fire and during the hose stream portion of the fire test. HNP Engineering evaluated the cable separation and movement with respect to cable functionality and concluded that there is no adverse correlation between cable separation and cable functionality during a fire. In other words, the cables can be in contact with one another or with support members during a fire, and it does not adversely impact the functionality of the cable. The only restriction identified is that the cables cannot come in physical contact with galvanized materials. To simplify installation inspections, the electrical separation criteria has been specified to the same value as the seismic inspection criteria, which is ½". The specific installation requirement for ½" of electrical separation will be incorporated into HNP drawings 6-B-060 Sheet 0007J and 6-B-060 Sheet 0007D by plant modification EC 52769, specifically the Fire Rated Cable Installation Notes and Details, Note 10 on 6-B-060 Sheet 0007J, and the Preferred/Acceptable Spatial Separation W/O Barriers Note 7 on 6-B-060 Sheet 0007D. The mark-ups for these drawings are included in Attachment 4.

Routing to protect against mechanical damage from other equipment: The potential exists for non-fire rated features within the plant to fail during a fire. To prevent the failure of these features from physically damaging (falling on) the fire-resistive cable, the design approach for installing fire-resistive cable calls for the cable to be routed as high as possible (along the ceiling) in the subject fire area. The fire test configuration was constructed to represent a ceiling application. The photographs of the test specimen on Pages 282-289 of the fire test report depict a concrete slab, representing a ceiling, with the test assembly mounted on the underside of the slab. For the cable to be routed beneath existing equipment, the equipment must be supported in such a manner that the equipment will not degrade the fire-resistive cable during a fire. This specific installation requirement will be incorporated into HNP drawing 6-B-060 Sheet 0007J by plant modification EC 52769, specifically, the Fire Rated Cable Installation Notes and Details, Note 11 on 6-B-060 Sheet 0007J. The mark-up for this drawing is included in Attachment 4.

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From the Second Request for Additional Information (RAI) dated December 6, 2005:
Response 1 (continued):

Restriction on contact with galvanized materials: During the fire test documented under Fire Test Report Project No. 14980-117047, the Meggitt cable samples were attached to galvanized coated support members. Pages 47-53 of the test report depict the tested support configurations and materials. The B-Line strut materials shown B11, B22 and B52 are hot dipped galvanized materials. During the test, zinc was released from the galvanized coating. The zinc reacted with the stainless steel jacket of the Meggitt cable and resulted in liquid metal embrittlement (holes) of the jacket. The cable samples subsequently failed to function electrically when subjected to water during the hose stream portion of the fire test.

During the fire test documented under Fire Test Report Project No. 14980-121039, the Meggitt cable samples were attached to both galvanized and stainless steel support members. During this test, the Meggitt cable samples were physically isolated from the galvanized support materials by the use of a stainless steel shield plate. Pages 49-54 of the test report depict the tested support configurations, materials and shield plate details. The Meggitt cable samples demonstrated continued electrical functionality during this fire test. As a result of the testing conducted under Fire Test Report Project No. 14980-121039, the installed Meggitt cable configuration HNP is required to be installed in such a manner that it does not come in direct contact with any galvanized materials. The specific installation requirement that Meggitt cable jacket not be allowed to come in contact with galvanized materials will be incorporated into HNP drawing 6-B-060 Sheet 0007J by plant modification EC 52769, specifically, the Fire Rated Cable Installation Notes and Details, Note 13 on 6-B-060 Sheet 0007J. The mark-up for this drawing is included in Attachment 4.

Grounding of Cable: During the fire test, Meggitt cable sample jackets were connected to ground at one point along the length of the cable. This connection to ground is shown on the Electrical Wiring Diagrams included in the fire test plan as Figures 7.1-7.4 (pages 43-46). In each of the four figures, the cable jacket is shown as "S metal shield." The specific installation requirement for cable jacket grounding will be incorporated into HNP drawings 6-B-060 Sheet 0007J and 2166-B-051 Sheet 0015 by plant modification EC 52769, specifically, the Fire Rated Cable Installation Notes and Details, Note 14 on 6-B-060 Sheet 0007J, and Note 31 on 2166-B-051 Sheet 0015. The mark-ups for these drawings are included in Attachment 4.

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From the Second Request for Additional Information (RAI) dated December 6, 2005:
Response 1 (continued):

Application specific evaluations to demonstrate that the cable is acceptable for its tested insulation resistance value: During the fire testing, insulation resistance data was collected. This data will be used in application specific analysis to determine if the Meggitt cable is acceptable for specific fire applications. The requirement to perform application specific electrical cable analysis will be incorporated into HNP drawing 6-B-060 Sheet 0007J by plant modification EC 52769, specifically, the Fire Rated Cable Installation Notes and Details, Note 16 on 6-B-060 Sheet 0007J. The mark-up for this drawing is included in Attachment 4. Attachment 4 also includes the applicable electrical evaluation portion and design drawings of HNP modification EC 52769.

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From the Second Request for Additional Information (RAI) dated December 6, 2005:
Request 2:

The fire tests have been carried out on the following Meggitt cables:

Cable #1: 4/C #8 AWG, power cable with one of the conductor energized from 480 VAC electrical source with a load current of approximately 0.8 ampere

Cable #2: 8/C #I2 AWG, control cable with one of the conductor energized from 120 VAC electrical source with a load current of approximately 0.8 ampere

Cable #3: 7/C #14 AWG, control cable wlth one of the conductor energized from 120 VAC electrical source with a load current of approximately 0.8 ampere

Cable #4: 7/C #10 AWG, control cable with one of the conductor energized from 120 VAC electrical source with a load current of approximately 0.8 ampere

Please confirm whether the Meggitt cable application will be limited to above nominal conductor size, number of conductors, voltage, and current values. If not, provide an explanation how the deviations will be bounded by the test configurations.

Response 2:

HNP does not intend to limit the Meggitt cable application to the conductor sizes, number of conductors, voltage and current values as listed in Request 2 of this RAI. HNP will ensure that the specific Meggitt applications are bounded by the testing which has been performed. Meggitt cable is available in a variety of conductor sizes as well as in a number of conductors. Meggitt cable configurations available and considered for inclusion in the fire test included 4/C #8, 4/C #10, 7/C #10, 8/C #12, 7/C #14 and 9/C #14. Generic Letter 86-10 Supplement 1 does not provide guidance with respect to cable selection for inclusion in a fire test. HNP selected several different Meggitt cable types to be included in the fire test to bound the variety of cable configurations available. UL Standard 2196, Section 4.4, which provides selection criteria for cables to include in a fire test, was used for guidance in cable selection. The criteria suggests the following considerations:

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From the Second Request for Additional Information (RAI) dated December 6, 2005:
Response 2 (continued):

UL 2196 Selection Criteria	Test Specimen Selected
Smallest conductor size	7/C #14
Minimum number of conductors	4/C #8
Minimum thickness of conductor insulation	7/C #10
Minimum thickness of insulation between conductors	7/C #10
Minimum thickness of insulation between conductors and the outer jacket	7/C #10

Because Meggitt cable is also available in #12 wire size, HNP chose to include a sample of an 8/C #12 cable in the test.

Based on the cable configurations selected for testing, and the megger testing, conductor resistance testing and high pot testing performed, all variations of the Meggitt cable configurations are bounded by the fire testing performed. With respect to voltage levels, the #8 power cable was tested to application < 1000 VAC. The control cables were tested for applications of < 250 VDC and < 120 VAC. The cable performance data collected during the tests was collected following the guidance of Generic Letter 86-10 Supplement 1.

Additional insulation resistance cable performance data was also collected following the method described in NUREG/CR-6776, Cable Insulation Resistance Measurements Made During Cable Fire Tests, published June 2002. This cable performance evaluation method energized a single conductor and monitored the adjacent conductors for indication of changes in insulation resistance. However, the currents utilized in this additional data collection method were not intended to be bounding with respect to field applications of the Meggitt cable. The bounding current for a particular cable is based on an application specific analysis (e.g., Attachment 4 of this RAI response for the VCT outlet valves).

As additional information to facilitate the review of the proposed request, Attachment 3 provides the specifications of the fire-resistive cable.

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SPECIFICATIONS FOR MEGGITT FIRE-RESISTIVE CABLE

Specifications for Meggitt Fire-Resistive Cable

APPENDIX R FIRE CABLE PHYSICAL CHARACTERISTICS

CHARACTERISTIC	SPECIFICATION
Dimensions	
Outside diameter	0.360" to 0.592"
Conductor Sizes	# 6 AWG to # 16 AWG
Sheath Thickness	0.0155 inches, Nominal
Cable Weight (nominal)	0.592" diameter, 0.4 lbs/foot 0.360" diameter, 0.13 lbs/foot
Materials	
Outer Jacket	321 Stainless Steel
Conductors	Nickel Clad (27%) Copper
Dielectric Insulator	Silicon Dioxide (SiO_2)

ELECTRICAL CHARACTERISTICS

PARAMETER	SPECIFICATION	
Voltage Rating	600 VAC	
Insulation Resistance	$1.5x10^{13}$ ohms-feet @ 70°F >$1.5x10^5$ ohms-feet @ 1925°F	
Conductor Resistance, calculated ohms/100 feet	Ni/Cu * @ RT	Ni/Cu* @ 1995°F
16 AWG	0.54	2.89
14 AWG	0.34	1.82
12 AWG	0.22	1.14
10 AWG	0.14	0.717
8 AWG	0.09	0.451
Coax cable Impedance	50 ohm nominal; 75 ohm, special request	
Coax Cable Capacitance	25 pf/ft nominal	

**Note:* *Nickel clad Copper conductors are sized to the equivalent copper conductor AWG size.*

GENERAL CHARACTERISTICS

CHARACTERISTIC	SPECIFICATION
Certification	Canadian Standards Association (CSA), Class I & II, Hazardous Locations
Test Verifications	ASTM E119-95 (3-hr. exposure) Generic Letter 86-10, Supplement 1 UL 1709 & Norwegian Petroleum Directorate High Rise Fire Exposure
Applications	Power, Control, Instrumentation, TC
Maximum Operating Temperature	1950 °F
Chemical Resistance	NaCl, Jet Fuel, Hydraulic Fluid; H_2SO_4, HF; and H_2S Fumes
Mechanical Properties	
Minimum Bend Radius	6 inches
Maximum Tensile Load	5,000 pounds

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT NO. 1
DOCKET NO. 50-400/LICENSE NO. NPF-63
APPLICABLE ELECTRICAL EVALUATION PORTION AND DESIGN DRAWINGS OF THE HARRIS NUCLEAR PLANT (HNP) MODIFICATION FOR THE VOLUME CONTROL TANK (VCT) OUTLET VALVES, ENGINEERING CHANGE (EC) 52769 TITLED, "1CS-165 AND 1CS-166 CABLE PROTECTION FOR 1-A-EPA, 1-A-EPB, 1-A-BAL-B"

Applicable Portions of EC 52769

Description

Electrical Evaluation, Section B00, Pages 51-62 of 100

Drawings, Section C02, Pages 16, 20, 22 & 32 of 36

Drawings, Section G02, Page 3 of 50

Drawings, Section C02, Page 32 of 36 (24" x 36" format)

Electrical Evaluation:

Procedure EGR-NGGC-0100 requires changes to the plant auxiliary electrical distribution system to be evaluated for potential adverse impact and for identification of required changes to associated electrical calculations. EC 52769 replaces some control cables associated with Motor Operated Valves 1CS-165 (1-LCV-115C or 2CS-L520SA-1) and 1CS-166 (1-LCV-115E or 2CS-L521SB-1) with Meggitt Safety Systems, Incorporated Type Si2400 "fire rated" cable. See Table 1 for a summary of the proposed cable changes and Table 2 for a comparison of electrical characteristics between the existing and proposed cable types.

Cable Sizing:
Control Cables 10243C-SA, 10243F-SA, 10245C-SB, 10245F-SB, 10245K-SB & 10245L-SB

Several of the cables identified for replacement have more conductors than what is available in the selected wire gauge replacement cable. The six existing cables identified will be replaced with ten fire rated cables. The following table identifies the replacement configuration. Note that there are changes in wire gauge size. This change is necessary to address voltage drop concerns at high temperatures (this is discussed in greater detail further in the evaluation).

Existing Cable Number	Existing Cable Size	Replacement Cable Numbers	Replacement Cable Sizes
10243C-SA	10/C #12	10243C-SA	7/C #10
		10243K-SA	4/C #10
10243F-SA	17/C #16	10243F-SA	9/C #14
		10243L-SA	7/C #14
10245C-SB	10/C #12	10245C-SB	7/C #10
		10245M-SB (Part)	7/C #10
10245K-SB	10/C #12	10245K-SB	7/C #10
		10245P-SB	4/C #10
10245F-SB	17/C #16	10245F-SB	9/C #14
		10245N-SB	7/C #14
10245L-SB	4/C #12	10245M-SB (Part)	7/C #10

Control cable selection criteria are specified in Procedure EGR-NGGC-0105. For control cables, there are no specific requirements regarding ampacity or fault current withstand; however, voltage drop must be evaluated. Cables 10243C-SA, 10243F-SA, 10245C-SB, 10245F-SB, 10245K-SB and 10245L-SB are control cables associated with MOVs 1CS-165 and 1CS-166 and are evaluated in Calculations E-5518.049 and E-5518.214.

In order to not reduce margin in the aforementioned control loop voltage drop calculations, the proposed Si2400 cables will be larger than the existing cables (existing # 12 awg will be replaced with #10 awg Si2400 cable and #16 will be replaced with #14). Only cable resistance is used in the control loop voltage drop calculations as allowed by Procedure EGR-NGGC-0105. The resistance of existing #12 awg cable is 1.886 ohms per 1000' at 50^0C; whereas, the resistance of the replacement Si2400 #10 awg cable is approximately 1.589 ohms/1000' at 50^0C. The resistance of existing #16 awg cable is 4.868 ohms/1000' at 50^0C; whereas, the resistance of the replacement Si2400 #14 awg cable is approximately 4.022 ohms/1000' at 50^0C.

For MOV 1CS-165, existing #12 awg Cable10243C-SA is being replaced with two #10 Si2400 cables (10243C-SA and 10243K-SA) and existing #16 awg cable 10243F-SA is being replaced with two #14 Si2400 cables (10243F-SA and 10243L-SA).

For MOV 1CS-166, existing #12 Cables 10245C-SB and 10245K-SB are being replaced with four Si2400 #10 cables (10245C-SB, part of 10245M-SB, 10245K-SB and 10245P-SB). The existing #16 Cable 10245F-SB is being replaced by two Si2400 #14 cables (10245F-SB and 10245N-SB). The existing #12 Cable 10245L-SB is being replaced by part of one Si2400 #10 cable (10245M-SB).

Unlike the existing plant cables, the replacement cables are designed to function during a fire scenario. During a fire, the section of cable within the fire area of concern will be subjected to elevated temperatures having an adverse affect on conductor resistance. Based on the replacement cable routes the following lengths of cable will be within fire areas (in other words, these lengths will see the elevated cable temperature due to fire):

Cable	Cable Length Within a Fire Area*	Total Cable Length	Fire Area	Fire Area Rating
10243C-SA	150'	297'	1-A-SWGRB	3 hour
10243K-SA	150'	297'	1-A-SWGRB	3 hour
10243F-SA	65'	115'	CSRA	1 hour
10243L-SA	65'	115'	CSRA	1 hour
10245C-SB	175'	344'	CSRA	1 hour
10245M-SB	175'	344'	CSRA	1 hour
10245K-SB	50'	114'	CSRB	1 hour
10245P-SB	50'	114'	CSRB	1 hour
10245F-SB	30'	91'	CSRB	1 hour
10245N-SB	30'	91'	CSRB	1 hour

*The cable lengths listed were derived from initial field walkdowns. These lengths have been used in the electrical analysis performed to support the design for this EC. Final designed cable routes resulted in shorter cable lengths within particular fire areas. These shorter routes are used elsewhere in the design evaluation. Because the longer lengths are conservative the electrical analysis is acceptable as is.

The conductor resistance per 1000' for the proposed replacement cables is similar to that of the existing cables for normal and LOCA plant conditions where the conductor temperature is assumed to be 50°C. The overall control loop voltage drop during contactor pickup is negligibly higher under "normal" plant conditions, which is acceptable. The voltage drop under LOCA conditions will improve slightly. The NETWORK computer runs for these two calculations have been updated and are included in Section C00 as "markups". Note, however, that conductor resistance will increase for the "new fire scenario" where postulated cable temperature is 1093.34°C (2000°F). The "new fire scenario" is addressed in a later section of this evaluation.

Impact on Electrical Distribution System Parameters:

The changes in control cable types used for Motor Operated Valves 1CS-165 and 1CS-166 will not result in changes to calculated ac power system voltages, loading or available fault current. In addition, there will be no impact on calculated EDG loading. Since there are no changes in calculated fault current and since there are no changes to overcurrent protective devices, there is no impact on overcurrent protective device coordination (selective tripping) including Appendix R Coordination.

Impacted Electrical Calculations:

All electrical calculations are either Priority 3 or Priority 4. No electrical calculations are required to be updated prior to turnover or closure of the EC. The following electrical calculations are impacted by EC 52769 and should be listed on the EC PassPort ADL and in Section C.2 of the EC. Any "markups" should be included in Section C00.

E-6003

See "markups" in Section C00. Tables J4 and J12 in Attachment J will be revised to change the minimum pickup and/or hold-in voltage for MCC-1A31-SA compartment. 4D and 1B35-SB compartment. 6B. Note that this change does not affect the worst case pickup / hold-in voltage for these two MCCs.

E-5518.049

See "markups" in Section C00. As a minimum, revise the resistance modeled for each conductor of Cables 10243C & 10243F (replaced with new cables 10243C, K, F and L) and re-run existing NETWORK runs. Note that each cable must be modeled as two cables with a splice to allow modeling the section within the "fire" at a higher resistance. Following is a summary of the required voltage for the present condition, post-modification condition with no fire and post-modification condition with a fire in the fire area with the longest length of Si2400 cable:

PATH	DESCRIPTION*	PRESENT	MOD (NO FIRE)	MOD (FIRE)
1	Opening Valve	296.34	296.47	308.12
2	Closing Valve	296.34	296.47	308.12
3	Opening Valve	247.55	247.55	247.55
4	Closing Valve (SI)	306.58	303.33	n/a for fire scenario

*Paths 1 & 2 involve "picking up" the open (or close) contactor using the Control Switch. Path 3 assumes the Open contactor is energized while the valve is in "mid-travel" and determines the required voltage to avoid contactor "dropout". Path 4 involves "picking up" the close contactor via an SI signal (does not apply to the fire scenario). Path 4 also includes auto swap over (VCT to RWST) on low level. This auto function is not credited for Safe Shutdown.

As can be seen above, the proposed cable changes have basically no impact on required voltages for normal plant conditions. For the LOCA scenario, there is actually a slight improvement in required voltage. Slightly higher voltages are required for the new "fire scenario" due to the higher resistance of that portion of cable affected by the postulated fire. However, there is considerable margin with respect to the MCC-1A31-SA criteria voltage established in calculation E-6003.

E-5518.214

See "markups" in Section C00. As a minimum, revise the resistance modeled for each conductor of Cables 10245C, 10245F, 10245K & 10245L (replaced with new cables 10245C, M, K, P, F and N) and re-run existing NETWORK runs. Note that cables 10245C, 10245F and 10245K must be modeled as two cables with a splice to allow modeling the section within the "fire" at a higher resistance. Cable 10245L is modeled as part of new cable 10245M with a splice. Following is a summary of the required voltage for the present condition, post-

modification condition with no fire and post-modification condition with a fire in the fire area with the longest length of Si2400 cable:

PATH	DESCRIPTION*	PRESENT	MOD (NO FIRE)	MOD (FIRE)
1	Opening Valve	302.72	303.78	324.56
2	Closing Valve	302.72	303.78	324.56
3	Opening Valve	249.70	249.85	251.12
4	Closing Valve (SI)	333.28	334.42	n/a for fire scenario

* Paths 1 & 2 involve "picking up" the open (or close) contactor using the Control Switch. Path 3 assumes the Open contactor is energized while the valve is in "mid-travel" and determines the required voltage to avoid contactor "dropout". Path 4 involves "picking up" the close contactor via an SI signal (does not apply to the fire scenario). Path 4 also includes auto swap over (VCT to RWST) on low level. This auto function is not credited for Safe Shutdown.

As can be seen above, the proposed cable changes have basically no impact on required voltages for normal plant conditions. For the LOCA scenario, there is actually a slight improvement in required voltage. Slightly higher voltages are required for the new "fire scenario" due to the higher resistance of that portion of cable affected by the postulated fire. However, there is considerable margin with respect to the MCC-1B35-SB criteria voltage established in calculation E-6003.

References:

EGR-NGGC-0100	R6	Electrical Distribution System Change Control
EGR-NGGC-0105	R3	Control Cable Sizing
EDC-0008	R10	Power Cable Sizing
E-6000	R8	Auxiliary System Load Study
E-6003	R5	Emergency Power System Voltage Criteria
E-5518.049	R0	Volume Control Tank Outlet Isolation Valve 1-LCV-115C
E-5518.214	R0	Volume Control Tank Outlet Isolation Valve 1-LCV-115E
6-B-401 0243	R20	Volume Control Tank Outlet Isolation Valve 1-LCV-115C
6-B-401 0245	R21	Volume Control Tank Outlet Isolation Valve 1-LCV-115E
6-B-041 175S01	R21	480V MCC 1A31-SA
6-B-041 179S02	R18	480V MCC 1B35-SB

Evaluation of New Fire Scenario:

The above evaluations determined that cable changes being made under EC 52769 will not adversely impact the electrical distribution system and/or supporting calculations under **existing** analyzed scenarios such as normal full power, shutdown, and LOCA. However, a new scenario has been developed which assumes a fire in the area through which the Si2400 "fire-rated" cables pass. It is assumed that the conductor temperature of the Si2400 cables affected by the postulated fire is approximately 2000°F (1093.34°C) under this scenario. Note that only the control cables for the affected MOVs are being replaced.

Control cable changes will not impact the MOV motor output torque, but they can impact the operation of MCC control circuit components. Therefore, it must be assured that MCC control circuit components (e.g. contactors) for the affected MOV motors are capable of operating during the new fire scenario. New NETWORK computer runs have been performed for the "fire scenario" for Calculations E-5518.049 & E-5518.214 where the temperature of the new Si2400 control cables is 1093.34°C. Worst case MCC voltage required for pickup is 325 volts and the worst case for dropout is 252 volts. These values are well within the calculated voltages shown in Calculation E-6000.

TABLE 1
Summary of Cable Changes

CABLE #	FROM	TO	EXISTING CABLE		NEW CABLE			
			TYPE	LGTH	Cable #	TYPE	LGTH	FIRE*
10243C-SA	1A31-SA-4D	MTC-1A(SA)	10/C – 12	297	10243C-SA	FR # 10	297	150
					10243K-SA	FR # 10	297	150
10243F-SA	MTC-1A(SA)	MCB-1A2	17/C – 16	115	10243F-SA	FR # 14	115	65
					10243L-SA	FR # 14	115	65
10245C-SB	1B35-SB-6B	ATP-SB	10/C – 12	344	10245C-SB	FR # 10	344	175
					10245M-SB	FR # 10	344	175
10245K-SB	ATP-SB	MTC-1B(SB)	10/C – 12	114	10245K-SB	FR # 10	114	50
					10245P-SB	FR # 10	114	50
10245F-SB	MTC-1B(SB)	MCB-1A2	17/C – 16	91	10245F-SB	FR # 14	91	30
					10245N-SB	FR # 14	91	30
10245L-SB	1B35-SB-6B	ATP-SB	4/C – 12	344	10245M-SB	FR # 10	344	175

*Portion of new Si2400 cable affected by a fire in the worst-case fire area (resulting in longest portion of cable exposed to fire conditions).

TABLE 2
Cable Characteristics

CABLE TYPE	R/1000' (21.1^0C)	R/1000' (25^0C)	R/1000' (50^0C)	R/1000' (1090^0C)
Exist 12 awg ctrl	n/a	1.720	1.886	n/a
Exist 16 awg ctrl	n/a	4.440	4.868	n/a
FR 10 awg ctrl	1.434	n/a	1.589	7.170
FR 14 awg ctrl	3.630	n/a	4.022	18.200

1. R/1000' at 25^0C for existing control cable obtained from E-5521.000, R1, Page A7. R/1000' at 21.11^0C for proposed Meggitt "fire-rated" cable obtained from Meggitt data. Twist factor has not been included for comparison purposes. Temperature correction factor for existing copper conductors is $(234.5 + T_2) / (234.5 + T_1)$ per Okonite Bulletin EHB-90. Resistance Temperature Coefficients for the proposed nickel-clad copper conductors have been calculated from Meggitt data for # 10 and # 14 awg as 246.95 and 246.03 respectively, which are applied in the aforementioned formula. Resistance at 50^0C has been calculated for control cable conductors using these resistance temperature coefficients. Resistance of "fire rated" cable at 2000 F (1093.34 C) obtained directly from Meggitt data. Inductive reactance is not used for control cable voltage drop calculations as allowed by procedure EGR-NGGC-0105.

Ampacity is not required for control cables (existing as well as proposed Meggitt "fire rated" cables).

Cable Separation:

Separation of safety related circuits are required to be maintained in accordance with Regulatory Guide 1.75. Separation is provided to maintain independence of electrical circuits and equipment so that the protective functions required during any design basis event can be accomplished. The degree and method of separation varies with the potential hazards in a particular area.

Because routing redundant cables in separate safety class structures affords a greater degree of assurance that a single event will not affect redundant systems, this EC routes redundant cables in separate safety class structures whenever practicable. In those instances in which it was not practicable, a combination of barriers, distances and consideration for the potential hazards were incorporated into the cable routing. Following is a detailed description of the cable routes:

Barrier – The cable itself contains an integrated three hour fire barrier. Factory splices carry the same three hour fire rating as the cable itself.

Distance – Within three hour fire areas it is possible that during a design basis fire some structural components may fatigue or even fail. This could result in falling support material, raceways and equipment. Because the Meggitt Safety System fire rated cable is considerably smaller in size (0.592") than most other installed equipment and raceways, consideration in the routing of this cable included keeping the fire rated cable as high as possible, thus avoiding potential damage from falling objects. The goal when routing the cable in a three hour fire area, was to have the cable above anything which has the potential to fall and damage the cable. The cable is credited in 2 one-hour fire area locations. In both 1-A-CSRA, and 1-A-CSRB the primary combustible hazard is IEEE 383 qualified cable and the areas are provided with suppression. While the tabulated combustible load for the two areas is high, the actual fire hazard is postulated to be a slow growth fire initiated by a cable failure or minor amounts of transient combustibles. Both areas are "no storage" locations where transient material may not be left beyond a work shift. This type of fire is not postulated to develop a hot gas layer sufficient to cause any structural support fatigue or failures. As a result, the structural supports, equipment and raceways do not present the same damage potential as in a three hour fire area. In a one hour fire area the cable route has been designed using the seismic two over one philosophy. The cable is not routed beneath anything which is not seismically supported which has a size and weight capable of damaging the cable. The cable routes on the RAB 305' and 286' elevations do not contain any pipe whip or missile potentials. The cable route on the RAB 261' elevation in the hallway to Motor Control Center 1B35-SB does contain mechanical equipment. Again, this cable is routed as high as possible in order to avoid potential sources of damage.

Seismic Clearance

Seismic modeling has been used to demonstrate acceptable interaction distance exist based on separation distances provided on the installation sketches contained within this EC. Typical installation separation distance provided on the sketches is 1½" cable centerline to cable centerline (0.908" outside of cable jacket to outside of cable jacket) at the supports. This modeling demonstrates that no adverse seismic interaction exists between new fire rated cables and existing equipment/components.

Cable functionality has also been demonstrated through seismic testing. A representative sample of cable types being installed by this EC were seismically tested by Trentec, Inc., under the SQURTS Program. Reference Test Report No. 4S002.0. During the seismic testing performed, the cables were installed with ½" of cable jacket to cable jacket separation at the supports. During the test the cables deflected to the point at which they came in contact with one another (0.0" separation). Even with the cable physical interaction, cable electrical functionality was successfully demonstrated. Therefore, the minimum seismic separation distance between cable jacket faces established by this

EC is ½". The ½" seismic separation distance will be incorporated onto plant drawing 2168-S-9459 "Safety and Non-Safety Installation Considerations" for fire rated cable installation inspection.

Electrical Separation
Cable fire testing was performed. A representative sample of cable types being installed by this EC were fire tested at Omega Point Laboratory under the direction of Framatome/Areva. Reference Test Report 14980-121039. The fire rated portion of the cables (this does not include the terminations) are constructed entirely out or non flammable materials. The cables do not burn or propagate fire. During the fire testing approximately 1½ " of cable jacket to cable jacket separation distance was maintained between the four cable samples tested. During the fire test, the entire content of the test furnace reached a temperature in excess of 1900°F. When the test assembly was removed from the test furnace at the end of the three hour test, all metal portions (including the cables) of the test assembly were red in color. There was no adverse interaction between cable samples or between cables and the support structure. Before, during and after the fire test electrical functionality was successfully demonstrated. It has been concluded that cable separation with respect to fire having an adverse interaction on cable electrical functionality is not a concern and separation in order to mitigate the propagation of fire with respect to the fire rated cable is also not a concern. For inspection purposes 2166-B-060 Sheet 7D will be updated by this EC to indicate that ½" of electrical separation is acceptable for metal sheathed Fire Rated Cable.

In conclusion, the seismic clearance distance between fire rated cables and other structures shall be in accordance with 2168-S-9459 as revised by this EC. Electrical separation distance between fire rated cables and other cables/raceways shall be in accordance with 2166-B-060 Sheet 7D as revised by this EC.

The Minimum Seismic Clearance Requirement for 3 and 1 Hour Fire Rated Cable is ½".
Minimum Separation Between Open or Enclosed Raceway and Fire Rated Cable is ½".

Cable Identification:

The Fire Rated Cable exhibits a combination of raceway characteristics and cable characteristics. Neither the raceway or cable marking/identification details provide in CAR 2166-B-060 provides direct applicability to Fire Rated Cable. For example the "Typical MI Cable Marker" instruction on sheet 7AB only identify the cable by number at the ends. If damage occurs to a fire rated cable somewhere in the middle of the route it could be very difficult to quickly determine the plant/system impact by not being able to easily identify what cable has been impacted. Based on this, new color code marking requirements and cable identification requirements will be added to CAR 2166-B-060 specifically for Fire Rated Cable. The following statement will be added to CAR 2166-B-060 Sheet 7A:
"Fire Rated Cable shall be color coded in accordance with 3.2.1A. The color coding shall be applied using tape extending around the outside of the cable jacket. The bands will have a minimum width of 2 inches and be spaced a maximum of 15 feet apart along the length of the cable. Cables shall have cable identification markers installed at each end of the cable as well as each color code location along the length of the cable. Reference Typical MI Cable Marker shown on sheet 7AB. Cable Markers shall be secured to the cable at both ends using stainless steel tie wire or bands."

For this EC the "Typical MI Cable Marker" will be extended from 7/8" long to 1" long to allow for a second fastening hole. Addition labels will be installed along the length of each Fire Rated Cable. These labels will identify the cables by cable number, safety train and that the cable is a three hour fire rated cable. These labels are in addition to the requirements of CAR 2166-B-060 and are being installed as an aid to accurately identify the cables as fire rated equipment.

Evaluation of Insulation Resistance Degradation During a Fire:

When Meggitt cable is exposed to fire, its insulation resistance degrades. The degraded insulation resistance will result in increased leakage current. The purpose of this evaluation is to determine if the reduction in insulation resistance and subsequent increase in leakage current is acceptable. Increase in leakage current can have adverse affects on control circuits as follows:

a) spurious opening of the control power transformer secondary-side fuse(s)
b) spurious "pick up" of a de-energized contactor
c) inability to "drop out" an energized contactor upon demand

This EC will evaluate a postulated (conservative) worst case scenario for the 1CS-165 and 1CS-166 control circuits in order to determine if the control circuits will still function properly considering the decrease in insulation resistance caused by the fire.

Control Circuit Contactor Data

Per EDB and Calculation E-5518.000, NEMA Size 2 contactors are used in safety-related Size 1 and Size 2 starter compartments. Per Calculation E-5521.000, Page A3, NEMA Size 2 contactors have the following electrical characteristics:

Pick Up Voltage	61.6 VAC	Drop Out Voltage	47.3 VAC
Inrush Resistance	17.4 Ω	Inrush Reactance	28.5 Ω
Hold In Resistance	72 Ω	Hold In Reactance	318 Ω

Based on pick up voltage and inrush resistance & reactance, the minimum current needed to pick up the contactor would be:

$$61.6 \text{ vac} / \sqrt{17.4^2 + 28.5^2} = \underline{1.845 \text{ amps}}$$

Likewise, using drop out voltage and hold-in resistance & reactance, the minimum current needed to prevent an energized contactor from dropping out would be:

$$47.3 \text{ vac} / \sqrt{72^2 + 318^2} = \underline{0.145 \text{ amps}}$$

Meggitt Cable Leakage Current Data

During Meggitt Safety System fire cable testing, leakage current data was collected using two methods (Reference Omega Point Laboratories Test Report 14980-121039). The first method involved meggering each control cable sample at 500 VDC and recording the readings. The second method involved energizing one conductor in each sample cable and electronically monitoring each of the other conductors within the cable for leakage current. The test samples exposed to the fire test included a 40 foot length of 7/C #10 cable of which 22.1 feet of the cable was subjected to the elevated temperatures of the test furnace. The cable sample was meggered repeatedly throughout the duration of the fire test and the lowest megger reading obtained was 0.19 Meg-ohm. Neglecting the insulation resistance of that portion of cable sample which was outside the furnace during the fire test, this equates to 4.199 Meg-ohms per foot of cable exposed to the fire test. Assuming that the control circuit voltage is 132 vac for conservatism, this would result in leakage current of 0.03144 ma / foot of conductor exposed to the fire.

1CS-165 Control Circuit Evaluation:

The mark-up of CWD 6-B-401 0243, shows existing plant cable 10243F-SA being replaced with two new fire rated cables 10243F-SA and 10243L-SA. The two replacement cables are routed together from inside the Main Control Board, out the bottom of the control board, through the floor and into the "A" Cable Spreading Room. The cables then run through the "A" Cable Spreading Room and exit by going up through the ceiling and into the bottom of Main Termination Cabinet 1A-SA. The total cable route is approximately 115 feet. The ends of the cables which will be located inside the Main Control Board and Main Termination Cabinet 1A-SA account for approximately 10 feet of the overall length. The remaining 105 feet of each of the cable runs are located within the "A" Cable Spreading Room in Fire Area CSRA. For conservatism and simplicity, it will be assumed that all utilized conductors of these two cables leak current which could pass through the contactor coil. From the CWD markup, there are 10 conductors being used which would equate to a total of 1050 feet of Meggitt cable in Fire Area CSRA resulting in 33 ma of leakage current. Existing cable 10243C-SA is also being replaced with two new fire rated cables 10243C-SA and 10243K-SA. The two replacement cables run parallel with each other following the same route. These two cables are routed from MCC-1A31-SA to Main Termination Cabinet 1A-SA. The cable route involves going through several fire areas. MCC-1A31-SA is located in the 286' RAB South Penetration Area. From there, the cables run through the "A" and "B" Switchgear Rooms into the "A" Cable Spreading Room then up through the ceiling and enter the bottom of Main Termination Cabinet 1A-SA. The longest section of these cables routed through a single three hour fire area is the section which is routed through the "B" Switchgear Room (Fire Area 1-A-SWGRB). The length of the cable within this room is approximately 120' taken from SK-52769-E-3000 and SK-52769-E-3003. New fire rated cable 10243C-SA is a 7/C #10 and 10243K-SA is a 4/C #10. Of these two cables, 9 conductors are used for a total of 1080 feet resulting in 34 ma of leakage current.

Per the extremely conservative calculations above, the worst case leakage current for 1CS-165 is 34 ma. This is not enough current to spuriously pick up a contactor (which requires 1,845 ma) or to keep an energized contactor from dropping out (which requires 145 ma).

Per EDB, control power fuse FU1/243 is a Gould-Shawmut ATM-3 fuse. Field walk down determined the fuse to be a Ferraz Shawmut A6Y3-2B 3 amp fuse. This is documented in AR 157873. The markup to Calculation E5518.049 presents three control circuit analysis cases during a postulated fire. Path 1F (picking up the open contactor) and Path 2F (picking up the close contactor) indicate 2.6377 amps through the fuse with an MCC voltage of 419vac. Adjusting for maximum allowed MCC voltage of 506 vac and adding the 34 ma of leakage current yields approximately 3.22 amps maximum. Per the markup to Calculation E-5518.049, an A6Y3-2B fuse can withstand 4.2 amperes for 60 seconds! Since this current will only last for a few milliseconds until the contactor picks up, this amount of current will not cause the fuse to blow. (Note that the fuse current even without the conservatively calculated leakage current of 34 ma is still 3.19 amperes, i.e. the leakage current causes an insignificant increase in current through the fuse). With regards to the DGVR fuse evaluation for pick-up with degraded voltage, the fuse current considering 34 ma of leakage current is 2.003 amperes which is much less than the fuse rating and therefore acceptable. Path 3F represents steady-state conditions during a fire with the MCC at it highest allowed voltage of 506 vac. In this case the 74 alarm relay is energized and the open contactor is energized. The control power transformer secondary-side fuse current is 0.6179 amps. This current plus the additional leakage current of 34 milliamps would result in control power fuse current of 0.652 amps which will not challenge the 3 ampere fuse.

The control power fuse rated at 3 amps can withstand the additional 34 milliamps of potential leakage current without adverse impact.

1CS-166 Control Circuit Evaluation:

The mark-up of CWD 6-B-401 0245 shows existing plant cable 10245F-SB being replaced with two new fire rated cables 10245F-SB and 10245N-SB. The two replacement cables are routed together from inside the Main Control Board, out the bottom of the control board, through the floor and into the "B" Cable Spreading Room, through the West wall into the stairwell leading to the 305' elevation. The cables exit the stairwell and enter the room located behind the Main Control Room which contains Main Termination Cabinet 1B-SB. The cables enter Main Termination Cabinet 1B-SB through the top and are terminated within the cabinet. Existing plant cable 10245K-SB is being replaced with two new fire rated cables 10245K-SB and 10245P-SB. The two replacement cables are routed together out the top of Main Termination Cabinet 1B-SB. The cables then enter the stairwell leading down to the 286' elevation of the Switchgear Room. The cables exist the East wall of the stairwell and into the "B" Cable Spreading Room. The cables are routed through the "B" Cable Spreading Room to Auxiliary Transfer Panel SB where they are terminated. Existing plant cables 10245C-SB and 10245L-SB are being replaced with new fire rated cables 10245C-SB and 10245M-SB. The two replacement cables are routed together out the top of Auxiliary Transfer Panel SB through the "B" and "A" Cable Spreading Rooms down to the 261' elevation of the RAB. The cables are routed in the hallway near MCC-1B35-SB. The cables are routed into the top of MCC 1B35-SB and terminated within the MCC. The fire areas identified previously, in which the new fire cables are routed, are primarily one-hour fire rated areas (MCC 1B35-SB areas, "B" Cable Spreading Room, "A" Cable Spreading Room). The longest cable route within a single fire area would be cables 10245C-SB and 10245M-SB routed through the "A" Cable Spreading Room. This length of cable route is approximately 55 feet. Reference SK-52769-E-3001. Since there are 12 utilized conductors, maximum leakage current would only be 12 * 55 ft * 0.03144 ma = 21 ma. (In addition to the other conservatisms previously mentioned with regards to 0.03144 ma / ft leakage and assuming all conductors contribute leakage current, the impact of a fire in a one-hour fire area on the insulation resistance is not as significant as in a three hour fire area due to the slightly lower temperatures).

Per the extremely conservative calculations above, the worst case leakage current for 1CS-166 is 21 ma. This is not enough current to spuriously pick up a contactor (which requires 1,845 ma) or to keep an energized contactor from dropping out (which requires 145 ma).

Per EDB, control power fuses FU1/245 & FU2/245 are Gould-Shawmut ATM-2 fuses. the markup to Calculation E5518.214 presents three control circuit analysis cases during a fire. Path 1F (picking up the open contactor) and Path 2F (picking up the close contactor) indicate 2.5218 amps through the fuse with an MCC voltage of 419vac. Adjusting for maximum allowed MCC voltage of 506 vac and adding the 21 ma of leakage current yields approximately 3.066 amps. Since this current only lasts for milliseconds until the contactor picks up, this amount of current will not cause the fuse to blow. (Note that the fuse current even without the conservatively calculated leakage current of 21 ma is still 3.045 amperes, i.e. an insignificant change). With regards to the DGVR fuse evaluation for pick-up with degraded voltage, the fuse current considering 21 ma of leakage current is 2.000 amperes which the 2 ampere fuse can readily handle for the required 60 seconds. Path 3F represents steady-state conditions during a fire with the MCC at it highest allowed voltage of 506 VAC. In this case the 74 alarm relay and the open contactor are energized. The control power fuse current is 0.6541 amps. This current plus the additional leakage current of 21 milliamps would result in secondary control power transformer current of 0.6751 amps which will not challenge the 2 ampere fuse.

The control power fuse rated at 2 amps can withstand the additional 21 milliamps of potential leakage current without adverse impact to the fuses.

Grounding:

Fire Rated Cables being installed by this EC are constructed with an outer metallic sheath. This sheath is required to be connected to the site grounding system. The cables being installed by this EC are not being physically tied to the equipment/cabinets to which they terminate using a grounding bushing. Therefore the cable sheath will be connected to the site grounding system by using a compression type grounding fitting over the outside of the cable sheath. Connection from the compression fitting to the site grounding system shall be made in accordance with 2166-B-051 for 120 VAC control cables.

Connection of the ground compression fitting to the Fire Rated Cable is not a fire rated (tested) configuration and as such, it shall be made in a section of the cable route in which the cable is not required to be fire rated. The areas of each cable route in which the cables are not required to be fire rated are the equipment terminations. The ground connection should be made as close to the cable termination point (at either end) as possible. As a minimum, the ground connection point on the Fire Rated Cable shall be made within the same Fire Area as the equipment termination (at either end of the cable).

e – FOR GROUNDING EQUIPMENT NO 2 AWG COPPER GROUNDING CABLE SHALL BE USED WHERE PHASE CONDUCTORS ARE NO 2 AWG OR SMALLER WHERE PHASE CONDUCTORS ARE LARGER THAN NO 2 AWG, NO 4/0 AWG OR LARGER (AS REQUIRED) COPPER GROUNDING CABLE SHALL BE USED

f – ALL BONDING OF GROUND CABLE AT EQUIPMENT SHALL BE ACCESSIBLE

g – FOR MOTOR OPERATED VALVES 1 hp AND ABOVE SEE SH 13

22 – SECTION OF CABLE TRAY HAVING A GALVANIZED STEEL TO STEEL OVERLAP TIGHTLY BOLTED BY MORE THAN TWO BOLTS PER LAPPED SIDE ARE A CONTINUOUS GROUND. IF TWO BOLTS OR LESS ARE USED AT A JOINT, A #2 COPPER GROUND TERMINATED IN CRIMPED RING LUGS WILL BE BOLTED TO BOTH SECTIONS OF TRAY

23 – GROUNDING AND ELECTRICAL CONTINUITY OF METALLIC CONDUIT SHALL BE IN ACCORDANCE WITH THE FOLLOWING INSTRUCTIONS

a – METALLIC CONDUIT SHALL BE ELECTRICALLY CONTINUOUS THROUGHOUT AND SHALL BE CONNECTED TO THE GROUNDING NETWORK THE FOLLOWING PROCEDURES SHALL BE OBSERVED

1) REMOVE ALL DIRT, FOREIGN MATTER, & CUTTING OIL FROM THREADS.

2)

3) PAINT THREADS WITH CHLORINATED RUBBER ZINC-RICH PAINT, SUBOX CO "GALVANEX NO III", OR EQUAL

4) MAKE-UP JOINTS IMMEDIATELY AFTER PAINTING WHILE PAINT IS STILL WET

5) DISCONTINUITIES SUCH AS CAUSED BY NON-METALLIC BOXES, GAPS IN CONDUIT, PLASTIC CONDUIT SECTIONS, ETC, SHALL BE AVOIDED BY INSTALLATION OF #2 AWG COPPER CABLE TO BOND ACROSS SUCH DISCONTINUITIES FOR BURIED OR SUBMERGED BONDS, USE INSULATED CABLE AND TAPE CONNECTIONS WITH PVC ELECTRICAL TAPE

b – STEEL CONDUITS TERMINATING AT STEEL PANELS SHALL BE GROUNDED TO PANEL BY USE OF DOUBLE LOCKNUTS OR GROUNDING BUSHINGS (SEE SHEET 4)

24 – ANY CONDUIT EMANATING FROM A TRAY IS CONTINUOUSLY GROUNDED IF TIGHTLY BOLTED TO THE TRAY SYSTEM FOR SUPPORT WITH METAL-TO-METAL CONTACT ANY CONDUIT TERMINATING IN A TRAY BUT NOT MAKING METAL-TO-METAL CONTACT TO THE TRAY SYSTEM SHALL BE GROUNDED TO THE TRAY BY MEANS OF A GROUNDING BUSHING AND A #2 COPPER LEAD BOLTED TO THE TRAY BY MEANS OF A CRIMPED RING LUG AS AN ALTERNATE TO GROUNDING BUSHINGS CONDUIT GROUND CLAMPS SUCH AS OZ GEDNEY TYPE CG OR BURNDY TYPE GAR OR EQUAL MAY BE USED TO MAKE THE GROUND CONNECTION ON THE CONDUIT WHERE IT IS REQUIRED.

25 – METALLIC CONDUITS EMERGING THROUGH CONCRETE OR FOUNDATIONS INTO SWITCHGEAR OR MOTOR CONTROL CENTERS THAT ARE NOT GROUNDED SHALL BE TERMINATED WITH A GROUNDING BUSHING AND CONNECTED TO THE SWITCHGEAR GROUNDING BUS WITH A #2/0 COPPER GROUNDING CABLE

26 – GROUNDING OF ALL 480-VOLT POWER RECEPTACLES SHALL BE BY MEANS OF AVAILABLE GROUND LOOP TAPS

27 – ANY EXPOSED BAR STEEL, DUE TO SCRAPING, ETC, IN NONCONTAINMENT AREAS SHALL BE RESURFACED WITH ONE COAT OF GALVANOX TYPE 3 ORGANIC ZINC PRIMER (OR APPROVED EQUAL) AT A DRY FILM THICKNESS OF 3 MILS MINIMUM TO 5 MILS MAXIMUM. COATING SHALL BE APPLIED TO A CLEAN SURFACE. IN CONTAINMENT AREAS, ANY EXPOSED BARE STEEL SHALL BE RESURFACED ONLY WITH KEELER AND LONG NO. 7107 PRIMER AT A DFT OF 3 MILS MIN TO 5 MILS MAX, COATING SHALL BE APPLIED TO A CLEAN SURFACE.

28 – ALL CONTINUOUS LENGTHS OF TUBETRACK ELECTRICAL RACEWAY SHALL BE PERMANENTLY AND EFFECTIVELY GROUNDED WITH CONNECTIONS AT INTERVALS OF NOT MORE THAN 200 FEET.

1) ALL JUMPERS AND BONDS SHALL BE A MINIMUM OF #2AWG COPPER GROUNDING CABLE AND THE GROUNDING/BONDING HARDWARE PER DETAIL "B", PAGE 13.

2) NON-CONTINUOUS LENGTHS OF TUBETRACK MUST EITHER BE BONDED TO A CONTINUOUS LENGTH OR MUST HAVE AN INDEPENDENT GROUND TO GROUND GRID.

3) A CONTINUOUS LENGTH OF TUBETRACK IS A SECTION OF TUBETRACK RACEWAY HAVING A GALV. STEEL TO STEEL OVERLAP TIGHTLY BOLTED BY A MIN. OF 1 BOLT PER LAPPED SIDE.

29.– TIN COATED OR LEAD-TIN COATED GROUND CABLE MAY BE USED THROUGHOUT THE PLANT OR YARD COMPLEX. BARE COPPER MAY BE USED:

1) ANYWHERE ABOVE GROUND.

2) EMBEDDED IN CONCRETE SO LONG AS THE STRUCTURE IS NOT SUBMERGED OR CONTINUOUSLY WET.

3) UNDERGROUND WHEN NOT WITHIN 30 INCHES OF ANY STEEL STRUCTURES OR MEMBERS. IF LOCATED WITHIN 30 INCHES, THE COPPER CABLE MUST BE WRAPPED WITH AN INSULATING TAPE (E.G. ELECTRICAL TAPE) UNTIL OUTSIDE 30 INCHES.

30.– PURCHASING REQUIREMENTS FOR A NNS COPPER GROUNDING CONDUCTOR

A. CONCENTRIC-LAY-STRANDED SOFT COPPER

B. BARE OR TIN COATED

C. CLASS B STRANDING

D. COATINGS PER ASTM B-33

E. LAYED PER ASTM B-8

31.– GROUNDING OF METAL SHEATHED FIRE RATED CABLES SHALL BE IN ACCORDANCE WITH THE FOLLOWING:

A. EACH CONTINUOUS SECTION OF FIRE RATED CABLE SHALL BE GROUNDED AT ONE END

B. THE GROUND CONNECTION POINT ON THE FIRE RATED CABLE SHOULD BE AT THE CABLE END TERMINATION.

C. GROUND CONNECTION TO THE FIRE RATED CABLE SHALL BE MADE USING A GROUNDING BUSHING.

ADD

Ø

EC52769

APPROVED FOR CONSTRUCTION

REV	DATE	BY	CHK	APPRD
6		JWB		

EBASCO SERVICES INCORPORATED

DIV ELEC. DR LM
CH S. NIKOLAKAKIS
DATE MAY 23 1978
APPROVED

CAROLINA POWER & LIGHT CO.
SHEARON HARRIS NUCLEAR P.P.
UNIT 1
GROUNDING INSTALLATION NOTES

CAR 2166
B-051
SH 0015

EC 52769

PREFERRED/ACCEPTABLE SPATIAL SEPARATION W/O BARRIERS

CONFIGURATION (1)	PREFERRED (2)	MIN. ACCEPTABLE ([illegible])
1) FROM - (X) OPEN RACEWAY TO - OPEN OR ENCLOSED RACEWAY	3'H, 5'V	3'H, 5'V
2) FROM - (P) HORIZ. OPEN RACEWAY TO - ENCLOSED RACEWAY (3)	3'H, 5'V	4"H, 12"V
3) FROM - (P) VERT. OPEN RACEWAY TO - ENCLOSED RACEWAY (3)	3'H, 5'V	12"H, 12"V
4) FROM - (P) V OR H OPEN RACEWAY TO - OPEN RACEWAY AND FLEX CONDUIT	3'H, 5'V	12"H, 36"V
5) FROM - (C) OR (L) OPEN RACEWAY TO - OPEN OR ENCLOSED RACEWAY	3'H, 5'V	1"H, 3"V
6) FROM - (X), (P), (C) OR (L) ENCLOSED RACEWAY TO - OPEN RACEWAY	3'H, 5'V	1"
7) FROM - (X), (P), (C) OR (L) ENCLOSED RACEWAY (5) TO - ENCLOSED RACEWAY (5)	1"	1"

(L) - LOW LEVEL, (C) - CONTROL, (P) - LOW VOLTAGE POWER, (X) - MED. VOLTAGE POWER
H - HORIZONTAL, V - VERTICAL, R/S - RIGID STEEL

NOTES:

(1) FROM - POTENTIAL SOURCE OF DAMAGE (NNS OR CLASS 1E), TO - PROTECTED CLASS 1E RACEWAY, SEE NOTE 2, SH. 7C.
(2) FOR GENERAL PLANT AREAS (FOR PREFERRED SEP. DISTANCE IN CABLE SPREAD AREAS SEE NOTE 4 SH. 7C)
(3) FOR THIS CONFIGURATION FLEX CONDUIT IS NOT CONSIDERED ENCLOSED RACEWAY
(4) WHERE THE MINIMUM ACCEPTABLE SPATIAL SEPARATION W/O BARRIERS CANNOT BE MAINTAINED THE "FROM" RACEWAY SHALL BE ENCLOSED IN ACCORDANCE WITH THE REQUIREMENTS OF SH. 7E
(5) FOR THIS CONFIGURATION WHEN CONSIDERING SPECIFICALLY R/S CONDUIT SEPARATION, 1/4" SEPARATION IS ACCEPTABLE WHEN THE "FROM" RACEWAY IS R/S CONDUIT AND THE "TO" RACEWAY IS ENCLOSED. THE 1/4" SEPARATION IS NOT APPLICABLE IF CONDUIT IS (X) CLASS OR IF CONDUIT IS ENCLOSED IN FIREWRAP.
(6) 3'H, 5'V IS THE MIN. ACCEPTABLE SPATIAL SEPARATION FROM EXPOSED COMMUNICATION CABLE ASSOCIATED WITH THE WIRELESS PBX (TELEPHONE) SYSTEM [illegible]
(7) MINIMUM SEPARATION BETWEEN OPEN OR ENCLOSED RACEWAY AND METAL SHEATHED FIRE RATED CABLE IS 1/2" ADD Ø EC52769

NUCLEAR SAFETY RELATED

APPROVED FOR CONSTRUCTION

8		JWB		
REV	DATE	BY	CK	APPROVED

CAROLINA POWER & LIGHT CO
SHEARON HARRIS NUCLEAR P.P.
UNIT 1
MISCELLANEOUS ELECTRICAL DETAILS AND NOTES

CAR-2166
B-060
SHEET 7D
EC56429

A	B	C	D	D1	E	F1	F2	F3	F4	G1	G2	G3	H	I1	I2	J1	J2	J3
CABLE TYPE	B/M NO.	VOLT RATING	CABLE SIZE	SPEC	CABLE WEIGHT LB/FT	T-MAX AXIAL TENSION-LBS PULLING W/PULLING EYES OR SERVES				T-MAX AXIAL TENSION-LBS PULLING W/BASKET GRIPS			OVERALL DIA OF CABLE "D" (IN)	MIN TRAINING RADIUS		T-MAX SIDEWALL PRESS. (LB/FT)AROUND BENDS OR SHEAVES;R-BENDS RADIUS (FT)		
						1/CABLE *	2/CABLES *	3/CABLES *		1/CABLE **	2/CABLES **	3/CABLES **		OUTSIDE CONT	INSIDE CONT.	1/CABLE	3/CABLES	BUNDLES
C	D98-22	6ØØV	BY MFR		Ø.16								Ø.43					
	D98-23		TYPE #1Ø5Ø		Ø.31													
	D98-25		BY MFR										Ø.25					
	D98-26		BY MFR										Ø.31					
	D98-27		5Ø/C #16															
	D98-3Ø		4/C #16										Ø.19					
	D98-31	6ØØV	4/C #1Ø ***	HNP-E-ØØØ1	Ø.342	N/A	N/A	N/A		N/A	N/A	N/A	Ø.59	6.ØØ	N/A	N/A	N/A	N/A
	D98-32	6ØØV	7/C #1Ø ***	HNP-E-ØØØ1	Ø.439	N/A	N/A	N/A		N/A	N/A	N/A	Ø.59	6.ØØ	N/A	N/A	N/A	N/A
	D98-33	6ØØV	7/C #14 ***	HNP-E-ØØØ1	Ø.3Ø1	N/A	N/A	N/A		N/A	N/A	N/A	Ø.59	6.ØØ	N/A	N/A	N/A	N/A
	D98-34	6ØØV	9/C #14 ***	HNP-E-ØØØ1	Ø.326	N/A	N/A	N/A		N/A	N/A	N/A	Ø.59	6.ØØ	N/A	N/A	N/A	N/A
	D98-35	6ØØV																
	D98-36	6ØØV																
L	D6Ø-Ø1	3ØØV	1PR #16 SH	CAR-SH-E-14C	Ø.1Ø	54	1Ø8	162		54	1Ø8	162	Ø.44	2.2Ø	N/A	3ØØR	■	■
	D6Ø-21	6ØØV	1PR #16 SH	HNP1-E-ØØ2	Ø.Ø8	42	84	126		42	84	126	Ø.32	1.ØØ	1.ØØ	1ØØØR	1ØØØR	1ØØØR
	D6Ø-41	6ØØV	1PR #16 SH	HNP1-E-ØØ2	Ø.Ø5	38	76	114		38	76	114	Ø.32	1.9Ø	1.9Ø	3ØØ	3ØØ	3ØØ
	D6Ø-61	3ØØV	1PR #16 SH	HNP1-E-ØØ2	Ø.Ø4	42	1Ø8	162		54	1Ø8	162	Ø.23	1.84	1.84	3ØØR	5ØØR	5ØØR
	D6Ø-Ø2	3ØØV	2PR #16 SH	CAR-SH-E-14C	Ø.25	1Ø8	216	324		1Ø8	216	324	Ø.79	3.95	N/A	3ØØR	■	■
	D6Ø-22	6ØØV	2PR #16 SH	HNP1-E-ØØ2	Ø.21	84	168	252		84	168	252	Ø.63	1.ØØ	1.ØØ	1ØØØR	1ØØØR	1ØØØR
	D6Ø-42	6ØØV	2PR #16 SH	HNP1-E-ØØ2	Ø.12	6Ø	12Ø	18Ø		6Ø	12Ø	18Ø	Ø.52	3.1Ø	3.1Ø	3ØØ	3ØØ	3ØØ
	D6Ø-62	3ØØV	2PR #16 SH	HNP1-E-ØØ2	Ø.Ø9	1Ø8	216	324		1Ø8	216	324	Ø.41	3.28	3.28	5ØØR	5ØØR	5ØØR
	D6Ø-Ø3	3ØØV	6PR #16 SH	CAR-SH-E-14C	Ø.57	325	65Ø	975		325	65Ø	975	1.15	5.75	N/A	3ØØR	■	■
	D6Ø-23	6ØØV	6PR #16 SH	HNP1-E-ØØ2	Ø.42	247	494	741		247	494	741	Ø.89	1.ØØ	1.ØØ	1ØØØR	1ØØØR	1ØØØR
	D6Ø-43	6ØØV	6PR #16 SH	HNP1-E-ØØ2	Ø.29	126	252	378		126	252	378	Ø.76	4.6Ø	4.6Ø	3ØØ	3ØØ	3ØØ
	D6Ø-63	3ØØV	6PR #16 SH	HNP1-E-ØØ2	Ø.22	325	65Ø	975		325	65Ø	975	Ø.58	4.64	4.64	5ØØR	5ØØR	5ØØR
	D6Ø-Ø4	3ØØV	4PR # 16 SH	CAR-SH-E-14C	Ø.4Ø	217	434	651		217	434	651	Ø.96	4.8Ø	N/A	3ØØR	■	■
	D6Ø-24	6ØØV	4PR # 16 SH	HNP1-E-ØØ2	Ø.27	165	33Ø	495		165	33Ø	495	Ø.72	1.ØØ	1.ØØ	1ØØØR	1ØØØR	1ØØØR
	D6Ø-44	6ØØV	4PR # 16 SH	HNP1-E-ØØ2	Ø.22	84	168	252		84	168	252	Ø.64	3.8Ø	3.8Ø	3ØØ	3ØØ	3ØØ
	D6Ø-64	3ØØV	4PR # 16 SH	HNP1-E-ØØ2	Ø.16	217	434	651		217	434	651	Ø.49	3.92	3.92	5ØØR	5ØØR	5ØØR
	D6Ø-Ø5	3ØØV	3/C # 16 SH	CAR-SH-E-14C	Ø.14	75	15Ø	225		75	15Ø	225	Ø.53	2.65	N/A	3ØØR	■	■
	D6Ø-25	6ØØV	3/C # 16 SH	HNP1-E-ØØ2	Ø.Ø95	61	122	183		61	122	183	Ø.34	Ø.5Ø	Ø.5Ø	1ØØØR	1ØØØR	1ØØØR

CABLE DATA TABLE 6-1

ADD

Ø ADD PER EC#52769 R/O

- O T-MAX = 5ØØR
- Ø T-MAX = $45ØR\sqrt{\Sigma Dn^2}$
- ■ T-MAX=3ØØR/KFw
- ● T-MAX=3ØØR
- ▲ T-MAX=1ØØR

N/A-NOT APPLICABLE
N/P-NOT PERMITTED
*(1) PULL EYE OR SERVE PER CABLE
**(1) BASKET GRIP PER CABLE
*** MEGGITT 3 HR FIRE RATED CABLE PER EC#52769

REV	DATE	DESCRIPTION	DWN	CHK	APP'D
4		INCORPORATED EC#52769	EJE		

PROFESSIONAL ENGINEER:
QUALITY LEVEL: SAFETY RELATED
CAROLINA POWER & LIGHT COMPANY NUCLEAR ENGINEERING DEPARTMENT
CP&L
PLANT: HARRIS PROJECT - UNIT 1 SCALE: NONE
TITLE: MISCELLANEOUS ELECTRICAL DETAILS AND NOTES
PLANT DWG. NO. CAR 2166-B-Ø6Ø ØØ28E

CPL-2168-S-9459

		Support Structure	HVAC Duct Side	HVAC Duct Top/Bot	Tube Track	Cable Tray Side	Cable Tray Top/Bot	Tubing * 1	Tubing * 1/2	Tubing * 3/8	Tubing * 1/4	** Conduit * [illegible]	** Conduit * 5	** Conduit * 4	** Conduit * 1/2-3	* Pipe * 4-42	* Pipe * 1/2-3
* Pipe *	1/2-3	3/4	1/2	3/8	1/2	1/2	1	1/2	3/4	1 1/4	2	1 1/4	1 1/2	1 1/2	2 1/8	1 1/4	1
* Pipe *	4-42	7/8	3/4	1/2	3/4	5/8	1 1/4	3/4	1	1 1/2	2 1/4	1 1/2	1 3/4	1 3/4	2 3/8	1 1/4	
** Conduit *	1/2-3	3/4	1 3/4	1	1 3/4	1 3/4	2 1/8	1 3/4	2	2 1/2	3 1/4	1	1 3/4	1 3/4	1 3/4		
** Conduit *	[illegible]	3/4	1 1/4	5/8	1 1/4	1 1/4	1 1/2	1 1/4	1 3/4	1 5/8	2 1/2	1	1 1/4	1 1/4			
** Conduit *	[illegible]	3/4	1 1/4	5/8	1 1/4	1 1/4	1 1/2	1 1/4	1 3/4	1 5/8	2 1/2	1	1				
** Conduit *	[illegible]	3/4	1	5/8	1	1	1 1/4	1	1 1/4	1 3/4	2 1/4	1					
Tubing *	1/4	1 3/4	1 1/2	1/2	1 1/2	1 1/2	1	3/4	1	1 1/2	2 1/4						
Tubing *	3/8	1 1/8	1	3/8	1	7/8	3/4	1/8	1/2	1							
Tubing *	1/2	3/8	1/4	3/8	3/8	1/8	3/4	1/8	1/4								
Tubing *	1	3/8	1/8	1/8	1/8	1/8	1/2	1/8									
Cable Tray	Top/Bot	5/8	1/2	1/2	1/2	1/2	1										
Cable Tray	Side	3/8	1/8	1/8	1/8	1/8											
Tube Track	Top/Bot/Side	3/8	1/8	1/8	1/8												
HVAC Duct	Top/Bot	3/8	1/4	1/4													
HVAC Duct	Side	3/8	1/4														
Support Structure		1/2															

* PIPE TEMPERATURES ≤ 200 °F (SEE NOTE 3) PIPE CLEARANCES DO NOT INCLUDE INSULATION THICKNESS. IF INSULATION THICKNESS IS NOT KNOWN MAINTAIN 6" CLEAR OF PIPE 4" AND SMALLER. FOR PIPE LARGER THAN 4" MAINTAIN 7" CLEAR

** SEE NOTE #6.

SEISMIC CLEARANCE DIMENSIONS

TABLE I

NOTES:

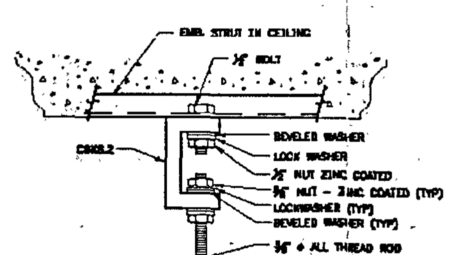
1. THIS CRITERIA DOES NOT APPLY TO NON-SEISMIC TRAPEZE TYPE CONDUIT AND TRAY HANGERS. THE REQUIRED HORIZONTAL CLEARANCE IS 4 1/2" FOR TRAPEZE WITH A THREADED ROD CLEAR LENGTH OF 60" OR LESS AND 3" FOR ROD CLEAR LENGTH GREATER THAN 60".
2. ALL DIMENSIONS ARE IN INCHES.
3. THE CLEARANCE DIMENSIONS INDICATED ON TABLE I ARE MINIMUM REQUIREMENTS DUE TO SEISMIC CONSIDERATIONS ONLY. THE TRUE CLEARANCE REQUIRED MAY BE GREATER THAN THE CLEARANCE IN TABLE I DUE TO TRAIN SEPARATION, THERMAL GROWTH, ETC. THE LARGEST CLEARANCE CONTROLS. REFERENCE DRAWING NO. 2165-G-187581, NOTE 11. WHERE THE ABOVE TABLE CONFLICTS WITH THE TABULATION GIVEN IN CAR 2165-G-187581, THE LARGER OF THE TWO REQUIRED CLEARANCES WILL GOVERN.
4. CLEARANCE IS DEFINED AS THE MEASURED DISTANCE BETWEEN THE APPLICABLE COMPONENT AND THE SURFACE OF PIPING, TUBING, TUBE TRACK, DUCT, CONDUIT, OR SUPPORT. WHERE COMPONENTS ARE INSULATED, CLEARANCE SHALL BE MEASURED TO THE SURFACE OF THE INSULATION.*
5. THIS SEISMIC CLEARANCE CRITERIA IS NOT APPLICABLE BETWEEN A SUPPORTING STRUCTURE AND ITS SUPPORTED COMPONENTS.
6. THE SEISMIC CLEARANCE REQUIREMENT FOR FLEX CONDUIT 1" DIA AND SMALLER TO ALL COMPONENTS LISTED IN TABLE I IS ZERO INCHES. FOR FLEX CONDUIT LARGER THAN 1" DIA CONTACT ENGINEERING FOR AN EVALUATION.
7. THE SEISMIC CLEARANCE REQUIREMENTS FOR 3 AND 1 HOUR FIRE RATED CABLE ROUTING IS 1/2" MINIMUM FROM THE OUTSIDE OF THE CABLE JACKET TO THE EDGE OF THE OTHER SUPPORT, STRUCTURE OR COMPONENT.

ADD ADD

EC52780 EC52780

GUIDELINES FOR INSTALLATION OF NON-SEISMIC COMPONENTS PER REGULATORY GUIDE 1.29

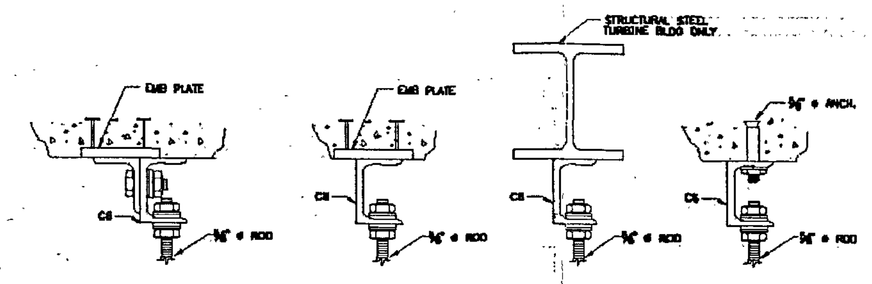
1) REVIEW THE INSTALLATION AREA TO IDENTIFY ANY SAFETY RELATED COMPONENTS LOCATED IN THE AREA.
2) NON-SEISMIC COMPONENTS SHOULD BE LOCATED AT LEAST ONE FOOT AWAY FROM OR BELOW SAFETY RELATED COMPONENTS. THIS APPLIES ONLY IF THE SAFETY RELATED TARGET IS SMALLER (SMALLER DIA, MASS, OR WALL THICKNESS) THAN THE NON-SEISMIC, NONSAFETY SOURCE COMPONENT.
3) NON-SEISMIC PIPING AND SUPPORTS LOCATED IN THE VICINITY OF SAFETY-RELATED COMPONENTS SHOULD BE INSTALLED USING U-BOLTS TO STABILIZE THE PIPING TO THE MAXIMUM EXTENT POSSIBLE.
4) WHEN USING CANTILEVERED STRUCTURAL SHAPES, THE NON-SEISMIC PIPE SHOULD REST ON THE STRUCTURAL MEMBER AND BE U-BOLTED TO IT RATHER THAN HUNG BENEATH THE MEMBER WITH A U-BOLT.
5) CLEVIS TYPE HANGERS SHOULD ONLY BE USED IN NONSAFETY AREAS. FOR INSTALLATIONS IN SAFETY-RELATED AREAS PIPE CLAMP AND EYE-ROD TYPE HANGERS SHOULD BE USED INSTEAD OF CLEVIS HANGERS SINCE THEY HAVE A LARGER LOAD CAPACITY AND ALLOW LATERAL MOVEMENT.
6) SAFETY-RELATED TUBING ROUTED TO TUBE TRACK SHOULD BE INSTALLED SUCH THAT THE TRACK ACTS AS A SHIELD FOR THE TUBE FROM GRAVITY MISSILES.
7) SPECIAL CARE SHOULD BE TAKEN IN AREAS WHERE SAFETY-RELATED TUBE LEAVES TUBE TRACK TO AVOID ROUTING THE TUBE UNDER NONSAFETY AND NON-SEISMIC COMPONENTS.
8) NON-SEISMIC COMPONENTS SUCH AS LIGHTING TRANSFORMERS, SPACE HEATERS AND HEAVY LIGHTING FIXTURES SHOULD BE LOCATED AWAY FROM SAFETY-RELATED COMPONENTS TO THE MAXIMUM EXTENT PRACTICABLE. LIGHTING TRANSFORMERS SHOULD ALSO BE LOCATED AS CLOSE TO THE FLOOR AS POSSIBLE.
9) IN ORDER TO BE CONSIDERED SEISMICALLY QUALIFIED PER REGULATORY GUIDE 1.29 THE MAXIMUM LOADING FOR ALL NON-SAFETY CONDUIT SUPPORTS, USING THREADED ROD HANGER WITH B-LINE (B22 AND OR B12) HORIZONTAL, AS DETAILED IN DWG SD/B-B-0533 SHT #2,3,4,6 & 16 SHALL BE LIMITED TO THE VALUES INDICATED BELOW WHERE L IS THE LENGTH OF THREADED ROD BETWEEN THE B-LINE OF CONCERN AND THE B-LINE OR CHANNEL ABOVE.
   A) FOR SUPPORT ATTACHED BY MEANS OTHER THAN EXPANSION ANCHORS, THE MAXIMUM B-LINE STRUT LOADS ARE:
      1) L ≤ 12" W=612 LBS
      2) 12" < L ≤ 24" W=1224 X L/24 LBS
      3) L > 24" W= 1224 LBS
      FOR DOUBLE AND TRIPLE TRAPEZE SUPPORTS, THE MAXIMUM TOTAL LOAD ON THE SUPPORT IS 1200 LBS WITH THE ABOVE VALUES APPLICABLE TO THE INDIVIDUAL STRUTS.
   B) FOR SUPPORTS ATTACHED TO THE CEILING WITH 5/8"Φ NON-Q PHILLIPS EXPANSION ANCHORS, THE MAXIMUM B-LINE STRUT LOADS ARE:
      1) L ≤ 12" W=361 LBS
      2) 12" < L ≤ 24" W=722 X L/24 LBS
      3) L > 24" W= 722 LBS
      FOR DOUBLE AND TRIPLE TRAPEZE SUPPORTS THE MAXIMUM TOTAL LOAD ON THE SUPPORT IS 700 LBS WITH THE ABOVE VALUES APPLICABLE TO THE INDIVIDUAL STRUTS.
10) IF THE ABOVE GUIDE CANNOT BE FOLLOWED NED SHALL BE CONTACTED FOR REVIEW OF THE PROPOSED INSTALLATION.



ELEVATION VIEW

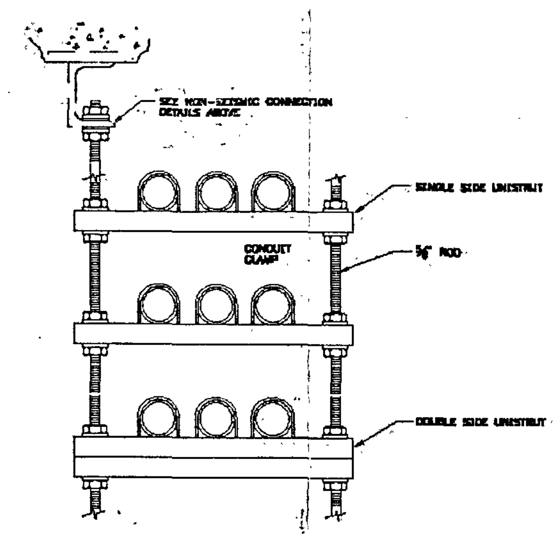
NOTES:
1. CONNECTION MAY BE USED IN CONJUNCTION WITH SD/B-B-0533 SHTS 2,3, OR 4 TO BUILD TRAPEZE SUPPORT.
2. CHANNEL MAY BE INSTALLED TO EMBEDDED STRUT AS SHOWN OR ROTATED UP TO 180°.
3. MAX. UNISTRUT LOAD 225#/FT IF BEYOND 6" FROM A LIGHT HANGER, AND 100#/FT OTHERWISE.

TYP SEISMICALLY QUALIFIED CONN DET
(COMMON BLDG EL 305.00')



NOTE:
FOR ADDITIONAL INFORMATION NOT SHOWN SEE DWG SD/B-0533 SHT 2, 3, 4, 6, AND 16.

TYPICAL NON-SEISMIC CONNECTION DETAILS



TYPICAL NON-SEISMIC TRAPEZE CONDUIT SUPPORT ELEVATION VIEW

7	REVISED AND REDRAWN IN CAD WITH THE FOLLOWING DESIGN CHANGES INCORPORATED: EC 52780	ELECTRONICALLY SIGNED

Progress Energy

QUALITY LEVEL: SAFETY RELATED IN PART

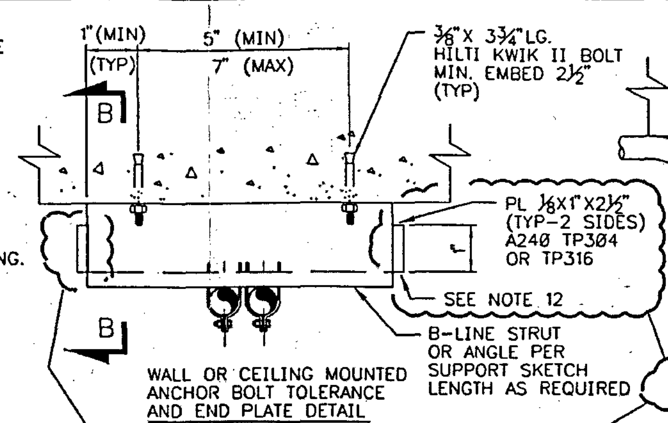
PLANT: HARRIS PROJECT - UNIT 1 SCALE: N/A

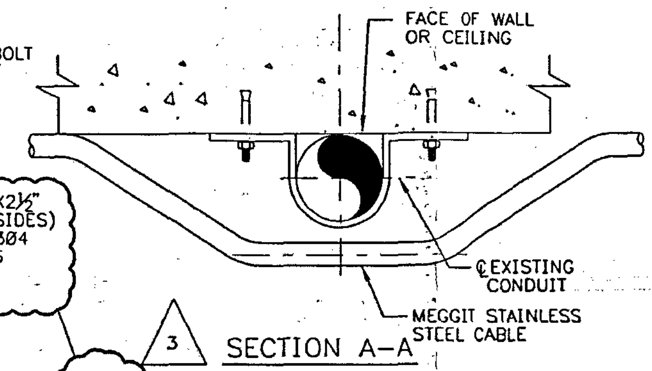
TITLE: SAFETY AND NON-SAFETY INSTALLATION CONSIDERATIONS

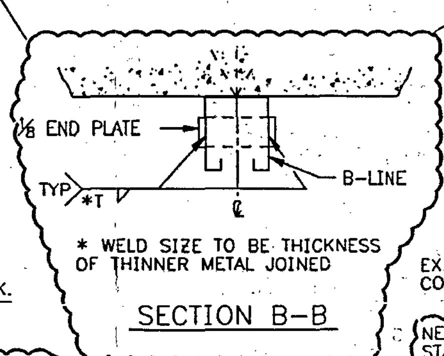
CPL-2168-S-9459

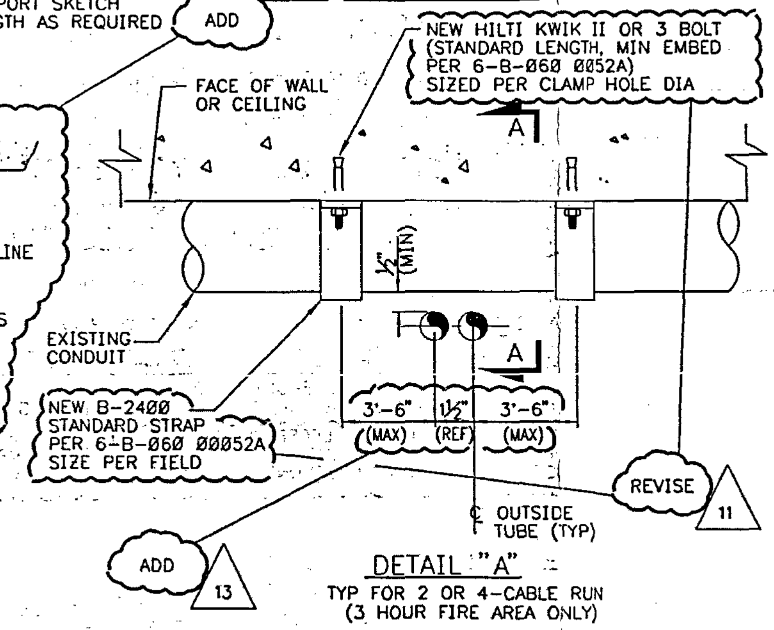
FIRE RATED CABLE INSTALLATION NOTES AND DETAILS:

1. FOR FIRE RATED CABLE MINIMUM BEND RADIUS REFER TO 2166-B-060 0028E
2. FIRE RATED CABLE MAY BE ATTACHED TO CHANNEL USING B-LINE B-2000-SS4, STAINLESS STEEL, TWO PIECE TUBING CLAMP. CLAMP SHALL BE TORQUED TO 25 IN-LBS.
3. FIRE RATED CABLE MAXIMUM SUPPORT SPAN IS 81".
4. FIRE RATED CABLE MAXIMUM UNSUPPORTED CANTILEVER LENGTH IS 36" SUPPORTS TESTED INCLUDE:
   A) TWO NYLON CABLE TIES, MIN 3/16" WIDE, INSTALLED CRISSCROSS TO A SUPPORT MEMBER
   B) B-2000-SS4 B-LINE CLAMP
   C) RIGID END TERMINATION SUCH AS BULKHEAD CONNECTION OR CGB BUSHING.
5. B-LINE CHANNEL SHALL BE PERPENDICULAR TO FIRE RATED CABLE.
6. IF REBAR IS ENCOUNTERED DURING ANCHOR INSTALLATION, REBAR SHALL NOT BE CUT. RELOCATE B-LINE CHANNEL IN ORDER TO AVOID HITTING REBAR. ENSURE MAXIMUM SPAN DISTANCES ARE NOT VIOLATED BY THE CHANNEL RELOCATION.
7. CENTER LINE OF FIRE RATED CABLE MAY BE LOCATED ANYWHERE ALONG THE LENGTH OF CHANNEL AS LONG AS MINIMUM EDGE DISTANCE OF 1/2" IS MAINTAINED.
8. CHANNEL LENGTH MAY BE ADJUSTED IF REQUIRED TO A MINIMUM LENGTH OF 4" FOR TWO CABLE CLAMPS AND 6 1/2" FOR FOUR CABLE CLAMPS.
9. FOR MINIMUM SEISMIC CLEARANCE FOR FIRE RATED CABLE REFER TO 2168-S-9459.
10. FOR MINIMUM ELECTRICAL SEPARATION REFER TO 2166-B-060 SH 7D
11. IN ORDER FOR FIRE RATED CABLE TO BE ROUTED UNDER EXISTING EQUIPMENT (IE: CONDUIT, CABLE TRAYS , PIPING, ETC). EXISTING EQUIPMENT MUST BE SUPPORTED IN SUCH A MANNER THAT THE EQUIPMENT WILL NOT DEGRADE FIRE RATED CABLE DURING A FIRE. REFER TO DETAIL "A" FOR OPTIONAL CONDUIT SUPPORT DETAIL.
12. SUPPORT CHANNEL END PLATES SHALL BE ADDED TO ANCHOR BOLTED B-LINE ONLY PER DETAIL AT RIGHT
13. FIRE RATED CABLE JACKET SHALL NOT COME IN CONTACT WITH GALVANIZED MATERIAL REFER TO INSTALLATION ADDITION OF NEW STAINLESS STEEL B-LINE CHANNEL TO AN EXISTING GALVANIZED B-LINE CHANNEL SUPPORT ON CAR 2166-B-060, SHEET 0007K.
14. GROUND FIRE RATED CABLE PER 2166-B-051 SH 0015.
15. SEE FIRE TEST REPORT CTP-1122 FOR FIRE TESTED SUPPORT DETAILS
16. CABLE INSULATION RESISTANCE (IR) DECREASES DURING A FIRE. FIRE TEST REPORT CTP-1122 DOCUMENTS IR VALUES DURING A THREE HOUR FIRE TEST. APPLICATION SPECIFIC EVALUATION MUST BE PERFORMED TO DEMONSTRATE CABLE IS ACCEPTABLE FOR SPECIFIC APPLICATIONS.









INSTALLATION NOTES SPECIFIC TO EC 52769:

1. ALL EXISTING SUPPORT WELDS ARE SHOWN FOR REFERENCE ONLY. NO NEW WELD MATERIAL IS BEING ADDED TO EXISTING SUPPORT WELDS (THE WELD SIZES SHOWN ARE THE MINIMUM WELD SIZE PER AISC).
2. NEW SUPPORT LOCATING DIMENSIONS/ORIENTATION AND CABLE ORIENTATION ON SUPPORT SKETCHES ARE REFERENCE ONLY AND FOR INSTALLATION GUIDANCE AND MAY BE ADJUSTED IN THE FIELD AS LONG AS THE MAXIMUM SPAN BETWEEN SUPPORTS OF 81" AND MINIMUM EDGE DISTANCES AND CLEARANCES REFERENCED ABOVE ARE MAINTAINED.
3. FOR ADDITIONAL REQUIREMENTS FOR NEW STAINLESS STEEL B-LINE CHANNEL BEING ADDED TO EXISTING GALVANIZED CHANNEL, REFER TO SK-52769-C-1000, SHEET 301.
4. ALL EXISTING STEEL SHOWN ON SUPPORT SKETCHES IS SAFETY RELATED UNLESS NOTED OTHERWISE.
5. 1/4" ANGLE IRON AND TUBE STEEL MAY BE SUBSTITUTED FOR 3/16" ANGLE IRON AND TUBE STEEL SHOWN ON SUPPORT SKETCHES.
6. SKETCH NO. SK-52769-1000 SH TYPICAL 1, 2 & 3 MAY BE SUBSTITUTED FOR ANY 1 HOUR SUPPORT.

ADD 7 · ADD · ADD 13

REFERENCE DWG:
6-B-060 0007K (SK-52769-C-1000 301)

FIRE RATED CABLE INSTALLATION NOTES AND DETAILS

REV	DATE	DESCRIPTION	DWN	CHK
5		ISSUE FOR EC 52769 R13	JWB	

Progress Energy

QUALITY LEVEL: NUCLEAR SAFETY RELATED
PLANT: HARRIS NUCLEAR PLANT — SCALE: NTS
TITLE: MISCELLANEOUS ELECTRICAL DETAILS & NOTES
PLANT DWG. NO: 6-B-060 0007J
MOD SKETCH NO: SK-52769-C-1000 — SHT: 300

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
DRAWING NO. CPL-2168-S-9459
"SAFETY AND NON-SAFETY INSTALLATION CONSIDERATIONS"

WITHIN THIS PACKAGE... OR BY SEARCHING USING THE DOCUMENT/REPORT NO.
DWG NO. CPL-2168-S-9459

D-01X