WOLF CREEK
NUCLEAR OPERATING CORPORATION

December 16, 2009

Terry J. Garrett
Vice President, Engineering

ET 09-0018

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

Subject: Docket No. 50-482: License Amendment Request (LAR) for Use of Fire-Resistive Electrical Cable

Gentlemen:

Pursuant to 10 CFR 50.90, Wolf Creek Nuclear Operating Corporation (WCNOC) hereby requests an amendment to the Renewed Facility Operating License No. NPF-42 for the Wolf Creek Generating Station (WCGS). This license amendment request is seeking approval by the Commission, pursuant to License Condition 2.C(5), to make changes to the approved fire protection program as described in the Updated Safety Analysis Report (USAR). Specifically, a deviation from certain technical commitments to 10 CFR 50, Appendix R, Section III.G.2, as described in Appendix 9.5E of the WCGS Updated Safety Analysis Report (USAR), is requested regarding the use of fire-resistive cable at WCGS for certain power and control cables associated with two motor-operated valves on Train B Component Cooling Water System.

Based on the technical analysis described herein, WCNOC believes that the use of fire-resistive cables in the manner specified in this request will not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire. However, since the approved WCGS Fire Protection Program does not specifically provide for fire-resistive cables as one of the approved methods to protect redundant safe shutdown components, this change could be interpreted as an adverse change. As such, WCNOC is submitting this request for approval in accordance with License Condition 2.C(5).

Attachment I provides the evaluation and justification for the proposed license amendment. Attachment II provides markups of the USAR including Appendix 9.5E. USAR Appendix 9.5E provides a design comparison to 10 CFR 50 Appendix R. Attachment III provides markups of E-1F9900, "Post Fire Safe Shutdown Manual Actions," E-1F9905, "Fire Hazard Analysis" and E-1F9910, "Post Fire Safe Shutdown Fire Area Analysis." E-1F9900, E-1F9905 and E-1F9910 are incorporated by reference in USAR Appendix 9.5.B, "Fire Hazards Analyses." Attachment IV provides a list of regulatory commitments.



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MRR

Enclosure I provides the Omega Point Laboratories Test Report for Meggitt Safety Systems, Inc. Cable Test, Project No. 14980-117047. Enclosure II provides the Omega Point Laboratories Test Report for Meggitt Safety Systems, Inc. Cable Test, Project No. 14980-121039. Enclosure III provides the WCGS Fire Rated Cable Installation Details.

It has been determined that this amendment application does not involve a significant hazard consideration as determined per 10 CFR 50.92. The amendment application was reviewed by the WCNOC Plant Safety Review Committee. In accordance with 10 CFR 50.91, a copy of this application is being provided to the designated Kansas State official.

WCNOC requests approval of this proposed amendment by July 1, 2010. Once approved, the amendment will be implemented within 180 days of receipt. This will allow sufficient time to implement the plant modification on the two motor-operated valves on Train B Component Cooling Water System.

If you have any questions concerning this matter, please contact me at (620) 364-4084, or Mr. Richard D. Flannigan at (620) 364-4117.

Sincerely,

Terry J. Garrett

TJG/rlt

Attachments: I Evaluation of Proposed Change
II Markup of USAR Pages
III Markups of E-1F9900, "Post Fire Safe Shutdown Manual Actions," E-1F9905, "Fire Hazard Analysis" and E-1F9910, "Post Fire Safe Shutdown Fire Area Analysis"
IV List of Regulatory Commitments

Enclosure: I Omega Point Laboratories Test Report for Meggitt Safety Systems, Inc. Cable Test, Project No. 14980-117047
II Omega Point Laboratories Test Report for Meggitt Safety Systems, Inc. Cable Test, Project No. 14980-121039
III WCGS Fire Rated Cable Installation Details

cc: E. E. Collins (NRC), w/a, w/e
T. A. Conley (KDHE), w/a, w/e
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B. K. Singal (NRC), w/a, w/e
Senior Resident Inspector (NRC), w/a, w/e

**STATE OF KANSAS )**
**) SS**
**COUNTY OF COFFEY )**

Terry J. Garrett, of lawful age, being first duly sworn upon oath says that he is Vice President Engineering of Wolf Creek Nuclear Operating Corporation; that he has read the foregoing document and knows the contents thereof; that he has executed the same for and on behalf of said Corporation with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By _____
Terry J. Garrett
Vice President Engineering

SUBSCRIBED and sworn to before me this 16th day of December, 2009.

NOTARY PUBLIC OFFICIAL SEAL STATE OF
RHONDA L. TIEMEYER
MY COMMISSION EXPIRES
January 11, 2010

Rhonda L. Tiemeyer
Notary Public

Expiration Date January 11, 2010

# EVALUATION OF PROPOSED CHANGE

Subject: License Amendment Request for Use of Fire-Resistive Electrical Cable

## 1. SUMMARY DESCRIPTION

This evaluation supports a request to amend Renewed Facility Operating License NPF-42 for the Wolf Creek Generating Station (WCGS). The proposed amendment would revise the Renewed Facility Operating License to deviate from certain WCGS Fire Protection Program requirements. The reason for this amendment is to allow the use of fire-resistive cable at WCGS for certain power and control cables associated with two motor-operated valves on Train B Component Cooling Water System in lieu of meeting the circuit separation protection commitments to 10 CFR 50, Appendix R, Section III.G.2 referenced in Appendix 9.5E of the Updated Safety Analysis Report (USAR).

Based on the technical analysis described herein, Wolf Creek Nuclear Operating Corporation (WCNOC) believes that the use of fire-resistive cables in the manner specified in this request will not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire. However, since the approved WCGS Fire Protection Program does not specifically provide for fire-resistive cables as one of the approved methods to protect redundant safe shutdown components, this change could be interpreted as an adverse change. As such, WCNOC is submitting this request for approval in accordance with License Condition 2.C(5).

## 2. DETAILED DESCRIPTION

The WCGS Fire Protection Program is described in USAR Section 9.5.1 and Appendices 9.5A through 9.5E. Historically, Appendix 9.5B provided the Fire Hazards Analysis. The Fire Hazards Analysis is now located in E-1F9905. Appendix 9.5B of the USAR incorporates by reference the following:

- E-1F9905, Fire Hazards Analysis
- E-1F9900, Post-Fire Safe Shutdown Manual Actions
- E-1F9910, Post-Fire Safe Shutdown Fire Area Analysis
- XX-E-013, Post-Fire Safe Shutdown (PFSSD) Analysis
- M-663-00017A, Fire Protection Evaluations for Unique or Unbounded Fire Barrier Configurations

USAR Appendix 9.5E provides a design comparison to 10 CFR 50, Appendix R and how WCNOC compares with the specific requirements of 10 CFR 50 Appendix R.

The WCGS post-fire safe shutdown analysis (PFSSDA) identified that, in some fire areas, separation of redundant safe shutdown circuits is not in accordance with WCGS commitments to 10 CFR 50, Appendix R. As these issues were discovered, WCNOC entered them in the corrective action program, made the appropriate notifications, implemented compensatory measures and developed plans to correct the concern. Corrective actions so far have included installing 1-hour or 3-hour fire wrap around the applicable circuits, rerouting cables out of the affected fire areas, establishing combustible control zones, installing additional automatic fire detection, and addition of hand switches in the main control room. Over the last three years, WCNOC has implemented 14 plant modifications to improve the post-fire safe shutdown capability and bring the plant into compliance with its commitments to 10 CFR 50 Appendix R.

Based on the PFSSDA, the Train B Component Cooling Water System is the protected train of component cooling water if a fire occurs in Fire Area A-27 (Rod Drive/MG Set Room). However, the power and control cables for valves EGHV0016 and EGHV0054 are routed through Fire Area A-27. Damage to the power and control cables will prevent operation of the valves from the Main Control Room (MCR). Therefore, WCNOC is proposing to install 3-hour rated fire-resistive electrical cable manufactured by Meggitt Safety Systems, Inc. (hereinafter referred to as Meggitt) in lieu of the existing electrical cables, to provide an equivalent level of protection specified by 10 CFR 50, Appendix R Section III.G.2.a. The cables are purchased as safety related, seismically-qualified, environmentally-qualified, Class 1E cables, which meet the 3-hour fire endurance rating when tested per the requirements of Supplement 1 to Generic Letter 86-10, "Implementation of Fire Protection Requirements," (Reference 6.1). For the proposed application, the cables are not used in a harsh environment and therefore, are not required to be environmentally qualified.

Valve EGHV0016 is on the component cooling water return line from the service loop. Valve EGHV0054 is on the component cooling water supply line to the service loop. The service loop is required for post-fire safe shutdown to supply component cooling water to the seal water heat exchanger and the reactor coolant pump thermal barrier heat exchangers during hot standby and the excess letdown heat exchanger during cold shutdown. The seal water heat exchanger is used to cool seal leakoff prior to returning to the centrifugal charging pump (CCP) suction and is used to cool CCP recirculation flow when the CCPs are operating at low flow conditions.

If, at the onset of a fire in Fire Area A-27, valves EGHV0016 and EGHV0054 are closed, and the fire damages the circuits associated with these valves before the Train B Component Cooling Water System is lined up, there would be no component cooling water flow to the seal water heat exchanger for cooling seal leakoff and CCP recirculation flow. Installation of fire wrap on the cable tray carrying EGHV0016 and EGHV0054 power and control cables is not an option, as derating the cables in the tray would result in too low of an ampacity for some of the circuits. Rerouting of the electrical circuits is also not an option because all possible routes would cause the same concern in other fire areas. WCNOC is proposing to route the new fire-resistive cable from the valves to the motor control center, which would include installation of the cable in Fire Areas A-16 and A-21. This routing was chosen because it provides a direct route from the valves to the motor control center.

## 3. TECHNICAL EVALUATION

10 CFR 50.48 requires that all operating nuclear power plants have a fire protection program that satisfies Criterion 3 of Appendix A to 10 CFR Part 50, which reads "Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, ..."

The WCGS Renewed Facility Operating License NFP-42, Condition 2.C(5), "Fire Protection," states:

(a) The Operating Corporation shall maintain in effect all provisions of the approved fire protection program as described in the SNUPPs Final Safety Analysis Report for the facility through Revision 17, the Wolf Creek site addendum through Revision 15, and as approved in the SER through Supplement 5, subject to provisions b and c below.

(b) The licensee may make changes to the approved fire protection program without prior approval of the Commission only if those changes will not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire.

The WCGS Fire Hazards Analysis (FHA) is documented in document E-1F9905, which is incorporated into the USAR by reference and is part of the approved fire protection program. Section 4.6.1 of E-1F9905 reads, in part "The design goal for safety-related areas outside of the Containment was to provide the equivalent of a 3-hour rated fire barrier between redundant trains, as described in 10 CFR 50, Appendix R, Paragraph III.G.2.a. Where this was not possible, credit was taken for the detection and suppression systems installed in the plant, and compliance to the provisions of Appendix R, Paragraphs III.G.2.b and c, was addressed."

10 CFR 50, Appendix R Section III.G.2 states, in part: "... one of the following means of ensuring that one of the redundant trains is free of fire damage shall be provided:

a. Separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that required of the barrier;

b. Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area; or

c. Enclosure of cable and equipment and associated non-safety circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area."

The WCGS USAR, Appendix 9.5E, provides a comparison of the WCGS Fire Protection Program against the requirements of Section III of Appendix R to 10 CFR 50. Although WCGS obtained its operating license after January 1, 1979, the NRC stated, in the WCGS SER (NUREG-0881) dated April, 1982, that they will condition the WCGS operating license to require WCGS to meet the technical requirements of Appendix R to 10 CFR 50, or provide equivalent protection. However, the Condition never appeared in the WCGS operating license when it was issued.

Table 9.5E-1 in Appendix 9.5E of the WCGS USAR indicates in response to the provisions in 10 CFR 50 Appendix R Section III.G that redundant trains of systems required to achieve and maintain hot standby are separated by 3-hour rated fire barriers or the equivalent provided by III.G.2. The Meggitt cable system has been demonstrated by testing and analysis as being capable of performing its intended function during and after the fire exposure as prescribed by Supplement 1 to Generic Letter 86-10, without the use of a fire barrier system.

Since the WCGS comparison to 10 CFR 50 Appendix R does not mention use of fire-resistant cable, the use of the Meggitt cable represents a deviation from the approved WCGS fire protection program, and approval from the NRC is being requested pursuant to License Condition 2.C(5).

Test Results

Two independent, three-hour fire qualification tests consistent with the WCNOC proposed applications were performed for the Shearon Harris Nuclear Plant, and both of these tests are used to bound the WCGS applications of Meggitt cable.

Enclosure II provides a copy of the fire test report, Omega Point Laboratories Test Report for Meggitt Safety Systems, Inc. Cable Test, Project No. 14980-121039, dated February 23, 2005, which demonstrates that, for the specific applications of this material proposed at WCGS, the fire-rated cable will perform its intended function during and after exposure to an American Society for Testing and Materials (ASTM) E-119, "Standard Test Methods for Fire Tests of Building Construction Materials," design basis fire.

Enclosure I provides a copy of an earlier test report, Omega Point Laboratories Test Report for Meggitt Safety Systems, Inc. Cable Test, Project No. 14980-117047, Revision 1, dated July 7, 2004, which provided acceptable insulation resistance data during the fire test and demonstrated the acceptability of the support designs tested. However, this earlier test did not successfully demonstrate continued electrical functionality for the complete duration of the fire test. During this fire test, the cable samples were installed on galvanized supports. At each location in which the cables came in contact with a horizontal support, the cable jacket was degraded as a result of liquid metal embrittlement of the stainless steel cable jacket from direct contact with galvanized material at high temperatures. The cable jacket failure did not reveal itself until the cables were subjected to the hose stream test at the end of the test, which subsequently resulted in water intrusion into the cables. Later testing (reference Enclosure II) used stainless steel support materials so that none of the cable samples were in direct contact with any galvanized material. No cable jacket degradation issues were encountered during this fire test.

Unlike the existing plant cables, the proposed cables described within this amendment request are designed to function during a fire exposure. The proposed cables are type Si2400 manufactured by Meggitt Safety Systems, Inc. This cable has demonstrated that it is capable of operating continuously for three hours during the most severe design basis fire, and it satisfies the other design considerations such as environmental qualification, seismic, and electrical characteristics. Testing of this fire-resistive cable has been conducted in accordance with Supplement 1 to Generic Letter 86-10 and ASTM E-119. This testing demonstrated that the cable is capable of providing an equivalent level of protection as would be provided by a 3-hour and 1-hour rated fire barrier as described by 10 CFR 50, Appendix R Section III.G.2.

Cable Routing and Supports

The fire testing performed on the fire-resistive cable (reference Enclosures I and II) also tested the support systems and attachment methods. All supports and connections were successfully tested and remained firm and secure. The support systems and attachment methods to be

used at WCGS for routing the fire resistive cables are designed to be consistent with those tested.

The WCGS design specifies that fire-resistive cables required to only withstand a 1-hour fire are to be routed with the most practical routes along walls and ceilings. Fire detectors and automatic fire suppression systems are installed in the 1-hour fire areas, which mitigate the possibility of damage from equipment or material failing and falling onto the fire-resistive cable.

The WCGS design specifies that fire-resistive cables are to be routed with a minimum of one inch separation. Testing confirms ½ inch separation was sufficient to prevent damage from adjacent cables. 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 inch of cable jacket to cable jacket separation at the support locations. During the seismic testing, cable electrical functionality was successfully demonstrated. Using a minimum of one inch will be conservative and afford additional protection to the cables.

Installation requirements for the cable and supports at WCGS are bounded by the tested configurations. The following table provides a comparison between the tested parameters and the WCGS design requirements for support of the Meggitt cable. For WCGS design details, see Enclosure III.

| **Parameter** | **Tested Configuration** | **WCGS Design Configuration** | **Conclusion** | **Applicable Test Report[1]** |
|---|---|---|---|---|
| Minimum cable bend radius | 6" | 6" | The tested configuration bounds the design configuration | 121039 |
| Support type/material | B-Line B54 Strut (1 5/8" wide x 13/16" high, 0.97 lb/ft) 304 Stainless Steel<br><br>Unistrut P1000 Strut (1 5/8" wide x 1 5/8" high, 1.90 lb/ft) galvanized | Unistrut P1000 (1 5/8" wide x 1 5/8" high, 1.90 lb/ft) 304 stainless steel<br><br>Unistrut P3300 (1 5/8" wide x 7/8" high, 1.35 lb/ft) 304 stainless steel | The tested configuration bounds the design configuration | 121039<br><br>117047 |
| Support attachment method | Welded to embed plate or steel member or anchored to concrete ceiling | Welded to existing steel member or anchored to concrete wall or ceiling | The tested configuration bounds the design configuration | 117047<br>121039 |

| Parameter | Tested Configuration | WCGS Design Configuration | Conclusion | Applicable Test Report[1] |
|---|---|---|---|---|
| Concrete anchors | 3/8" Stainless Steel Hilti Kwik II Bolt 2 ½" min embedment | 3/8" Stainless Steel Hilti Kwik Bolt III, 2 ½" min embedment | The tested configuration bounds the design configuration | 117047 |
| Maximum support span | 81" | 81" | The tested configuration bounds the design configuration | 121039 |
| Cable securement method | B-Line B2000, 304 Stainless Steel 3/8" electrical metallic tubing (EMT) conduit clamp or B2088, 304 Stainless Steel one hole 5/8" O.D. tubing clamp | Unistrut P1425, 304 Stainless Steel 3/8" EMT conduit clamp or P2014, 304 Stainless Steel one hole 5/8" O.D. tubing clamp | The Unistrut clamps are equivalent to the B-Line clamps in materials and thickness. Therefore, there is reasonable assurance the Unistrut clamps will perform the safe as the B-Line clamps during a fire. | 121039 |
| Clamp torque force | B2000 conduit clamp - 25 in-lbs<br><br>B2088 O.D. tubing clamp - 4 ft-lbs | P1425 conduit clamp - 25 in-lbs<br><br>P2014 O.D. tubing clamp - 4 ft-lbs | The tested configuration bounds the design configuration | 121039 |

1. Test reports are as follows:

   117047 - Omega Point Laboratories Test Report for Meggitt Safety Systems, Inc. Cable Test, Project No. 14980-117047, Revision 1, dated July 7, 2004 (Enclosure I)

   121039 - Omega Point Laboratories Test Report for Meggitt Safety Systems, Inc. Cable Test, Project No. 14980-121039, dated February 23, 2005 (Enclosure II)

Consistent with NRC Information Notice 2006-02, "Use of Galvanized Supports and Cable Trays with Meggitt Si 2400 Stainless-Steel-Jacketed Electrical Cables," (Reference 6.2) the WCGS design specifies that Meggitt stainless steel cable is not to be installed in direct contact with galvanized materials. In addition, the design for the Meggitt cable routing considers other potential design basis impacts that may affect the ability to achieve safe shutdown after a design basis accident. These impacts include, but are not limited to, pipe whip, missiles, high energy line breaks and falling objects.

Electrical Evaluation

The Meggitt Si 2400 fire-resistive cables are an acceptable replacement for normal cables with organic insulation and jackets. The cables have a slightly increased linear resistance due to the nickel cladded copper conductors, and significantly increased linear resistance during a fire due to high temperatures.

**Electrical Evaluation Methodology**

Each application of the cables has been analyzed to verify acceptable total resistance along the entire circuit length, typically twice the cable length for control circuits. Cable routing, which dictates the cable length, and conductor size was selected to ensure the total circuit resistance, and hence the circuit's voltage drop, are acceptable and will not adversely impact the OPERABILITY of the circuit and the equipment associated with the circuit.

Additionally, during a fire, the higher temperatures of up to 1925 °F will decrease the value of insulation resistance. Due to lower insulation resistance, leakage current to other conductors and the grounded stainless steel jacket will increase. This increased leakage current is additive to the circuit's normal current. Each application of the fire-resistive cable was analyzed to ensure that leakage current during a fire remains below an acceptable level.

The manufacturer provides a minimum insulation resistance of 1 meg-ohm per foot. Fire tests of the cable show a higher value of insulation resistance at 1925 °F, using the manufacturer's value of 1 meg-ohm per foot is conservative and will ensure the cable insulation is more than adequate.

Applicable WCNOC calculations have been revised, as necessary, to show the acceptability of the fire-resistive cables. At a minimum the results of the calculations have been shown to envelope the voltage drops of the fire-resistive cables and verify that the cable exceeds OPERABILITY requirements during normal operation and during a fire.

The WCGS design specifies that stainless steel jacket of the fire-resistive cables are to be grounded through their connection to terminal boxes that provide a fault current return path to the power source. A fault in one cable will be contained by its stainless steel jacket, the jacket itself returning the fault current to the power source and causing the circuit protective device to clear the fault before extensive damage can occur. This is similar to cases involving conduits, which are installed with a minimum of one inch separation

**Electrical Evaluation for Valve EGHV0016**

The power and control circuits for valve EGHV0016 will be made up of a combination of fire-resistance rated cable and conventional cable. Approximately 64 feet of 3 conductor #6 American Wire Gauge (AWG) fire-resistive cable and 34 feet of 3 conductor #12 AWG conventional cable will be used for the power circuit. Approximately 64 feet of 7 conductor #12 AWG fire-resistive cable and 220 feet of 7 conductor #14 AWG conventional cable will be used for the control circuit. The linear electrical resistance of the fire-resistive cables is 0.0021 ohms per foot for #12 AWG conductors, and 0.0005 ohms per foot for #6 AWG conductors; both at 70 °F. At 1925 °F, the resistance values increase to 0.0114 ohms per foot for #12 AWG

conductors, and 0.00266 ohms per foot for #6 AWG conductors. In comparison, the conventional cables currently used for power and control of the valve has linear resistance values at 194 °F of 0.00310 ohms per foot for the #14 AWG conductors and 0.00215 ohms per foot for the #12 AWG conductors.

The EGHV0016 motor power circuit is required to deliver the minimum motor terminal voltage necessary to operate the valve. Using the fire-resistive cable lengths provided above as well as linear resistance values for conventional cable in the equations from WCNOC calculation XX-E-004, "AC Motor Operated Valve Minimum Terminal Voltage," the minimum motor terminal voltage for EGHV0016 would be 380.25 volts during a fire that will heat the Si 2400 cable to 1925 °F. This is a slight improvement over the current application where only conventional cable is used and the existing minimum motor terminal voltage of 378.979 volts from calculation XX-E-004 is identified. For normal non-fire 70 °F conditions of the cable, the conductor resistance will be significantly lower and the motor terminal voltage will be higher. Therefore, the use of the Si 2400 cable for the power circuit is acceptable, as it will actually improve motor terminal voltage in the proposed configuration.

WCNOC calculation XX-E-012, "Safety-Related MCC Control Circuit Allowable Wire Lengths," evaluates a control circuit having a 100 volt amp control power transformer and a size 1 starter. These control circuit components are equivalent to the ones for EGHV0016, though the calculation is more conservative as it includes an auxiliary relay, whereas EGHV006's circuit does not have the relay. Calculation XX-E-012 shows that the size 1 starter will energize and pick up with a control circuit length of 3580, having a resistance of 11.098 ohms.

The EGHV0016 control circuit will have a total circuit length of 568 feet. This total length consists of 440 feet of existing #14 AWG conductors and 128 feet of #12 AWG fire-resistive conductors. As was done for other similar valve motors in calculation XX-E-012, 400 feet of #14 AWG conventional cable is added to account for internal wire length, fuse and relay/switch contacts in the motor control center (MCC), main control board (MCB) and the motor.

Using the resistance values of 3.1 ohms per 1000 feet (per calculation XX-E-012) for the existing #14 AWG conventional cables (840 feet total length), and 1.14 ohms per 100 feet at 1925 °F for the #12 AWG fire-resistive cable (128 feet total length), the total circuit resistance is 4.06 ohms. This value of 4.06 ohms is significantly lower than the allowable value of 11.098 ohms determined by calculation XX-E-012. Therefore, the use of the Si 2400 cable in the control circuit of EGHV0016 is acceptable.

The insulation resistance for the fire-resistive cables is 1,000,000 ohms foot. Using a minimum MCC voltage of 423.2 volts and the aforementioned length of 64 feet, the maximum leakage current for the power cable will be 0.0156 amperes during a fire. With the leakage current the motor terminal voltage is still 380.25 volts, which is higher than the present 378.979 volts with the existing cables.

The control circuit with 2 conductors at line voltage will have a maximum leakage current of 0.0141 amperes in the fire-resistive cable at 1925 °F. Using the methodology of calculation XX-E-012 and accounting for the insulation leakage current as another load on the circuit, the available starter coil voltage will be 95.93 volts. This voltage is above the minimum 88.8 volts necessary for pick-up of a size 1 starter.

**Electrical Evaluation for Valve EGHV0054**

The power and control circuits for valve EGHV0054 will be made up of a combination of fire-resistance rated cable and conventional cable. Approximately 64 feet of 3 conductor #6 AWG fire-resistive cable, 28 feet of 3 conductor #8 AWG conventional cable and 90 feet of 3 conductor #12 AWG conventional cable will be used for the power circuit. Approximately 64 feet of 7 conductor #12 AWG fire-resistive cable and 302 feet of #14 AWG conventional cable will be used for the control circuit. The linear electrical resistance of the fire-resistive cables is 0.0021 ohms per foot for #12 AWG conductors, and 0.0005 ohms per foot for 6 AWG conductors; both at 70 °F. At 1925 °F, the resistance values increase to 0.0114 ohms per foot for #12 AWG conductors, and 0.00266 ohms per foot for #6 AWG conductors. In comparison, the conventional cables currently used for power and control of the valve has linear resistance values at 194 °F of 0.00310 ohms per foot for the #14 AWG conductors and 0.00215 ohms per foot for the #12 AWG conductors.

The EGHV0054 motor power circuit is required to deliver the minimum motor terminal voltage necessary to operate the valve. Using the fire-resistive cable lengths provided above as well as linear resistance values for conventional cable in the equations from calculation XX-E-004, the minimum motor terminal voltage for EGHV0054 would be 379.38 volts, during a fire that will heat the Si 2400 cable to 1925 °F. This is a slight improvement over the current application where only conventional cable is used and the existing minimum motor terminal voltage of 379.340 volts given in the results of calculation XX-E-004 is identified. For normal non-fire 70 °F conditions of the cable, the conductor resistance will be significantly lower and the motor terminal voltage will be higher. Therefore, the use of Si 2400 cable for the power circuit is acceptable, as it will actually improve motor terminal voltage in the proposed configuration.

Calculation XX-E-012 evaluates a control circuit having a 100 VA control power transformer and a size 1 starter. These control circuit components are equivalent to the ones for EGHV0054. Calculation XX-E-012 shows that the size 1 starter will energize and pick up with a control circuit length of 3580, having a resistance of 11.098 ohms.

The EGHV0054 control circuit will have a total circuit length of 732 feet. This total length consists of 604 feet of existing #14 AWG conductors and 128 feet of #12 AWG fire-resistive conductors. As was done for other similar valve motors in calculation XX-E-012, 400 feet of #14 AWG conventional cable is added to account for internal wire length, fuse and relay/switch contacts in the MCC, MCB and the motor.

Using the resistance values of 3.1 ohms per 1000 feet (per calculation XX-E-012) for the existing #14AWG conventional cables (1,004 feet total length), and 1.14 ohms per 100 feet at 1925 °F for the #12 AWG fire-resistive cable (128 feet total length), the total circuit resistance is 4.57 ohms. This value of 4.57 ohms is significantly lower than the allowable value of 11.098 ohms determined by calculation XX-E-012. Therefore, the use of the Si 2400 cable in the control circuit of EGHV0054 is acceptable.

The insulation resistance for the fire-resistive cables is 1,000,000 ohms foot. Using a minimum MCC voltage of 423.2 volts and the aforementioned length of 64 feet, the maximum leakage current for the power cable will be 0.0156 amperes during a fire. With the leakage current the motor terminal voltage becomes 379.377 volts, which is still higher than the present 379.340 volts with the existing cables.

The control circuit with 2 conductors at line voltage will have a maximum leakage current of 0.0155 amperes in the fire resistive cable at 1925 °F. Using the methodology of calculation XX-E-012 and accounting for the insulation leakage current as another load on the circuit, the available starter coil voltage will be 91.45 volts. This voltage is above the minimum 88.8 volts necessary for pick-up of a size 1 starter.

Conclusion

Based on the above evaluation, the use of fire-resistive cable in the configuration described for the power and control circuits for valves EGHV0016 and EGHV0054 does not affect the function of the valves and is therefore acceptable.

## 4. REGULATORY EVALUATION

### 4.1 Applicable Regulatory Requirements/Criteria

10 CFR 50, Section 48, Fire Protection, states in paragraph (a) that "Each operating nuclear power plant must have a fire protection plan that satisfies Criterion 3 of Appendix A of this part." Paragraph (e) states "Nuclear power plants licensed to operate after January 1, 1979, shall...satisfy Criterion 3 of Appendix A to this part in accordance with the provisions of their licenses."

10 CFR 50, Appendix A, General Design Criterion 3, Fire Protection, requires that structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions.

10 CFR 50, Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979", Section III.G.2 requires that cables whose fire damage could prevent the operation or cause mal-operation of safe shutdown functions be physically protected from fire damage by one of three methods.

Since WCGS was licensed after January 1, 1979, WCNOC is not obligated to meet the requirements of Section III.G.2. However, USAR Appendix 9.5E provides a comparison of the WCGS design to Appendix R. The NRC has not previously reviewed the use of fire-resistive cable at WCGS proposed in this amendment request.

### 4.2 Precedent

Amendment No. 123 to Shearon Harris Nuclear Power Plant, Unit 1 Facility Operating License No. NPF-62 approved the use of fire-resistive electrical cables in lieu of alternatives specified in Section C5.b.2 of Branch Technical Position Chemical Engineering Branch 9.5-1 for certain volume control tank outlet valves. (Reference 6.3)

### 4.3 Significant Hazards Consideration

The proposed amendment allows the use fire-resistive cable at the Wolf Creek Generating Station (WCGS) for certain power and control cables associated with two motor-operated valves on Train B Component Cooling Water System in lieu of meeting the circuit separation

protection commitments to 10 CFR 50, Appendix R, Section III.G.2 referenced in Appendix 9.5E of the Updated Safety Analysis Report (USAR).

WCNOC has evaluated whether or not a significant hazards consideration is involved with the proposed amendment(s) by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   **Response:** No.

   The design function of structures, systems and components are not impacted by the proposed change. The proposed change involves the use of fire-resistive cable at WCGS for certain power and control cables associated with two motor-operated valves (EGHV0016 and EGHV0054) on Train B Component Cooling Water System and will not initiate an event. The proposed change does not alter or prevent the ability of structures, systems, and components (SSCs) from performing their intended function to mitigate the consequences of an initiating event within the assumed acceptance limits. The Meggitt Si 2400 fire-resistive cable has been independently tested to applicable requirements and the implementation design reflects the test results. Therefore, the probability of any accident previously evaluated is not increased. Equipment required to mitigate an accident remains capable of performing the assumed function.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   **Response:** No.

   The proposed change will not alter the requirements or function for systems required during accident conditions. The design function of structures, systems and components are not impacted by the proposed change. No new or different accidents result from implementing Meggitt Si 2400 fire-resistive cable in Fire Areas A-16 and A-21. The Meggitt Si 2400 fire-resistive cable has been independently tested to applicable requirements and the implementation design reflects the test results. The use of Meggitt Si 2400 fire-resistive cable is not a significant change in the methods governing normal plant operation.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

   **Response:** No.

   The proposed change does not alter the manner in which safety limits, limiting safety system settings or limiting conditions for operation are determined. The safety analysis

acceptance criteria are not affected by this change. The proposed change will not result in plant operation in a configuration outside the design basis for an unacceptable period of time without mitigating actions. The proposed change does not affect systems that respond to safely shutdown the plant and to maintain the plant in a safe shutdown condition.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, WCNOC concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

### 4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

## 5. ENVIRONMENTAL CONSIDERATION

WCNOC has evaluated the proposed changes and determined that the changes do not involve (i) a significant hazards consideration, (ii) a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

## 6. REFERENCES

6.1 Supplement 1 to Generic Letter 86-10, "Fire Endurance Acceptance Criteria for Fire Barrier Systems Used to Separate Redundant Safe Shutdown Trains Within the Same Fire Area (Supplement 1 to Generic Letter 86-10, "Implementation of Fire Protection Requirements")," March 24, 1994

6.2 NRC Information Notice 2006-02, "Use of Galvanized Supports and Cable Trays with Meggitt Si 2400 Stainless-Steel-Jacketed Electrical Cables," January 16, 2006.

6.3 "Shearon Harris Nuclear Power Plant, Unit 1 – Issuance of Amendment on Use of Fire Resistive Cable (TAC NO. MC8134)," May 1, 2006. (ADAMS Accession number ML0061140227)

**Markup of USAR Pages**

REGULATORY GUIDE 1.130 REVISION 1 DATED 10/78

Service Limits and Loading Combinations for Class 1 Plate-and-Shell-Type Component Supports

DISCUSSION:

According to the NRC implementation guidance for this regulatory guide, it is not applicable to WCGS. However, the following discussion is provided for information purposes.

For ASME Section III components not furnished with the NSSS, the Class 1 supports are of the linear type and not the plate and shell type. Therefore, this regulatory guide does not apply.

The Westinghouse position with respect to this regulatory guide is as follows.

a. Paragraph B.1 states that increases are not allowed for bolted connections for emergency and faulted conditions. The Westinghouse position is that it is reasonable to allow an increase in the limits for bolted connections for these conditions. Further justification concerning this position can be found in Item 1 of the discussion on Regulatory Guide 1.124.

b. The method described in Paragraph C.7(b) of the Regulatory Guide is overly conservative and inconsistent with the stress limits presented in Appendix F. Westinghouse will use the provisions of F-1370(d) to determine service level D allowable loads for supports designed by the load rating method.

REGULATORY GUIDE 1.131 REVISION 0 DATED 8/77

Qualification Tests of Electric Cables, Field Splices, and Connections for Light-Water-Cooled Nuclear Power Plants

DISCUSSION:

The recommendations of this regulatory guide are met with the exceptions noted in Section 8.1.4.3.

REGULATORY GUIDE 1.132 REVISION 1 DATED 3/79

Site Investigations for Foundations of Nuclear Power Plants

Stainless steel clad fire-resistive cables are type tested to ensure qualification for use in safety-related circuits. Due to the materials and construction of the fire-resistive cables, the guidance in Regulatory Guide 1.131 is not applicable to these cables.

TABLE 3.2-1 (Sheet 23)

CLASSIFICATIONS OF STRUCTURES, COMPONENTS, AND SYSTEMS (14)

| | System/Component | Seismic Category I (1) | Quality Group Classification (2) | ANS Safety Class (3) | Quality Assurance (4) | Principal Construction Codes and Standards (5) | Location (6) | Remarks |
|---|---|---|---|---|---|---|---|---|
| 10.2 | Class 1E Low Voltage System | | | | | | | |
| | Load center unit substations | Y | NA | NA | Y-B | IEEE-308, 336 | C/A/I | |
| | Motor control centers | Y | NA | NA | Y-B | IEEE-308, 336 | C/A/D/I | |
| | 600 Volt power and control cable | Y | NA | NA | Y-B | IEEE-308, 336 | A/C/D/F/ I/R | |
| | Integral and fractional hp induction motors | Y | NA | NA | Y-B | IEEE-308, 336, 344 NEMA MG-1 | A/C/D/F/ I/R | |
| 10.3 | Class 1E 125 V DC System | | | | | | | |
| | Batteries and battery charger | Y | NA | NA | Y-B | IEEE-308, 336 | C | |
| | DC distribution panels | Y | NA | NA | Y-B | IEEE-308, 336 | C | |
| | Emergency lighting dc | Y | NA | NA | Y-B | MS | C | |
| 10.4 | Class 1E Instrument AC Power | | | | | | | |
| | Vital ac power supply | Y | NA | NA | Y-B | IEEE-308, 336 | C | |
| | 120 V ac vital panels | Y | NA | NA | Y-B | IEEE-308, 336 | C | |
| | 600 V instrument cable | Y | NA | NA | Y-B | IEEE-308, 336 | A/C/D/ F/I | |
| 10.5 | Reactor Building Cable Penetrations | Y | B | 2 | Y-B | IEEE-317, 336 | A/C | |
| 10.6 | Conduit Supports and Tray Supports | Y | NA | NA | Y-B | ASTM | All | |
| 10.7 | Raceway Installation | Y | NA | NA | Y-B | IEEE-336 | All | |
| 10.8 | Load Shedding and Emergency Load Sequencing | Y | NA | NA | Y-B | IEEE-308, 336 | C | |
| 10.9 | Auxiliary Relay Racks | Y | NA | NA | Y-B | ICEA, NEMA IEEE-336 | A/C | |
| 10.10 | Transformers | | | | | | | |
| | Essential service water | Y | NA | NA | Y-B | IEEE-308 | I | |
| | Regulating | Y | NA | NA | Y-B | IEEE-308 | C | |
| 10.11 | Status Indicating Systems | Y | NA | NA | Y-B/W3 | IEEE-308, 336 | C | |
| 10.12 | Local Control Stations | Y | NA | NA | Y-B | IEEE-308, 336 | A/D/F | |
| | 600 Volt fire-resistive power and control cable | Y | NA | NA | N | IEEE-344 | A/B/D/E/F I/O/R/T/U | |

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conservative 20 percent value. However, in the interest of conservatism, a bilinear curve, which effectively bounds the lower end of nearly all the points, was utilized. This curve is given in Figure 3.7(B)-21. This curve represents the recommended design values of equivalent viscous damping.

In addition to the determination of equivalent viscous damping, as described in the test report, linear analysis was performed on finite element models of several of the tray system test setups. These analyses confirmed that a very high viscous damping was required in order to predict responses similar to those recorded during the dynamic testing. These analyses confirmed that the application of the damping values recommended for design in a linear analysis was consistent with the results of the test program and, therefore, would result in a conservative design of support systems.

3.7(B).4 SEISMIC INSTRUMENTATION

3.7(B).4.1 Comparison with Regulatory Guide 1.12, Rev. 1 (April, 1974)

The seismic instrumentation program complies with Regulatory Guide 1.12, Rev. 1, except for the items listed below:

a. Response spectrum recorders are not supplied as discrete instruments except on the containment base mat. A spectrum analyzer permanently installed in the control room presents more complete information than that presented by response spectrum recorders. Data from the strong motion accelerometers are fed into the spectrum analyzer to produce earthquake spectra immediately following an earthquake. All locations where response spectrum recorders are required by the regulatory guide are monitored by strong motion accelerometers. This system achieves the intent of Regulatory Guide 1.12, Rev. 1.

b. The seismic trigger designed for in the free field have an actuated level adjustable over a minimum range of 0.01g to 0.03g, in lieu of the minimum sensitivity level of 0.005g specified in ANSI N18.5. Triggering levels below 0.01g are likely to produce spurious triggering.

Stainless steel 600 volt fire-resistive control and power cables are routed independent of raceways. Fire-resistive cable will be supported by stainless steel unistrut attached to the concrete walls at intervals governed by span loading. Generally, the supports will be standard design used for small conduit, except for the use of stainless steel unistrut and clamps. Seismic testing and analysis verify the adequacy of the supports for fire-resistive cable.

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TABLE 3.11(B)-3 (Sheet 68)

| COMPONENT NUMBER | DESCRIPTION | LOCATION ROOM No. | SPEC. NUMBER | (4) SHUTDN HOT | SHUTDN COLD | CATEGORY LOCA | CATEGORY MSLB | CATEGORY HELB | NORM ENV | ACCIDENT ENVIRONMENT T | P | R | H | SP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ZSI219 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI219 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI233 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI233 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI234 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI234 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI243 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI243 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI249 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI249 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI250 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI250 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI258 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZSI258 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZTB-1 | TERMINAL BOXES | (7) (8) | E-028 | | | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZTB-2 | TERMINAL BOXES | (5) | E-028 | | | A | A | A | T1 | F25 | F39 | T2 | T2 | NA |
| ZZB | 5 KV POWER CABLES | (5) | E-029 | X | X | A | D | D | T1 | F25 | F39 | T2 | T2 | NA |
| ZZC1 | 600 VOLT COPPER CONTROL CABLE | (2) | E-057 | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZC2 | 600 VOLT COPPER CONTROL CABLE | (2) | E-057A | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZC3 | 600 VOLT COPPER CONTROL CABLE | (2) | E-057B | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZG | 600 VOLT POWER CABLE | (2) | E-058 | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZJ | 600 VOLT SHIELDED INSTRUMENTATION CABLE | (2) | E-062 | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZJ1 | 600 VOLT SHIELDED INSTRUMENTATION CABLE | (2) | E-062A | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZP | PREFABRICATED CABLE ASSEMBLIES | (2) (9) | E-095 | X | X | A | A | D | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZR | CABLE BREAKOUT KIT | (2) | (1) | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZS | 600 VOLT SHIELDED INSTRUMENTATION CABLE | (2) | E-062 | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZT | THERMOCOUPLE EXTENSION CABLE | (2) | E-061 | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZU | 5 KV CABLE SPLICE MATERIAL | (5) | E-029 | X | X | A | D | D | T1 | F25 | F39 | T2 | T2 | NA |
| ZZV | CABLE END SEAL KIT | (2) | (1) | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZW | NUCLEAR MOTOR CONNECTION KITS | (2) | (1) | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZX | COAXIAL & TRIAXIAL CABLE | (2) | E-060 | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZY | 600 V CABLE TERMINATION MATERIAL | (2) | (1) | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZY | HEAT SHRINK FLD. SPLICING SYSTEM | (2) | (1) | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZZ | STUB CONNECTION KIT | (2) | (1) | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZZ | TERMINAL LUGS | (2) | (1) | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZZ | TRANSITION SPLICE KIT | (2) | (1) | X | X | A | A | A | T1 | F3 | F6 | T4 | T2 | T5 |
| ZZC4 | 600 VOLT FIRE-RESISTIVE CONTROL AND POWER CABLE | (5) | E-057C | X | X | D | D | A | T1 | F25 | F39 | T2 | T2 | NA |

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TABLE 3.11(B)-7

SPECIFICATIONS REVIEWED UNDER THE NUREG-0588 PROGRAM

| SPECIFICATION | DESCRIPTION |
|---|---|
| E01013-1 | Termination Material (stub conn. kits) |
| E01013-2 | Termination Material (ht. shrink fld spl.) |
| E01013-3 | Termination Material (motor conn. kits) |
| E01013-4 | Termination Material (end sealing kits) |
| E009 | Switchgear Potential Transformer Cubicles (1) |
| E018 | Motor Control Centers (2) |
| E028 | Local Control Stations/Terminal Boxes |
| E028A | Switches (2) |
| E029 | 5 kV Power Cable |
| E035 | Electrical Penetrations |
| E035B | Electrical Penetration Modules |
| E057 | 600 V Control Cable |
| E057A | 600 V Control Cable |
| E057B | 600 V Control Cable |
| E058 | 600 V Power Cable |
| E060-1 | Triaxial and Coaxial Cable |
| E060-2 | Triaxial Cable Assembly (nuclear detectors) (1) |
| E061 | Thermocouple Cable |
| E062 | 600 V Instrumentation Cable |
| E062A | 600 V Instrumentation Cable |
| E093 | Auxiliary Relay Racks |
| J301-1 | Pressure Transmitters (IC) |
| J301-2 | Pressure Transmitters (OC) |
| E057C | 600V Fire-Resistive Cable |

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Within a cabinet or panel associated and identified with a single safety-related separation group, no identification of the safety-related wiring is required. The separation group of the panel or cabinet, however, is clearly identified.

Within a panel or cabinet otherwise associated and identified with a single safety-related separation group, nonsafety-related wiring is clearly identified. However, provided such nonsafety-related wiring is maintained at a small quantity, identification of the safety-related wiring is not required.

All noncabinet-mounted protective equipment and components are provided with an identification tag or nameplate. Small electrical components, such as relays, have nameplates on the enclosure which houses them. All cables are numbered with identification tags. In congested areas, such as under or over the control boards, instrument racks, etc., cable trays and conduits containing redundant circuits shall be identified, using permanent markings. The purpose of such markings is to facilitate cable routing identification for future modifications or additions. Positive permanent identification of cables and/or conductors are made at all terminal points. There are also identification nameplates on the input panels of the solid state protection system.

7.1.2.4 Conformance to Criteria

A listing of applicable criteria and the sections where conformance is discussed is given in Table 7.1-2.

7.1.2.5 Conformance to NRC Regulatory Guides

7.1.2.5.1 General

Conformance of BOP equipment to Regulatory Guides 1.22, 1.53, 1.62, 1.105, and 1.118 is addressed in Tables 7.1-3, 4, 5, 6, and 7, respectively.

Other regulatory guides pertinent to this section are: 1.7, 1.11, 1.21, 1.26, 1.29, 1.30, 1.40, 1.45, 1.47, 1.63, 1.68, 1.73, 1.75, 1.80, 1.89, 1.97, 1.100, 1.106 and 1.139. References to discussions of these regulatory guides are provided in Appendix 3A.

An additional discussion of the NSSS conformance to Regulatory Guide 1.22 and IEEE-338 and -379 is given in the following sections.

Fire-resistive cables, with stainless steel jacketing, are routed as separate conduits, and numbered with permanent identification.

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TABLE 7.4-6 (Sheet 40)

| Component ID | Component name | Room No | Spec No | Hot SD | Cold SD |
|---|---|---|---|---|---|
| ZSE215 | ELECTRICAL PENETRATION MODULES (ENCAPSULATION) | 1204 | E-035B | X | X |
| ZSE216 | ELECTRICAL PENETRATION ASSY (ENCAPSULATION) | 1203 | E-035 | X | X |
| ZSE216 | ELECTRICAL PENETRATION MODULES (ENCAPSULATION) | 1203 | E-035B | X | X |
| ZSE217 | ELECTRICAL PENETRATION ASSY (ENCAPSULATION) | 1203 | E-035 | X | X |
| ZSE217 | ELECTRICAL PENETRATION MODULES (ENCAPSULATION) | 1203 | E-035B | X | X |
| ZSE218 | ELECTRICAL PENETRATION ASSY | 1409 | E-035 | X | X |
| ZSE218 | ELECTRICAL PENETRATION MODULES | 1409 | E-035B | X | X |
| ZSE219 | ELECTRICAL PENETRATION ASSY | 1409 | E-035 | X | X |
| ZSE219 | ELECTRICAL PENETRATION MODULES | 1409 | E-035B | X | X |
| ZSE233 | ELECTRICAL PENETRATION ASSY | 1409 | E-035 | X | X |
| ZSE233 | ELECTRICAL PENETRATION MODULES | 1409 | E-035B | X | X |
| ZSE234 | ELECTRICAL PENETRATION ASSY | 1409 | E-035 | X | X |
| ZSE234 | ELECTRICAL PENETRATION MODULES | 1409 | E-035B | X | X |
| ZSE243 | ELECTRICAL PENETRATION ASSY | 1409 | E-035 | X | X |
| ZSE243 | ELECTRICAL PENETRATION MODULES | 1409 | E-035B | X | X |
| ZSE249 | ELECTRICAL PENETRATION ASSY | 1409 | E-035 | X | X |
| ZSE249 | ELECTRICAL PENETRATION MODULES | 1409 | E-035B | X | X |
| ZSE250 | ELECTRICAL PENETRATION ASSY | 1409 | E-035 | X | X |
| ZSE250 | ELECTRICAL PENETRATION MODULES | 1409 | E-035B | X | X |
| ZSE258 | ELECTRICAL PENETRATION ASSY | 1409 | E-035 | X | X |
| ZSE258 | ELECTRICAL PENETRATION MODULE | 1409 | E-035B | X | X |
| ZSI215 | VALVE TERMINAL BOX | 1204 | E-028 | | X |
| ZSI215 | ELECTRICAL PENETRATION MODULE | 1204 | E-035B | | X |
| ZSI216 | VALVE TERMINAL BOX | 1203 | E-028 | | X |
| ZSI216 | ELECTRICAL PENETRATION MODULE | 1203 | E-035B | | X |
| ZSI218 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X |
| ZSI218 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X |
| ZSI219 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X |
| ZSI219 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X |
| ZSI233 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X |
| ZSI233 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X |
| ZSI234 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X |
| ZSI234 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X |
| ZSI243 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X |
| ZSI243 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X |
| ZSI249 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X |
| ZSI249 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X |
| ZSI250 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X |
| ZSI250 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X |
| ZSI258 | ELECTRICAL PENETRATION ASSY | 2000 | E-035 | X | X |
| ZSI258 | ELECTRICAL PENETRATION MODULE | 2000 | E-035B | X | X |
| ZZB | 5 KV POWER CABLES | (5) | E-029 | X | X |
| ZZC1 | 600 VOLT COPPER CONTROL CABLE | (2) | E-057 | X | X |
| ZZC2 | 600 VOLT COPPER CONTROL CABLE | (2) | E-057A | X | X |
| ZZC3 | 600 VOLT COPPER CONTROL CABLE | (2) | E-057B | X | X |
| ZZG | 600 VOLT POWER CABLE | (2) | E-058 | X | X |
| ZZJ | 600 VOLT SHIELDED INSTRUMENTATION CABLE | (2) | E-062 | X | X |
| ZZJ1 | 600 VOLT SHIELDED INSTRUMENTATION CABLE | (2) | E-062A | X | X |
| ZZP | PREFABRICATED CABLE ASSEMBLIES | (2) | E-095 | X | X |
| ZZC4 | 600 VOLT FIRE-RESISTIVE CONTROL AND POWER CABLE | (5) | E-057C | X | X |

b. Where small control or instrument devices are supplied with short pigtails, the field cable may be terminated to the pigtail by means of an approved connection, which is adequately insulated, located close to the device, and enclosed in the connecting conduit.

c. Another possible area would be in the event of cable damage in an operating plant where a splice might be preferable over total replacement of the cable. Such instances are resolved on a case-by-case basis.

d. In cases in which field-run cables are incompatible with the terminal size on the devices to which they must terminate, a splice to a short, appropriate pigtail may be made to permit the required termination. Such instances are approved on a case-by-case basis, where the adequacy of the pigtail is confirmed and splices are made with qualified materials and are restricted to enclosures such as MCCs, termination compartments, and panels.

e. Splices made with qualified materials are used within enclosures where specified by design.

Paragraph 5.1.2

Exposed Class 1E raceways are marked in a distinct, permanent manner at intervals not exceeding 15 feet and at points of entry to and exit from enclosed areas.

In addition, separate color identification is provided for each separation group of field wired, safety-related cables.

As stated in reference to Paragraph 4.5, associated circuits are identified the same as their related Class 1E circuits, and are, therefore, distinguished from one another as stated above.

See Section 8.3.1.1.3.

Paragraph 5.1.3

Section 8.3.1.1.4.1.1 satisfies this paragraph.

Paragraph 5.1.4

Section 8.3.1.1.4.1.1 satisfies this paragraph.

Paragraph 5.2.1

Sections 8.3.1.1.1.3 satisfy this paragraph.

f. The 600 volt fire-resistive control and power cables are fitted with termination kits on both ends that are either factory installed or field installed. The termination kits provide transition from solid cable conductors to stranded pigtails suited for making cable terminations. The kits, along with the fire-resistive cables are covered by specification E-057C. Splices for terminating the fire-resistive cables will be in accordance with paragraphs b, d and e above.

g. The 600 volt fire-resistive control and power cables typically have a maximum manufactured length of 100 feet. Factory installed or field installed splices provide for increased cable length. The splices are covered in the fire-resistive cable specification E-057C, and maintain the fire rating and structural integrity of the cables.

REGULATORY GUIDE 1.118, PERIODIC TESTING OF ELECTRIC POWER AND PROTECTION SYSTEMS - Refer to Appendix 3A for the response to this regulatory guide.

REGULATORY GUIDE 1.131, QUALIFICATION TESTS OF ELECTRIC CABLES, FIELD SPLICES, AND CONNECTIONS FOR LIGHT-WATER-COOLED NUCLEAR POWER PLANTS - The requirements of IEEE Standard 383, 1974 have been used for the qualification of cables, field splices, and connections.

The cable, field splices, and connections are qualified to the environmental conditions and all design basis events (e.g., steam line break) by testing and/or analysis.

Type tests for design basis event conditions consist of subjecting nonaged and aged cables, field splices, and connections to a sequence of environmental extremes that simulate the most severe postulated conditions of a design basis event and specified conditions of installation. Type tests demonstrate margin by application of multiple transients or increased level. Electrical and physical performance of the cable is measured during and following the environmental cycle. All environmental conditions are enveloped by the qualification program. However, the factors for margin given in Section 6.3.1.5 of IEEE 323 are not used.

Testing data is provided to establish the long-term performance of the insulation. Data is evaluated using the Arrhenius technique, using a minimum of three data points including 136 C and two others at least 10 C apart in temperature. No on-going qualification is used.

The recommendations of Regulatory Guide 1.89 are discussed later in this section.

Vertical tray flame testing is performed in accordance with IEEE 383, Paragraph 2.5. However, aged samples are not used.

No field splices are used in the cable trays.

Fire tests are performed with the vertical tray perpendicular to the plane of the horizon.

A gas burner flame source releasing approximately 70,000 Btu/hr is used.

The ribbon gas burner flame source is mounted in accordance with the requirements of the regulatory guide, except that the flame is directed from the back side of the cable tray.

The 600 volt fire-resistive control and power cables are type tested to 1925 F to verify 1 hour and 3 hour fire ratings, and to verify environmental qualifications in accordance with NRC Generic Letter 86-10, Supplement 1. The fire testing requirements of NRC Generic Letter 86-10, Supplement 1, exceed the flame test requirements of IEEE 383.

8.3.1.3 Physical Identification of Safety-Related Equipment

Each circuit (scheme) and raceway is given a unique alphanumeric identification. This identification provides a means of distinguishing a circuit or raceway association with a particular channel or load group, and is assigned on the basis of the following criteria:

SEPARATION GROUP 1 - A safety-related instrumentation, control, or power scheme/raceway associated with safety-related load group 1 or protection system channel 1.

SEPARATION GROUP 2 - A safety-related instrumentation, control, or power scheme/raceway associated with protection system channel 2.

SEPARATION GROUP 3 - A safety-related instrumentation, power, or control scheme/raceway associated with protection system channel 3.

SEPARATION GROUP 4 - A safety-related instrumentation, control, or power scheme/raceway associated with safety-related load group 2 or protection system channel 4.

Nonsafety-related cables and raceways associated with normal plant (non-Class IE) equipment are uniquely identified and separately routed from safety-related cables and raceways, as described in Section 8.1.4.3.

The unique identification afforded all nonsafety-related cables is generally black; however, other colors (other than Red, White, Blue and Yellow) may be used for non-safety related cable in isolated cases.

Nameplates with colored backgrounds are provided for all IEEE 308 Class 1E equipment (such as transformers, motors, motor control centers, switchgear, panels, and switchboards) under A/E scope. Each separation group has its distinguishing color. The applicable channel or load group designation is marked on each nameplate. For the identification of instrumentation and control equipment, refer to Section 7.1.2.3.

Raceways are marked in a distinct, permanent manner at intervals not to exceed 15 feet and at points of entry to, and exit from, enclosed areas.

Color identification is provided for each separation group of field-wired, safety-related cables.

Within control panels where more than one separation group is present, wiring is identified by separation group designation or, if enclosed by conduit, the conduit is identified by separation group designation.

The 600 volt fire-resistive control and power cables are routed independent of raceways. The fire-resistive cables are distinctly and permanently marked in the same manner as described above for raceways.

The 600 volt fire-resistive control and power cables are routed independent of raceways. The fire-resistive cables are routed in the same manner as conduits.

b. Cables associated with each safety-related separation group, as defined in Section 8.3.1.3, are run in separate conduits, cable trays, ducts, and penetrations.

c. The arrangement of electrical equipment and cabling minimizes the possibility of a fire in one separation group from propagating to another separation group.

In the absence of confirming analyses to support less stringent requirements, the following rules apply to those areas in which the only source of fire is electrical. Areas in which the only source of fire is electrical are divided into two groups--cable spreading rooms and general plant areas. (See Section 8.3.1.4.1.4 for exemptions) Table 8.3-5 contains analyses of alternate minimum separation distances as allowed by RG 1.75.

GENERAL - Routing of instrumentation, control, or power cables through rooms or spaces where there is a potential for accumulation of large quantities of combustible fluids is avoided. Where such routing is unavoidable, only cables of one separation group are allowed. In addition, the cables are enclosed in conduit. Openings in solid floors for vertical runs of cables are sealed with fire resistant material.

GENERAL PLANT AREAS - In plant areas from which equipment with potential hazards such as missiles, external fires, and pipe whip are excluded, the separation criteria are as follows:

a. Cable trays of different separation groups have a minimum horizontal separation of 3 feet if no physical barrier exists between the trays. In the limited number of areas where horizontal separation of 3 feet is unattainable, a fire barrier is installed extending at least 1 foot above the top of the tray (or to the ceiling) and 1 foot below the bottom of the tray (or to the floor).

b. For cable trays of different separation groups, there is a minimum vertical separation of 5 feet between open-top trays stacked vertically. In the limited number of areas where trays of different separation groups are stacked with less than 5 feet of vertical separation, a fire barrier is placed between the two separation groups. The barrier extends 1 foot to each side of the tray system (or to the wall).

with the exception of 600 volt fire-resistive control and power cables which are routed independent of raceways.

c. In the case where a tray of one separation group crosses over a tray of a different separation group and the vertical separation is less than 5 feet, a fire barrier is installed extending 1 foot from each side of each tray and 5 feet along each tray from the crossover.

d. Where it is necessary that cables of different separation groups approach the same or adjacent control panels with less than 3-foot horizontal or 5-foot vertical spacing, isolation is maintained by installing both separation groups in steel conduit or enclosed wireway or by installing fire barriers between the separation groups. In the case of horizontal separation, the barrier extends 1 foot below the bottom of the tray (or to the floor) to 1 foot above the top of the tray (or to the ceiling). In the case of vertical spacing, the barrier extends 1 foot on each side of the tray system (or to the wall).

e. Isolation between separation groups is considered to be adequate where physical separation is less than that indicated in Items a, b, and c above, provided the circuits of different separation groups are run in enclosed raceways that qualify as barriers or other barriers are installed between the different separation groups. The minimum distance between these enclosed raceways and between barriers and raceways is 1 inch. The barriers are installed as described in a through d above.

In cases of open trays containing safety-related cables and totally enclosed conduits containing non-safety-related cables, the safety design basis is to protect the safety-related cables from failure of the non-safety-related circuits, and not vice-versa. In consideration of this limit, enclosing the non-safety circuits in raceway and maintaining at least one inch separation provides an acceptable level of protection. The conduit can contain only a limited quantity of combustible material (cable insulation and jacket). Furthermore, there is insufficient oxygen inside the conduit to support combustion of more than a fraction of the available material.

Based on these considerations, it is established that one-inch separation between a conduit containing non-safety-related circuits and an open tray containing safety-related circuits is sufficient to assure that any failure within the non-safety related circuits will not propagate into and compromise the integrity of the safety related circuits.

Additionally, 600 volt fire-resistive control and power cables are capable of withstanding fire and can be routed with 1 inch isolation distance from other separation groups and non-safety raceways.

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, with the exception of stainless steel fire-resistive cables,

The Electrical Raceway Separation Verification Test reports for Limerick Units 1 & 2 are applicable to WCNOC for the following reasons:

1. WCNOC uses similar cables made by the same manufactures as the cables used in the test. Cables used by WCNOC made by different manufactures than those used in the test use the same type of insulation material (cross-linked polyethylene or cross-linked ethylene propylene rubber) and jacket material (chlorosulfonated polyethylene or neoprene). In addition, all class 1E cables are qualified to the same standards such as IEEE-323 and IEEE-383 and are manufactured to the same IPCEA standards.

2. The WCNOC electrical raceway configurations are similar to the electrical raceway configurations used in the test.

3. The fault current used in the test is very conservative compared to the maximum credible fault current that could develop for the configuration of circuits described above in this section.

Physical separation between transient electrical cables and Class 1E raceway/cables/equipment may on a temporary basis fail to meet the 3 foot - 5 foot requirement per Reg. Guide 1.75 Rev. 1 and IEEE 384-1974.

Transient electrical cables are defined as follows: transient electrical cables are those non-safety related cables used on a temporary basis in support of field work activities or testing/monitoring which will remain in place for a short duration of time and which do not require a permanent plant modification or a temporary modification for their use. Transient cables typically include but are not limited to: extension cords, temporary power leads, temporary lighting cords, hand power tool cords, welding leads, communication cables, computer cables, video cables, test leads, (DMM's, recorders, data acquisition equipment, etc.) and instrumentation leads.

Transient cable separation requirements are delineated in plant administrative procedures. All deviations from the administrative procedures will require an engineering evaluation.

Physical separation between Local Area Network (LAN) cable and Class 1E raceway may on a limited basis, fail to meet the 3 foot horizontal and 5 foot vertical requirement of R.G. 1.75 and IEEE 384-1974. These cables are installed in "free air". Physical separation of 1 inch horizontal and 3 inches vertical is maintained between the "free air" cables and Class 1E raceway.

LAN cables consist of fiber optic cables and 4 pair - 24 AWGUTP, Category 5/5e cables, both of which meet the flame spread requirements of IEEE 383-1974. The fiber optic cable carries no electrical energy, cannot conduct electrical current and will not propagate a flame. Consequently these cables pose no risk to Class 1E electrical circuits. The 24 AWGUTP Category 5 copper conductor cables carry digital computer data only and consequently do not pose a risk with respect to degrading the functions of Class 1E electrical circuits.

Stainless steel fire-resistive cables have been type tested for exceeding the standards of IEEE-323 and IEEE-383.

TABLE 9.5A-1 (Sheet 30)

| APCSB 9.5-1 Appendix A | WCGS |
|---|---|
| 3. Electrical Cable Construction, Cable Trays and Cable Penetrations | |
| a) Only non-combustible materials should be used for cable tray construction. | Galvanized steel is used for cable tray construction. |
| b) See Section E.3 for fire protection guidelines for cable spreading rooms. | See Section E.3. |
| c) Automatic water sprinkler systems should be provided for cable trays outside the cable spreading room. Cables should be designed to allow wetting down with deluge water without electrical faulting. Manual hose stations and portable hand extinguishers should be provided as backup. Safety-related equipment in the vicinity of such cable trays does not itself require water fire protection but is subject to unacceptable damage from sprinkler water discharge, should be protected from sprinkler system operation or malfunction. | Automatic sprinkler systems are provided for vertical cable chases, the cable area above the suspended ceiling in the access control area which contain Class 1E cables, and zones in the auxiliary building with cable concentrations. Manually charged, closed head sprinkler systems are provided for the two cable penetration areas inside the containment. Cables are designed to allow wetting down without electrical faulting. Manual hose stations and portable hand extinguishers are provided as backup. Sprinkler systems are not installed in areas where sprinkler operation would cause damage to safe shutdown equipment. |
| When safety-related cables do not satisfy the provisions of Regulatory Guide 1.75, all exposed cables should be covered with an approved fire retardant coating and a fixed automatic water fire suppression system should be provided. | Safety-related cables satisfy the provisions of Regulatory Guide 1.75.<br>Safety-related fire-resistive cables exceed the intent of the provisions of Regulatory Guide 1.75. |

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TABLE 9.5A-1 (Sheet 32)

| APCSB 9.5-1 Appendix A | | WCGS |
|---|---|---|
| | cables to limit spread of fire in cable ventings. (Possible cable derating owing to use of such coating materials must be considered during design.) | |
| f) | Electrical cable constructions should as a minimum pass the current IEEE No. 383 flame test. (This does not imply that cables passing this test will not require additional fire protection.)<br><br>For cable installation in operating plants and plants under construction that do not meet the IEEE No. 383 flame test requirements, all cables must be covered with an approved flame retardant coating and properly derated. | Safety-related electrical cable passes the IEEE 383-1974 flame test or meet the intent of this requirement as discussed in Appendix 9.5B.<br><br>Fire-resistive cables are constructed from non-flammable materials: silicon dioxide insulation, copper nickel conductors and stainless steel jacketing, and are tested to exceed any flame test requirements of IEEE 383. |
| g) | To the extent practical, cable construction that does not give off corrosive gases while burning should be used. (Applicable to new cable installations.) | See response to D.2(c) above. |

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TABLE 9.5E-1 (Sheet 6)

| 10CFR50 Appendix R | | WCGS |
|---|---|---|
| | | batteries are served by a battery charger that can be manually connected to the plant emergency ac power supply.<br><br>The ESW pumphouse also complies. |
| III. G. | Fire Protection of Safe Shutdown Capability | |
| | 1. Fire protection features shall be provided for structures, systems, and components important to safe shutdown. These features shall be capable of limiting fire danger so that: | USAR Appendix 9.5B provides an area-by-area analysis of the power block that demonstrates that no single fire can prevent safe shutdown. |
| | a. One train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control station(s) is free of fire damage; and | Redundant trains of systems required to achieve and maintain hot standby are separated by 3-hour-rated fire barriers, or the equivalent provided by III.G.2, or else a diverse means of providing the safe shutdown capability exists and is unaffected by the fire. |
| | b. Systems necessary to achieve and maintain cold shutdown from either the control room or emergency control station(s) can be repaired within 72 hours. | For redundant trains of systems required to achieve and maintain cold shutdown that could potentially be affected by |
| | 2. Except as provided for in paragraph G.3 of this section, | |

Fire-resistive cable, which has been successfully tested per the requirements of NRC Generic Letter 86-10, Supplement 1, may be used in lieu of the rated fire barrier requirement in III.G.2.a and c.

## LIST OF REGULATORY COMMITMENTS

The following table identifies those actions committed to by WCNOC in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments. Please direct questions regarding these commitments to Mr. Richard Flannigan at (620) 364-4117.

REGULATORY COMMITMENTS

| Regulatory commitment | Due |
|---|---|
| Implement License Amendment | Once approved, the amendment will be implemented within 180 days of receipt. |