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Vogtle Project

March 14, 1988

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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PLANT VOGTLE - UNITS 1 AND 2
NRC DOCKETS 50-424, 50-425
OPERATING LICENSE NPF-68, CONSTRUCTION PERMIT CPPR-109
ELECTRICAL SEPARATION CRITERIA

Gentlemen:

The electrical cable separation criteria utilized in the design of the Vogtle Electric Generating Plant has been established in accordance with the standard separation guidance of Regulatory Guide 1.75, and by testing and analyses for reduced minimum separation distances as approved by the NRC in SER Supplement 4. Additional testing has recently been conducted to establish reduced separation distances for cable and raceway configurations not previously tested or analyzed. This testing was conducted by the same laboratory and was in accordance with the same criteria as the tests conducted in May 1986, and approved in SSER 4.

Attachment A is the proposed changes to the FSAR which incorporate the results of this additional testing, and changes required as a result of a 10CFR21 and 50.55(e) reportability evaluation on this subject (GPC letter GN-1431, dated 2/24/88). Also included in Attachment A is a brief explanation or justification of each of the changes proposed. This justification identifies the basis for each change by reference to the prior Wyle Laboratories Test (Report No. 49141-02), the new Wyle Laboratory Test (Report No. 17959-02), or to the documented engineering analysis. Since these proposed FSAR changes will be incorporated into a future Amendment to the FSAR, your review of these proposed changes is requested.

Detailed information on the additional testing is provided in Attachments B and C. A summary of the test, configurations tested, and test results is provided as Attachment B. Attachment C is Wyle Laboratories Test Report No. 17959-02, dated December 1987. This test report documents the additional testing performed. Five (5) copies of this test report are enclosed.

Should you have any questions, please advise.

Sincerely,

J. A. Bailey

J. A. Bailey
Project Licensing Manager

B021
1/1

JAB/wkl
Enclosures

xc: NRC Regional Administrator
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ATTACHMENT A

DRAFT FSAR PAGES AND JUSTIFICATIONS

Analyses have also been performed for reduced separation of Class 1E 4160V cables from non-1E 480V and lower voltage cables

distance between enclosed raceways qualified as barriers is 1 in. The minimum separation distance between non-Class 1E conduit and Class 1E open top cable trays is 1 in. 5 25

Testing and analyses have been performed for circuits of voltage levels 480 volts or lower to determine alternate reduced separation distances where these general minimum separation distances have not been met. The testing and analyses have been performed as allowed by Section 5.1.1.2 of IEEE 384-1974 and by Regulatory Guide 1.75. Refer to table 8.3.1-4 for circuits where analysis has been used. 8 25

B. Within general plant areas the minimum vertical separation is 5 ft, and the minimum horizontal separation is 3 ft for open top cable tray. The minimum separation distance between enclosed raceways qualified as barriers is 1 in. The minimum separation distance between non-Class 1E conduit and Class 1E open top cable trays is 1 in. 5 25

Testing and analyses have been performed for circuits of voltage levels 480 volts or lower to determine alternate reduced separation distances where these general minimum separation distances have not been met. The testing and analyses have been performed as allowed by Section 5.1.1.2 of IEEE 384-1974 and by Regulatory Guide 1.75. Refer to table 8.3.1-4 for circuits where analysis has been used. 8 25

C. Within panels and control boards,[a] the minimum spatial separation between components or cables of different separation groups (both field-routed and vendor-supplied internal wiring) is 6 in. Where it is not possible to maintain this separation, barriers are installed between components and wiring of different separation groups, or analysis has been performed to determine the minimum separation requirements. Refer to subsection 7.1.2 for separation requirements inside Westinghouse panels and control boards and to table 8.3.1-4 for circuits where analysis has been used. 25 25 9

a. The control board or panel is considered to extend to the bottom of the floor penetration fire barrier seal including any floor slots, penetrations, etc. 25

Amend. 5 4/84
Amend. 9 8/84
Amend. 25 9/86

Where barriers are required, one of the following methods of providing separation is used between any two separation groups within panels and control boards:

1. If both groups are redundant Class 1E circuits, separation is provided by routing the circuits in separate metallic conduit or enclosed wire duct, or by wrapping the wires of one or both of the separation groups in silicon dioxide cloth (siltemp 188 CH). Alternatively, the non-Class 1E cables may be 25

2. If one of the separation groups is non-Class 1E, only those circuits are required to be routed in metallic conduit or enclosed wire duct. ~~or~~ wrapped in silicon dioxide cloth (siltemp 188 CH). See table 8.3.1-4 for further details.

3. A single barrier is provided ~~with a 1~~ metallic-in. maintained air space between the components or cables of redundant separation groups and the barrier.

   a. The control board or panel is considered to extend to the bottom of the floor penetration fire barrier seal including any floor slots, penetrations, etc. 25

Amend. 5 4/84
Amend. 9 8/84
Amend. 25 9/86

D. Where spatial separation requirements between raceways of different separation groups are not met, fire barriers are installed as follows:

1. Where the minimum vertical separation is not maintained, a barrier is installed which extends at least 6 in. on each side of the tray system or to the wall, if a wall is within 6 in. when the trays are arranged in stacks.

   Within the cable spreading area, where the trays cross each other, ~~the~~ a barrier extending at least 1 ft on each side of the tray system is installed. ~~for those trays in the cable spreading area~~. 20

   However, for trays containing circuits 480V or lower voltage and cables 2/0 AWG or smaller, the barrier need only extend 1 ft. on each side of the top and bottom trays.

   Within the general plant areas, however, the barrier extending at least 1 ft on each side of the top trays and 3 ft on each side of the bottom trays is installed.

2. Where the minimum horizontal separation is not maintained, a barrier is installed which extends from at least 1 ft above (or to the ceiling) to at least 1 ft below (or to the floor) the tray system.

E. Where raceways of different separation groups are brought to a single enclosure, separation is accomplished by the use of conduit routed in opposite directions from the enclosure, using the enclosure as a barrier, or by wrapping the cabling of one of the separation groups in silicon dioxide cloth (siltemp 188 CH). Refer to table 8.3.1-4 for details of the use of silicon dioxide cloth as a barrier. 25

Non-Class 1E circuits are electrically isolated from Class 1E circuits, and Class 1E circuits from different separation groups are electrically isolated with the use of isolation devices, shielding and wiring techniques, physical separation (in accordance with Regulatory Guide 1.75 for circuits in raceways), or an appropriate combination thereof.

Certain applications use two Class 1E circuit breakers in series as isolation devices. The non-Class 1E motor space heaters for Class 1E motors are discussed in the response to question 430.62. The cables feeding the non-Class 1E pressurizer heaters use two Class 1E circuit breakers in series as isolation in the 25

Amend. 9 8/84
Amend. 20 12/85
Amend. 25 9/86

TABLE 8.3.1-4 (SHEET 1 OF 6) 25 30

CIRCUITS ANALYZED FOR SEPARATION REQUIREMENTS

A.[a]

1. 7300 Process Control System
2. Nuclear Instrumentation System
3. Solid State Protection System

Insert A

C ~~B~~. VEGP generally complies with the separation requirements of IEEE 384-1974. A series of tests and analyses has been performed for circuits of 480 V or lower voltage to establish alternate reduced minimum separation distances where separation distances specified in IEEE 384 are not met. These tests and analyses have been performed as allowed by Sections 5.1.1.2 and 5.6.2 of IEEE 384-1974 and Regulatory Guide 1.75. The test results are documented in Wyle Laboratories Test Report No. 48141-02 and Wyle Laboratories Test Report No. 17959-02, which ~~has~~ have been submitted for review by the NRC under separate cover. 25

Analyses have also been performed to justify separation of Class 1E 4160 V cables from non-1E 480 V and lower cables.

Based on the Wyle Laboratories test results,[b] the following minimum separation distances were established: 30

The separation distances are applied between raceways and cables of any separation group for both vertical (above and below) and horizontal (side by side) physical configurations or as noted.

Configuration/Service Level	Minimum Spatial Separation Distance
1. Between trays carrying cables of 480 V or lower voltage of sizes 2/0 AWG or smaller.	12 in.

a. The analyses/tests performed for the above equipment are further described in paragraph 7.1.2.2.1.

b. The test configuration of target cables above the fault cable represents the worst case, since heat/flame has tendency to flare vertically upwards. 30

Amend. 25 9/86
Amend. 30 12/86

INSERT A

Add new paragraph B:

An analysis was performed for selected Unit One cables larger than #8 AWG and terminating in multi-train panels. The analysis determined which cables could not ignite under fault conditions (i.e. where there is insufficient available energy or where the backup protection was fast enough to open the faulted circuit before the cables could ignite). Those cables which could not ignite under fault conditions were exempted from separation verification.

See Insert B

TABLE 8.3.1-4 (SHEET 2 OF 6)

Configuration/Service Level	Minimum Spatial Separation Distance
2. Tray[c] or free air cables to a non-Class 1E rigid steel conduit carrying cables of 480 V or lower voltage and sizes 2/0 AWG or smaller.	1/2 in.
2a. Tray or free-air cables to rigid steel conduit (installed at the bottom or in horizontal side-by-side configuration) carrying cables of 480 V or lower voltage, and sizes 2/0 AWG or smaller.	
3. Tray or free air cables to a rigid steel conduit (the free air cables, cables in the tray and in the conduit are limited to 480 V or lower voltage sizes 2/0 AWG or smaller).	1 in.
4. Tray or free air cables to a non-Class 1E flexible conduit carrying cables of 480 V or lower voltage of sizes 2/0 AWG or smaller.	1 in.
4a. Tray or free-air cables to flexible conduit (installed at the bottom or in a horizontal side-by-side configuration) carrying cables of 480 V or lower voltage, and sizes 2/0 AWG or smaller.	1 in.
5. Tray or free air cables to a flexible conduit (the free air cable, cables in the tray and in the conduit are limited to 480 V or lower voltage of sizes 2/0 AWG or smaller).	1 in.
6. Tray or free air cable to a non-Class 1E aluminum sheathed cable of sizes number 8 AWG or smaller or a non-class 1E electrical metallic tubing (EMT) carrying cables of sizes number 8 awg or smaller.	1 in.

c. For the purpose of testing, the cables in the punched bottom tray are considered the same as cables in free-air since the cables in the tray are directly exposed to the heat generated by the faulted cable in the areas of the tray that have been punched.

Amend. 25 9/86
Amend. 30 12/86
Amend. 34 8/87

INSERT B
sh. 1 of 3

Configuration/Service Level	Minimum Spatial Separation Distance
2. Cables in solid bottom tray (or tray with cover on the bottom) from non-Class 1E cables in tray or free air (the non-Class 1E cables are limited to 480V or lower voltage and size #2/0 AWG or smaller).	3/4 in.
3. Cables in tray running either vertically, or horizontally (side-by-side) from horizontal non-Class 1E cable in tray or free air (the non-Class 1E cables are limited to 480V or lower voltage and size #2/0 AWG or smaller).	1 in.
3a. Free air cables running either vertically, or horizontally (side-by-side) from horizontal non-Class 1E cable in tray or free air (the non-Class 1E cables are limited to 480V or lower voltage and size #2/0 AWG or smaller).	1-3/4 in.
4. Tray[c] or free air cables to a non-Class 1E rigid steel conduit carrying cables of 480V or lower voltage and sizes #2/0 AWG or smaller.	Contact
4a. Tray or free air cables to a non-Class 1E rigid steel conduit carrying cables of 480V or lower voltage and sizes #3/0 AWG through 500MCM.	3/4 in.
5. Tray or free air cables to a rigid steel conduit (the free air cables, cables in the tray, and in the conduit are limited to 480V or lower voltage and size #2/0 AWG or smaller).	1/2 in.
5a. Cables in tray to a rigid steel conduit routed below or beside the tray (the cables in the tray, and in the conduit are limited to 480V or lower voltage and size #2/0 AWG or smaller).	Contact
6. Tray or free air cables to a non-Class 1E flexible conduit (the non-Class 1E cables are limited to 480V or lower voltage and size #2/0 AWG or smaller).	1 in.
6a. Tray or free air cables to a non-Class 1E stripped flexible conduit (the non-Class 1E cables are limited to 480V or lower voltage and size #2/0 AWG or smaller).	Contact
7. Tray or free air cables to a flexible conduit (the free air cables, cables in the tray and in the conduit are limited to 480V or lower voltage and size #2/0 AWG or smaller).	1 in.
8. Tray or free air cables to a non-Class 1E aluminum sheathed cable of size #8 AWG or smaller	1 in.

c. FOR THE PURPOSE OF TESTING, THE CABLES IN THE PUNCHED BOTTOM TRAY ARE CONSIDERED THE SAME AS CABLES IN FREE-AIR SINCE THE CABLES IN THE TRAY ARE DIRECTLY EXPOSED TO THE HEAT GENERATED BY THE FAULTED CABLE IN THE AREAS OF THE TRAY THAT HAVE BEEN PUNCHED.

Configuration/Service Level	Minimum Spatial Separation Distance
or non-Class 1E electrical metallic tubing (EMT) carrying cables of sizes #8 AWG or smaller. (Limited to lighting, communications, and fire detection cables)	
9. Tray or free air cables to a non-Class 1E metal-clad cable (type MC) of size #8 AWG or smaller.	3/4 in.
10. Tray or free air cables to a non-Class 1E steel-armored 480V cable (500 MCM or smaller).	3/4 in.
10a. Tray or free air cables (480V or lower voltage and size #2/0 AWG or smaller) to steel-armored 480V cable (500 MCM or smaller).	3/4 in.
11. Cables in flexible conduit to cables in flexible conduit he cables are limited to 480V or lower voltar d size 500MCM or smaller).	1 in.
11a. Cables in s pped flexible conduit to non-Class 1E cables in stripped flexible conduit (the non-Class 1E cables are limited to 480V or lower voltage and size #2/0 AWG or smaller).	Contact
11b. Cables in stripped flexible conduit to cables in stripped flexible conduit (the cables are limited to 480V or lower voltage and size #2/0 AWG or smaller).	Contact
12. Cables in flexible conduit to non-Class 1E cables in rigid steel conduit (the non-Class 1E cables are limited to 480V or lower voltage and size #2/0 AWG or smaller).	Contact
13. Between two rigid steel conduits (the cables in the conduits are limited to 480V or lower voltage and size #2/0 AWG or smaller).	Contact
13a. Cables in rigid steel conduit to non-Class 1E cables in rigid steel conduit (the non-Class 1E cables are limited to 480V or lower voltage and size #2/0 AWG or smaller).	Contact
14. Between perpendicular rigid steel conduits carrying cables of 480V or lower voltage and sizes #3/0 AWG through 500MCM.	1/8 in.
15. Cables in rigid steel conduit crossing non-Class 1E cables in tray or free air (the non-Class 1E cables are limited to 480V or lower voltage and size #2/0 AWG or smaller). The angle of crossing shall be 30° or greater.	Contact
16. Free air cables to free air cables, where one	6 in.

Configuration/Service Level	Minimum Spatial Separation Distance
of the groups is wrapped in three layers (200% overlap) of silicon dioxide cloth (Siltemp 188 CH). Service voltage is limited to 400V or lower voltage and sizes of 500MCM or smaller.	
17. Free air cables to free air control or instrumentation cables (#8 AWG or smaller). The control or instrumentation cables are wrapped in two layers (100% overlap) of silicon dioxide cloth (Siltemp 188 CH).	1 in.

See insert B

TABLE 8.3.1-4 (SHEET 3 OF 6) 30

Configuration/Service Level	Minimum Spatial Separation Distance
7. Tray or free air cables to a non-Class 1E metal-clad cable (type MC) of sizes number 8 AWG or smaller.	3/4 in.
8. Tray or free air cables to a non-Class 1E steel-armored 480-V cable.	3/4 in.
8a. Tray or free-air cables to steel-armored 480 V cable installed at the bottom or in a horizontal side-by-side configuration.	3/4 in. 30
9. Tray or free air cables to a non-Class 1E rigid steel conduit carrying cables of 480 V or lower voltage of sizes 500 MCM or smaller.	3/4 in.
10. Free air cables to free air cables, where one of the groups is wrapped in three layers (200% overlap) of silicon dioxide cloth (siltemp 188 CH). Service voltage is limited to 480 V or lower.	6 in. 25
11. Free air cables to free air control or instrumentation cables. The control or instrument cables are wrapped in two layers (100% overlap) of silicon dioxide cloth (siltemp 188 CH).	1 in.
12. Between rigid steel conduits carrying control, instrumentation or power cables of 480 V or lower voltage of sizes number 12 AWG or smaller.	In contact
13. Between perpendicular rigid steel conduits carrying cables of 480 V or lower voltage.	1/8 in.
14. Between two rigid steel conduits installed in a horizontal side-by-side configuration. The cables in the conduits are limited to 480 V or lower voltage of sizes 2/0 AWG or smaller.	In contact

TABLE 8.3.1-4 (SHEET 4 OF 6) 30

Configuration/Service Level	Minimum Spatial Separation Distance
18 ~~15.~~ Between free air instrumentation or control cables of 125-V dc or 120-V ac or lower, sizes number 8 AWG or smaller.	1 in.
19 ~~16.~~ Between free air instrumentation or control cables (125-V dc or 120-V ac or lower sizes number 8 AWG or smaller) with either group of cables wrapped in two layers (100% overlap) of silicon dioxide cloth (siltemp 188 CH).	In contact
20 ~~17.~~ Where raceways of different separation groups are brought to a single enclosure and:	
a. The lower separation group (i.e., separation group installed below the other separation group), wrapped in three layers (200% overlap) of silicon dioxide cloth (siltemp 188 CH). The cables are limited to 480 V or lower voltage of sizes 500 MCM or smaller.	6 in.
b. One separation group is control or instrumentation cables (#8 AWG or smaller) and is wrapped in two layers (100% overlap of silicon dioxide cloth. Cables of the other separation group are limited to 480 V or lower voltage of sizes 500 MCM or smaller.	1 in.
c. ~~The upper separation group (i.e., separation group installed above the other separation group), or one separation group in a side-by-side configuration is~~ Class 1E cable(s) to non-Class 1E cables with the Class 1E cable(s) wrapped in two layers (100% overlap) of silicon dioxide cloth. The cables are limited to 480 V or lower voltage of sizes 500 MCM or smaller.	1 in.

25

TABLE 8.3.1-4 (SHEET 5 OF 6)

21. ~~18~~. Within panels and control boards:

a. Between instrumentation or control cables of 125-V dc or 120-V ac ~~or~~ of sizes number 8 AWG or smaller. 1 in.

b. Between instrumentation or control cables with either group of cables wrapped in two layers (100% overlap) of silicon dioxide cloth (siltemp 188 CH). The cables are limited to 120-V ac, 125-V dc, or lower voltage of sizes number 8 AWG or smaller. In contact

Insert C

Where:

Tray -	Ventilated (punched bottom) tray or tray fittings, solid bottom tray, or tray fittings
Conduit -	Hot dipped galvanized rigid steel conduit
Flexible Conduit -	Flexible steel conduit, sealtite, type UA
Steel-Armored - Cable	EPR insulation/hypalon jacket with galvanized steel armor. Used for 480-V switchgear loads in tray only.
Aluminum Sheathed - Cable (ALS)	A factory assembly of insulated conductors enclosed in a smooth continuous aluminum sheath. Used for lighting system application.
Metal-Clad Cable - (MC)	A factory assembly of one or more conductors each individually insulated, covered with an overall insulating jacket, and all enclosed in a metallic sheath of interlocking galvanized steel. Used in non-1E circuit only.
Electrical - Metallic Tubing (EMT)	Thinwall, steel conduit which conforms to ANSI standard C80.3-1977. This material provides a barrier equal to, or better than, the aluminum sheathing on ALS because it is manufactured from steel which has higher strength and a higher melting temperature than aluminum.

INSERT C

Add to new paragraph 21:

c. Separation distances shown for general plant areas in items 4, 5, 6, 10, 13, and 14 have been applied to separation requirements within panels.

d. Separation distances for cable installed in rigid steel or flexible conduit inside panels are the same as those tested in items 11, 11a, 11b, 12, 13, 13a, and 14.

Info Only
No Changes

TABLE 8.3.1-4 (SHEET 5a OF 6)

Free air cables may consist of steel armored or nonarmored cables, ALS, or type MC cables of any size or voltage level unless otherwise limited in the specific configuration description.

Info Only
No Changes

TABLE 8.3.1-4 (SHEET 6 OF 6) 30

C. A series of tests and analyses has been performed for circuits entering 480-120-V isolation transformers manufactured by Sola Electric. For these transformers, the standard separation of 6 in. as stated in paragraph 8.3.1.4.3 has not been met. The tests and analyses have been performed as allowed by Sections 5.1.1.2 and 5.6.2 of IEEE 384-1974 and Regulatory Guide 1.75. The tests represent the worst case conditions for transformer operation (ambient temperature of 50°C and transformer secondary bolted short circuit conditions). The test procedures and results are documented in Sola Electric Transformer Test Report, Log XSAA04-33.

25

Based on data in this test report, no separation is required (cables may be in contact) between the transformer primary and secondary field-installed cables terminated inside the transformer wiring compartment. Considering the current limiting characteristics of this type of isolation transformer, these cables are rated to carry the maximum transformer secondary short circuit current without exceeding their qualified operating temperature. Also, the insulation voltage rating of these cables exceeds any voltage carried by other cables which are routed in the same raceway with cables connected to the secondary side of the transformers. Therefore, potential transformer secondary circuit hot shorts will not impose a voltage that will overstress the insulation of these cables.

Justification:

The addition of 4.16kV (class IE) cables to paragraph 8.3.1.4.3.B reflects the extension of the Wyle Lab test results (Test Report Numbers 48141-02 and 17959-02) to a voltage rating of cable not explicitly tested. The testing did not explicitly test 4.16kV cables as targets, however it did test large 480V power cables as targets. The inclusion of 4.16Kv cables as a target cable is substantiated by the fact that the 4.16kV cables are less susceptible to damage from a fire generated by another cable than the cables explicitly tested. The 4.16kV cables are made of the same basic materials as the 480V power cables, but are specified to have thicker insulation and an equal to or heavier jacket. The separation requirements for 4.16kV cables are not reduced for instances where the 4.16kV cable is considered the faulted (burning) cable, due to the unavailability of relevant test data. This change is considered a clarification of the previous requirement, and does not reduce the original commitment.

The change to paragraph 8.3.1.4.3.C.2 to insert the word metallic is a clarification of the commitment, and reflects the existing interpretation of the phrase "enclosed wire duct". The restriction to metallic wire duct eliminates any confusion that might arise due to the widespread use of plastic wire ducts by equipment manufacturers. The other change is a rephrasing of the existing paragraph and does not change the commitment.

The change to the second paragraph of 8.3.1.4.3.D.1 is a rephrasing of the original paragraph and does not change the commitment.

The change to the third paragraph of 8.3.1.4.3.D.1 is based on the Wyle Lab Test Report Number 48141-02 for cable configuration #1, as reflected previously in FSAR Table 8.3.1-4 paragraph 1. The FSAR commitment in paragraph 1 of Table 8.3.1-4 allows separation of 12 inches for trays carrying cables of 480V or lower voltage with sizes 2/0 AWG or smaller. This change is an application of that tested distance to the free air tracking distance around a separation barrier for trays containing cables that meet the same restrictions. This is a clarification to the original commitment, since it is considered a natural and logical extension of another commitment already in the FSAR, and therefore does not reduce the intent of the original requirement.

Paragraph B: The analysis of Calculation X3CQ11 does show, for each cable eliminated from the walkdown, that the available energy is not sufficient to damage the cable or that the backup circuit protection will open the faulted circuit before insulation damage occurs. The postulated fault condition is considered to occur in the cabinet where the cable terminates. Outside the cabinet, adequate separation has been verified by walkdown. The results of this analysis justify specific exceptions to the separation requirements imposed by Construction Specification X3AR01.

The addition of Class 1E 4160V cables to Table 8.3.1-4 paragraph C (which was paragraph B in the FSAR through Amendment 34) is justified the same as the change for paragraph 8.3.1.4.3.B (above).

Wyle Laboratories Test Report No. 17959-02 (Wyle II) is a supplement to Wyle Laboratories Test Report No. 48141-02 and is added for reference since some of the following changes to the FSAR are based on it.

Paragraph 1 remains unchanged, and is based on Wyle Laboratories Test Report No. 48141-02 (Wyle I).

Paragraph 2 is demonstrated as acceptable by Wyle II, (Configuration #1, Test #1).

Paragraph 3 is demonstrated as acceptable by Wyle II, (Configuration #2, Test #1).

Paragraph 3a is demonstrated as acceptable by Wyle II, (Configuration #2, Test #1) with 3/4 inch added to the tray to tray distance as allowance for the 3/4 inch lip on the tray used during testing.

Paragraph 4 was originally paragraph 2 in the FSAR (through Amendment 34), and had a minimum spatial separation distance of 1/2 inch. Based on Wyle II, Configuration #4, Test #1 the distance is now reduced to "contact".

Paragraph 4a was originally paragraph 9 in the FSAR (through Amendment 34). It has been relocated and the size range clarified so as not to conflict with paragraph 4. Paragraph 4a is based on Wyle I (Configuration #2, Test #5) with rigid steel conduit considered as a better barrier than the armor on the cable actually tested.

Paragraph 5 was originally paragraphs 2a and 3 in the FSAR (through Amendment 34). The two paragraphs have been combined, and the separation distance reduced to 1/2 inch overall based on Wyle I (Configuration #2, Test #1) and Wyle II (Configuration #1, Test #2).

Paragraph 5a is demonstrated as acceptable by Wyle II (Configuration #4, Test #1 and Configuration #5).

Paragraph 6 was originally paragraph 4 in the FSAR (through Amendment 34). It has been reformated and is based on Wyle I (Configuration #2, Test #2).

Paragraph 6a is demonstrated as acceptable by Wyle II (Configuration #4, Test #3).

Paragraph 7 was originally paragraphs 4a and 5 in the FSAR (through Amendment 34). It is based on Wyle I (Configuration #2, Test #2 and Configuration #3, Test #1).

Paragraph 8 was originally paragraph 6 in the FSAR (through Amendment 34). It is based on Wyle I (Configuration #2, Test #3). The limitation to lighting, communication, and fire detection circuits is added to reflect the accepted use of ALS and EMT at Plant Vogtle. Both communications and fire detection circuits are at voltage and current levels equal to or below those used in lighting circuits.

Paragraph 9 was originally paragraph 7 in the FSAR (through Amendment 34). It is based on Wyle I (Configuration #2, Test #4).

Paragraph 10 was originally paragraph 8 in the FSAR (through Amendment 34). The 500MCM limitation is added to reflect the original test restriction in Wyle I (Configuration #2, Test #5).

Paragraph 10a was originally paragraph 8a in the FSAR (through Amendment 34). It is based on Wyle I (Configuration #2, Test #5) and Wyle II (Configuration #1, Test #2). The horizontal side-by-side restriction is no longer applicable based on the Wyle II reference.

Paragraph 11 is demonstrated as acceptable based on Wyle II (Configuration #3, Test #1).

Paragraph 11a is demonstrated as acceptable based on Wyle II (Configuration #4, Test #3).

Paragraph 11b is demonstrated as acceptable based on Wyle II (Configuration #4, Test #3).

Paragraph 12 is demonstrated as acceptable based on Wyle II (Configuration #3, Test #2).

Paragraph 13 was originally paragraphs 12 and 14 in the FSAR (through Amendment 34). It is based on Wyle I (Configuration #5, Test #3) and Wyle II (Configuration #3, Test #2). The side-by-side restriction is no longer applicable based on the Wyle II reference.

Paragraph 13a is demonstrated as acceptable based on Wyle I (Configuration #5, Test #3) and Wyle II (Configuration #3, Test #2).

Paragraph 14 was originally paragraph 13 in the FSAR (through Amendment 34). The 500MCM limitation is added to reflect the original test restriction in Wyle I (Configuration #5, Test #2).

Paragraph 15 is demonstrated as acceptable based on Wyle II (Configuration #4, Test #2).

Paragraph 16 was originally paragraph 10 in the FSAR (through Amendment 34). The 500MCM limitation is added to reflect the original test restriction in Wyle I (Configuration #4, Test #1a and 2).

Paragraph 17 was originally paragraph 11 in the FSAR (through Amendment 34). The #8 AWG or smaller limitation is added to reflect the original test restriction in Wyle I (Configuration #4, Test #2 and Configuration #6, Test #2).

Paragraph 18 was originally paragraph 15 in the FSAR (through Amendment 34). It is demonstrated as acceptable based on Wyle I (Configuration #6, Test #3).

Paragraph 19 was originally paragraph 16 in the FSAR (through Amendment 34). It is demonstrated as acceptable based on Wyle I (Configuration #6, Test #1 and 2).

Paragraph 20 was originally paragraph 17 in the FSAR (through Amendment 34). It is demonstrated as acceptable based on Wyle I (Configuration #4, Test #1a, Configuration #4, Test #2 and Configuration #6, Test #3). The #8 AWG or smaller limitation is added to reflect the original test restriction in Wyle I. The change in sub-paragraph 'c' reflects the separation requirement that the Class 1E group be wrapped in accordance with Wyle I.

Paragraphs 21.a and 21.b were originally paragraphs 18.a and 18.b in the FSAR (through Amendment 34). They are demonstrated as acceptable based on Wyle I (Configuration #6, Test #1, 2, and 3). The change to sub-paragraph 'a' is a revision to agree with the addition of paragraphs 21.c and 21.d (below).

Paragraphs 21.c and 21.d are based on engineering evaluation of Wyle I and Wyle II testing for external to panel configurations and the subsequent application of selected minimal spatial separation distances to identical internal panel separation configurations.

ATTACHMENT B

TEST RESULT SUMMARY

PURPOSE

Additional cable and raceway configurations have been identified subsequent to the separation reduction testing conducted in 1986. The purpose of the new testing is to provide justification for the configurations per the requirements of R.G. 1.75 and IEEE in lieu of applying generic separation distances.

TEST METHOD

The subject cable and raceway combinations were configured using VEGP cable and raceway in a test lab to replicate as much as possible actual field condition. An identified fault cable (selected on the basis of most severe ignition and fault temperature), was energized until it open circuited. Target cables were monitored with thermocouples for temperature, were energized with conservative values of voltage and current, and were monitored for continuity during and after the test. The cables were then inspected, and given a Post-Overcurrent Functional Test (insulation resistance greater than 16 x 10^6 ohms measured at 1000 VDC and a high potential test at 7200VDC).

CONFIGURATIONS TESTED

Configuration/ Test No.	Fault Cable Size & Location	Target Cable Location	Tested Separation Distance	Existing Criteria
1/1	3-1/C 2/0 AWG Free Air	Cable Tray with Bottom Cover	3/4" V & H	12" V & H
1/2	3-1/C 2/0 AWG Free Air	Armored Cable & Rigid Conduit	3/4" V & H 1/2" V & H	3/4" V & H (Free air cable limited to above 1" V & 1/2" H or horizontal side-by-side configuration with respect to target cable)

Configuration/ Test No.	Fault Cable Size & Location	Target Cable Location	Separation Distance	Existing Criteria
2/1	3-1/C 2/0 AWG Horizontal Tray	Vertical Tray	1" H	12" H
3/1	3-1/C 500 MCM Flex Conduit	Flex Conduit	1" V & H	1" V & H (Limited to 2/0 AWG cable or smaller)
3/2	3-1/C 2/0 AWG in Rigid Conduit	Rigid & Flex Conduit	0" (in contact)	0" (In contact) - (#12 AWG or smaller) 1/8" (crossing) 1/2" vertical (side-by-side)
4/1	3-1/C 2/0 AWG in Rigid Conduit	Free air (2 ea.)	0" V & H	1/2" V & H
4/2	3 1/C 2/0 AWG Free Air	Rigid Conduit Crossing at a 27° Angle	0" V	1" V & H
4/3	3-1/C 2/0 AWG Flex. Conduit with Coating Removed	Free Air & Flex Conduit with Coating Removed	0" V & H	1" V & H
5/1A	3-1/c 2/0 AWG Horizontal Tray	Rigid Conduit On Side and Below Tray	0" V & H	1/2" V, 0" H

TEST RESULTS

All cables met their acceptance criteria which was:

1. All target cables shall carry applied voltage and current during and after the testing.

2. Measured insulation resistance shall be greater than 16×10^{6} ohms with 1000 VDC applied for 60 seconds.

3. There shall be no evidence of insulation breakdown or flashover with a potential of 7200 VDC applied for 60 seconds.

TEST RESULTS (Continued)

Only one target cable in test configuration 1/2 was visibly affected. The jacket of a 2/C No. 14 AWG cable was blistered in a 4" section near the end of the rigid conduit. There were no cracks or openings visible in the jacket, and the cable passed all acceptance tests.

SUMMARY

Testing completed for the separation configurations and distances described above are sufficient to justify their use in lieu of generic separation distances for Plant Vogtle. The test methodology and acceptance criteria are the same as described and accepted by the NRC in SER Supplement 4.