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Your Reference: Westinghouse Response To Westinghouse/WECTEC Report No. 99901467/2016-201
And Notice Of Nonconformance

Subject: Response for Request for Additional Information in Regard to Notice of Nonconformance
Cited in NRC Inspection Report No. 99901467/2016-201 Dated February 2, 2017

Westinghouse acknowledges receipt of your request for additional information in regard to our response to the Notice of Nonconformance 99901467/2016-201-01. Westinghouse has reviewed the request and we have broken up the responses into two separate responses. As requested, the two (2) responses to your questions associated with this nonconformance issue are described in the attachment to this letter.

Very truly yours,

A handwritten signature in black ink, appearing to read 'Sarah T. DiTommaso', with a long horizontal line extending to the right.

Sarah T. DiTommaso, Manager
AP1000 ITAAC & Inspection Support

IED9
NRD

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NRC Inquiry #1

It is not clear that the scope of the issue, identified in the Nonconformance, would be solely limited to isolation devices that are used between Class 1E and non-Class 1E components. Please provide information that justifies your position that the catastrophic failure of the subject devices would not cause an explosion or fire that could propagate to other safety divisions, since it is our understanding that the minimum separation requirements contained in IEEE 384 were derived based upon testing that was performed at less than full interrupting ratings. Consequently, conformance to IEEE 384 alone would not ensure that a maximum fault in one division, combined with a catastrophic failure of the subject breaker (or fuse), would not propagate to other safety divisions.

Response:

Westinghouse reviewed the first inquiry and has identified two subject areas that require to be addressed. The first subject area is justification for the Westinghouse position that a catastrophic failure of the equipment would be confined to a single division. The second subject area is in relation to IEEE 384 cable separation requirements and the acceptability of the requirements in relation to interrupting ratings.

Catastrophic Failure of Equipment

In the original response, Westinghouse identified that a catastrophic failure of the interrupting devices would not cause an explosion or fire that would propagate into other divisions. The circuit breakers and fuses applicable to ITAAC 2.6.03.08 within the Class 1E dc and Uninterruptable Power Supply System (IDS) are redundant in each AP1000 division. Each division of IDS equipment is located in separate fire areas. The AP1000 general arrangement drawings depict each division of IDS equipment located in separate fire areas. In addition, the Westinghouse Fire Protection Analysis Report, which identifies consequences and mitigation for fires, identifies that a fire in any one area affects only the described area. The fire areas have boundaries of adequate rating which is based on the maximum amount of combustible material in the area. As a result, a fire in any one division would be contained from the other divisions by the fire boundaries. Note that this is external to containment because there is no IDS distribution equipment inside containment.

The inquiry goes beyond fire and questions whether an explosion could propagate to other safety divisions as a result of an inadequate interrupting rating. As noted above, the subject equipment in each safety division of IDS is contained within separate, isolated fire areas. The boundaries of these fire areas are either re-enforced concrete walls or Durasteel. In this case, the catastrophic failure of the device causing an explosion would need to propagate past the boundary of the distribution equipment. Any explosion or fire could not propagate through the fire barriers between divisions, beyond the boundary of the Durasteel or re-enforced concrete walls. The available energy from the explosion failing to clear prior to breach of a fire barrier and propagating to distribution equipment of another division is not an analyzed condition because it is deemed to be not credible given the structural requirements of the building.

IEEE 384 Cable Separation Requirements

The second subject area in the request for information states, "Consequently, conformance to IEEE 384 alone would not ensure that a maximum fault in one division and failure of the interrupting device would not propagate to other safety divisions." Also the request states that it is the NRC's "understanding that the minimum separation requirements contained in IEEE 384 were derived based upon testing that was performed at less than full interrupting ratings."

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Westinghouse has addressed this from an equipment failure perspective in the above description but will also address this from the cable/raceway separation perspective, as follows.

The spatial separation distance requirements listed in IEEE Std. 384 are independent of the Class 1E/non-Class 1E categorization of the source cable. Non Class-1E interrupting equipment cannot be credited because there are no safety related critical design characteristics of non-Class 1E interrupting devices by definition. As a result, Westinghouse interprets this to mean that no credit can be assumed for the operability of an upstream protective device, including an interrupting rating device, for source cables and circuits which are Class 1E or non-Class 1E.

The separation distances in IEEE Std. 384 were developed based on the concept that the source cable will continue to be consumed by the fault-initiated fire until the time the conductor fails to an open circuit condition. Once in the open circuit condition, there would be no additional energy to continue the fire. This is supported by the position of IEEE Std. 384 that the spatial separation distances are based on cables being constructed of limited flame propagation material in accordance with IEEE Std. 383.

Westinghouse maintains that fault interrupting capability is limited to IEEE Std. 384 isolation barrier interrupting devices. IEEE Std. 384 requires the following for fuses and breakers that are used in IEEE 384 isolation barriers:

- For breakers, IEEE Std. 384 states “the isolation device will interrupt prior to initiation of a trip of any upstream breaker” (section 7.1.2.1 (1))
- For fuses, IEEE Std. 384 states “each fuse be tested to verify overcurrent protection (for example, resistance measurement) as designed” (section 7.2.2.2 (1)) and “the fuse time overcurrent trip characteristic for all circuit faults shall cause the fuse to open prior to the initiation of an opening of any upstream interrupting device” (section 7.2.2.2 (3)).

By the breakers and fuses meeting these requirements any fault is prevented from propagating beyond the isolation device and causing degradation below an acceptable level. Also, the device (breaker, fuse) will isolate the faulted non-1E circuit from the 1E by assuring the interrupting capability to the maximum available fault current. The testing used to demonstrate the interrupting capability of IEEE 384 breakers and fuses is conducted to ensure that any failures of a Class 1E system caused by a fault in the non-Class 1E system are removed.

Note that Westinghouse reviewed IEEE Std. 384-1992 Appendix, IEEE Std. 384-2008 Appendix B and IEEE Transaction of Energy Conversion “Cable Separation - What Do Industry Programs Show?” to determine how the separation requirements were derived. IEEE Std. 384-1981 is the version committed to by AP1000 and the IEEE Transaction of Energy Conversion is referenced in the design certification.

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NRC Inquiry #2

Also, since the same breakers are apparently used for multiple applications (both those credited as isolation devices as well as those that supply Class 1E power), does (or will) Westinghouse assign a different Part Number or designation to breakers that have had interrupting ratings verified versus those whose ratings have not been verified? If not, does (or will) Westinghouse clearly disclose to their customers that the dedication of the breakers does not include verification of the interrupting ratings? If not, what would prevent a licensee from substituting a verified breaker from one that was not?

Response:

Westinghouse uses the same identification number (part number) for breakers or fuses that are used as both isolation devices and those that supply Class 1E power. However, where the same equipment is used for multiple applications, the equipment is dedicated under the same commercial dedication instruction to the most stringent requirements. Although interrupting rating would not be considered a critical characteristic for a fuse or breaker that is only used in Class 1E applications, it would be treated the same as an isolation device with respect to interrupting rating. As mentioned in the original notice of non-conformance response, the commercial dedication instructions of these devices will be revised to include critical characteristics associated with the verified ratings regardless of the installed application.

Devices that were supplied prior to completion of testing to verify interrupting ratings fall into one of the following two categories:

1. Equipment that did not specify interrupting rating as a critical characteristic but was commercially dedicated with instructions that included all recurring testing required verifying the Interrupt Rating (IR). For this category, only documentation changes are required to the commercial dedication instructions to indicate IR as a critical characteristic and to reference the one-time IEEE Std. 384 test reports.
2. Equipment that was commercially dedicated without the recurring testing required verifying the Interrupt Rating (IR) listed. The commercial dedication instructions for this equipment has been revised in accordance with the committed action from the previous response letter dated February 2, 2017. Since new test instructions are included in the commercial dedication instructions, these components are being replaced in the installed equipment through field changes.