RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: **210-8239**

SRP Section: **08.03.01 – AC Power Systems (Onsite)**

Application Section: **8.3.1**

Date of RAI Issue: **09/14/2015**

Question No. 08.03.01-20

DCD Tier 2 discusses about the physical independence, the criteria governing the physical separation of redundant equipment, including the design of cables and raceways and their implementation, as set forth in IEEE Std. 384 as endorsed by RG 1.75.

For containment, penetration areas, cable spreading rooms, control rooms and other congested areas, discuss when cable derating is required and the criteria used for derating cables in cable raceways.

DCD Section 8.2.1.4 discusses the separation between the preferred power supply I and II. It discusses the cables that are routed from the SATs to the switchgears. The staff noted that the SAT LV side cables appear to be in a congested routing for connecting multiple secondary winding cables to the Class 1E and non-Class 1E switchgear. Please discuss how the APR1400 design addresses cable routing (through the trenches), cable spacing and separation, specifically when sharing safety-related cables of different voltage levels in raceways with non-safety-related cables, so that the design has capacity and capability to avoid unintended safety impact.

Also to satisfy the guidance provided in RG 1.75 for independence of electrical safety systems. Discuss the Administrative Programs that are developed to distinguish 1) cable routing, separation, and cable identification of redundant Class 1E circuits, 2) the independence of non-Class 1E circuits from Class 1E circuits, and 3) determining the raceway fill and whether cable derating is required.

Response

The following provides additional information on the subjects the staff requested.

Cable ampacity derating

Base ampacities of cables installed in all plant areas including containment, penetration area, cable spreading rooms, and control rooms are determined per NEMA WC 51 (ICEA P-54-440) or IEEE S-135-1 (ICEA P-46-426) as applicable. The following derating factors are applied to the cable ampacities according to the conditions that the cables are subjected to.

- Temperature correction factor

  When a cable is installed or runs through an area(s) where ambient temperature exceeds 40 °C (according to APR 1400 Environment Qualification Parameter Report (EQPR)), the temperature correction factor per NEMA WC 51(for tray installation) or IEEE S-135-1(for conduit installation) is applied to the base ampacity.

- Grouping Factor

  When cables are installed in solid metal trays with maintained spacing, or in exposed or enclosed conduits, and multiple cables are grouped in the same installation, grouping factors per IEEE S-135-1 are applied to the base ampacity.

- Correction factor for fire stop or fire wrap

  When a cable runs through a fire stop or a fire wrap applied over the cable trays in which the cable is installed, specific correction factor is applied to consider the thermal insulation effect of the fire stop or fire wrap.

  The value of the derating factor is obtained from the cable derating tables and curve in IEEE Std. 666, chapter 12 unless otherwise specified by the fire stop/wrap manufacturer.

Cable routing of SAT LV side cables

Cables from the SATs to the switchgears are routed in non-Class 1E cable trays through the cable tray tunnels, between SATs and building entries, and inside the turbine building or the auxiliary building.

Separate cable trays by voltage level (e.g., 13.8kV, 4.16kV, 480V, control, and instrumentation) are arranged typically in vertical direction with practical clearance between the cable trays. For each cable tray, appropriate cable spacing method is applied (e.g., maintained spacing for medium voltage cable trays and random fill spacing for low voltage, control and instrumentation cable trays). A typical layout (section view) of cable trays arrangement in the cable tray tunnel and a profile of maintained spacing of MV cables are provided in Attachment 1.

Since the cables from the SATs to the Class 1E switchgears are part of preferred power supply (PPS) circuits, they are non-Class 1E (non-safety related) and no separation requirements is imposed for the cables with other non-Class 1E cables.

Administrative Programs for independence of Class 1E system

The APR 1400 applies a dedicated cable and raceway numbering system in which cable routing, separation, and cable identification of redundant Class 1E circuits are distinguished by naming convention. In the detailed design phase, the COL applicant is to establish administrative program(s), including application of dedicated cable and raceway management database tool as necessary, which is(are) developed on the basis of the cable and raceway numbering system to efficiently manage cable routing and cable termination, and verify that the cable design fulfills the acceptance criteria (i.e., separation, filling criteria, and ampacity).

The cable management database tool will provide the following functions.

- In order that a Class 1E cable assigned to a channel can be routed on the same channel of raceway, the cable management database tool validates cable routing data by checking whether the cable's channel corresponds to the raceway's channel.

- In the same manner, the cable management database tool validates whether all non-Class 1E cables are routed on non-Class 1E raceways to ensure the independence between Class 1E and non-Class 1E circuits.

- As the result of the cable routing, raceway fill is automatically calculated and strictly monitored by the cable management database tool. The raceway fill is calculated by equation below.

  %Fill = Sum of (Cable area) / Raceway area x 100%

  Also, the cable management database tool calculates the derated ampacities of power cables installed in a cable tray according to its fill ratio and compares the calculated ampacity of each cable with the full load current of the corresponding cable. The ampacity of power cables installed in cable tray is calculated according to NEMA WC 51.

Impact on DCD

DCD Tier 2, Table 1.8-2 and Subsections 8.3.1.1.10 and 8.3.3 will be revised as shown in Attachment 2.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

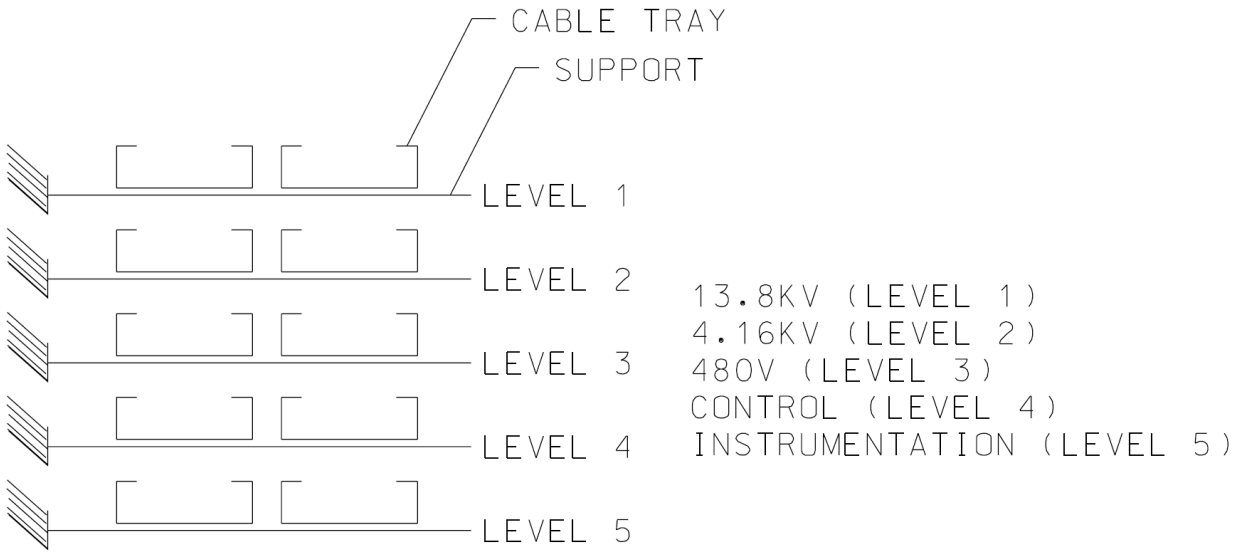
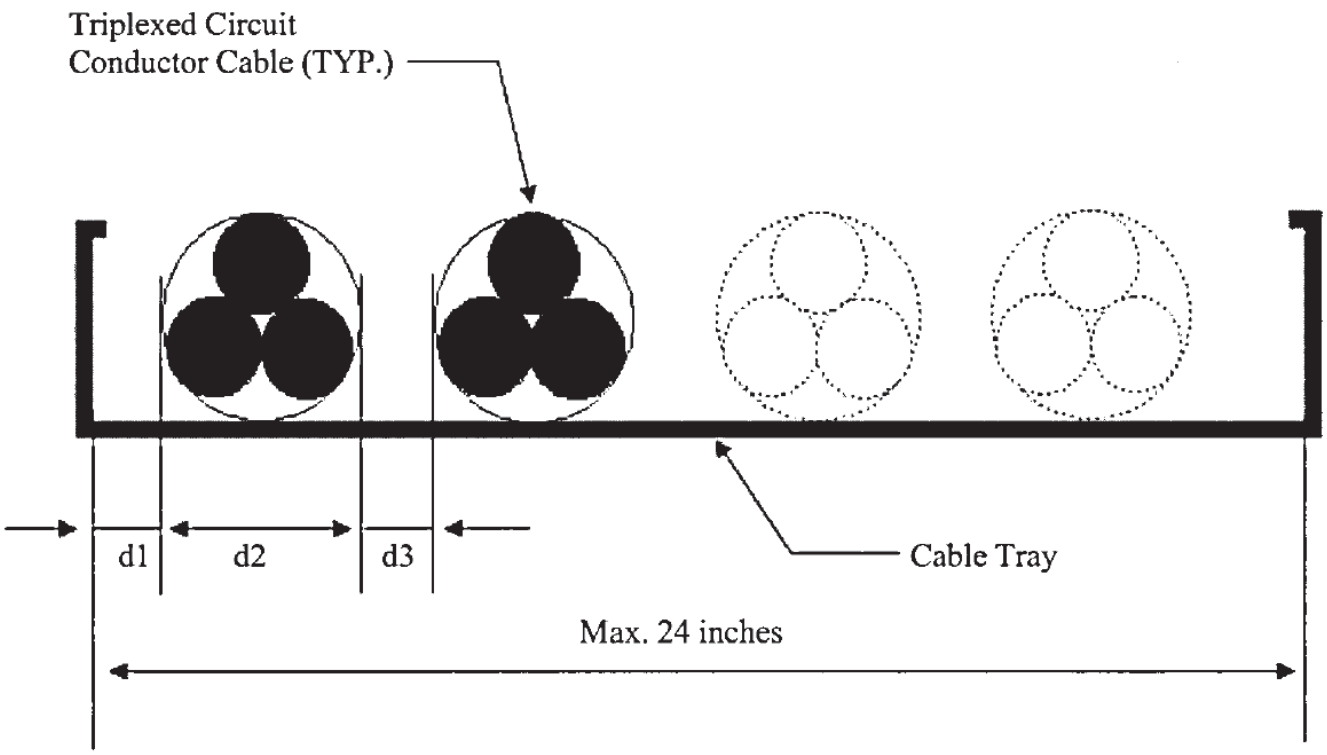


Figure 1. Cable tray arrangement(section view) in cable tray tunnel



d1 = Minimum 1 inch
d2 = Diameter of triplexed circuit conductor
d3 = Minimum 0.25 times d2

Figure 2. Profile of maintained spacing of MV cables

Table 1.8-2 (11 of 29)

Item No.	Description
COL 8.3(1)	The COL applicant is to provide and to design a mobile generator and its support equipment.
COL 8.3(2)	The COL applicant is to describe and provide detailed ground grid and lightning protection.
COL 8.3(3)	The COL applicant is to provide testing, inspection, and monitoring programs for detecting insulation degradation of underground and inaccessible power cables within the scope of 10 CFR 50.65.
COL 8.3(4)	The COL applicant is to provide protective device coordination.
COL 8.3(5)	The COL applicant is to provide insulation coordination of surge and lightning protection.
COL 8.3(6)	The COL applicant is to develop the maintenance program to optimize the life and performance of the batteries.
COL 8.3(7)	The COL applicant is to provide short circuit analysis of onsite dc power system with actual data.
COL 8.3(8)	The COL applicant is to describe any special features of the design that would permit online replacement of an individual cell, group of cells, or entire battery.
COL 8.4(1)	The COL applicant is to identify local power sources and transmission paths that could be made available to resupply power to the plant following the loss of a grid or the SBO.
COL 8.4(2)	The COL applicant is to develop detailed procedures for manually aligning the alternate AC power supply when two (Trains A and B) of the four diesel generators are unavailable during a loss of offsite power event.
COL 9.1(1)	The COL applicant is to provide operational procedures and maintenance program as related to leak detection and contamination control.
COL 9.1(2)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations.
COL 9.1(3)	The COL applicant is to address the load-handling procedures. Load-handling procedures are established for component handling procedures and plant operating procedures in accordance with ASME B30.2. ASME B30.2 requires establishing component handling procedures that include (1) a safe load path for lifting heavy loads to perform special handling component inspections, (2) acceptance criteria prior to lift, and (3) use of steps and proper sequence in handling the load. ASME B30.2 requires plant operating procedure guidelines that include appropriate crane operator training and crane inspections. ASME B30.2 also requires that the load-handling procedures include preparing operating procedures for preoperational load testing and checkouts of interlocks, brakes, hoisting cables, control circuitry, and lubrication of OHLHS equipment.
COL 8.3(13)	The COL applicant is to establish Administrative Program(s), including application of dedicated cable and raceway management database tool as necessary, which is(are) developed on the basis of the cable and raceway numbering system to efficiently manage cable routing and cable termination and verify that the cable design fulfills the acceptance criteria (i.e., separation, filling criteria, and ampacity).

Add

d. Control

e. Instrumentation

If the trays are stacked, the order from top to bottom is as shown above.

Cables of each train run in separate raceways are physically separated from cables of the other trains. Separation of trains is in accordance with IEEE Std. 384, as endorsed by NRC RG 1.75. Raceways for non-Class 1E are separated from each Class 1E train A, B, C, and D in accordance with IEEE Std. 384. The raceway in the cable spreading area, main control room, and other congested areas is designed in accordance with IEEE Std. 384. The power and control wiring in control boards or panels is separated in accordance with IEEE Std. 420 (Reference 40).

Medium-voltage power cables are routed in an open-top ladder-type cable tray in a single layer with maintained spacing. The distance between adjacent cables within a tray is one-quarter the diameter of the larger cable. The cable tray fill criterion for low-voltage power cables does not exceed 30 percent of the cross-sectional area of the open-top ladder-type tray. The cable tray fill criterion for control cable does not exceed 50 percent of the cross-sectional area of the open-top ladder-type tray. Solid-bottom and solid-cover type cable trays are used for routing instrumentation cables, with an allowable fill of 50 percent of tray cross-sectional area. Cable splicing in a raceway is prohibited.

8.3.1.2 Analysis

The APR1400 Class 1E ac power system is designed to meet the requirements of GDCs 2, 4, 5, 17, 18, 33, 34, 35, 38, 41, 44, 50, and the intent of NRC RGs 1.6, 1.9, 1.32, 1.47, 1.53, 1.63, 1.75, 1.81, 1.106, 1.118, 1.153, 1.155, 1.160, and 1.204. The criteria and guidelines are shown in Table 8.1-2 and include their applicability in the electrical system design.

Add

The COL applicant is to establish Administrative Program(s), including application of dedicated cable and raceway management database tool as necessary, which is(are) developed on the basis of the cable and raceway numbering system to efficiently manage cable routing and cable termination and verify that the cable design fulfills the acceptance criteria (i.e., separation, filling criteria, and ampacity). (COL 8.3(13)).

The ground detector has an alarm in the MCR to monitor constant grounding and recording. The ground detector has high sensitivity.

8.3.3 Combined License Information

COL 8.3(1) The COL applicant is to provide and to design a mobile generator and its support equipment.

COL 8.3(2) The COL applicant is to describe and provide detailed ground grid and lightning protection.

COL 8.3(3) The COL applicant is to provide testing, inspection, and monitoring programs for detecting insulation degradation of underground and inaccessible power cables within the scope of 10 CFR 50.65.

COL 8.3(4) The COL applicant is to provide protective device coordination.

COL 8.3(5) The COL applicant is to provide insulation coordination of surge and lightning protection.

COL 8.3(6) The COL applicant is to develop the maintenance program to optimize the life and performance of the batteries.

COL 8.3(7) The COL applicant is to provide a short-circuit analysis of the onsite dc power system with actual data.

COL 8.3 (8) The COL applicant is to describe any special features of the design that would permit online replacement of an individual cell, group of cells, or entire battery.

8.3.4 References

1. IEEE Std. 141-1993, “IEEE Recommended Practice for Electric Power Distribution for Industrial Plants,” Institute of Electrical and Electronics Engineers, 1993.

Add

COL 8.3(13) The COL applicant is to establish Administrative Program(s), including application of dedicated cable and raceway management database tool as necessary, which is(are) developed on the basis of the cable and raceway numbering system to efficiently manage cable routing and cable termination and verify that the cable design fulfills the acceptance criteria (i.e., separation, filling criteria, and ampacity).