KHNPDCDRAIsPEm Resource

From:	Ward, William
Sent:	Monday, February 29, 2016 3:40 PM
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Cc:	Lee, Samuel; Ciocco, Jeff; Otto, Ngola; Zimmerman, Jacob; Steckel, James
Subject:	APR1400 Design Certification Application RAI 420-8482 [19.3 - Beyond Design Basis External Event (APR1400)]
Attachments:	APR1400 DC RAI 420 EEB 8482.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, the following RAI question response times. We may adjust the schedule accordingly.

19.03-30 : 60days
19.03-31 : 60days
19.03-32 : 45days
19.03-33 : 60days
19.03-34 : 60days
19.03-35 : 45days
19.03-36: 60days
19.03-37 : 60days
19.03-38 : 60days
19.03-39 : 60days

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 420-8482

Issue Date: 02/29/2016
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 19.03 Beyond Design Basis External Event (APR1400)
Application Section: DCD 19.3, Ch. 8, Ch. 9

QUESTIONS

19.03 Beyond Design Basis External Event (APR1400)-30

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

In Design Control Document (DCD) Tier 2 Section 19.3.2.3.4 (Reference 5), Technical Report (TR), APR1400-E-P-NR-14005-P, Revision 0 “Evaluations and Design Enhancements to Incorporate lessons Learned from Fukushima Dai-Ichi Nuclear Accident,” Section 5.1.2.3.1.1.2 explains that the Phase 1 coping time can be extended to 16 hours because additional cooling is not required in the main control room (MCR), electrical, turbine driven auxiliary feed-water pump (TDAFWP), and instrumentation and control (I&C) equipment rooms; and that the TDAFWPs are powered from the Class 1E batteries in Trains C/D for 16 hours without load shedding. TR, APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.6.1.2, “DC Power” states in part that Train C and D batteries have a capacity of 8,800 amp hour (Ah) and can supply direct current (dc) power up to 16 hours without load shedding.

1. Clarify whether the TDAFWPs are powered from the Class 1E batteries, or are only the instrumentation/controls associated TDAFWPs being powered by the Class 1E batteries?

2. Provide load analysis and methodology used in order to demonstrate that the batteries have the capacity to last for both 8 hours and 16 hours without load shedding.

3. Provide the battery duty cycle diagram for Train C and D that depicts the direct current (dc) load profile and the battery division(s) providing power to the corresponding loads along the timeline for the mitigating strategies to maintain core cooling, containment, and spent fuel pool cooling during all modes of operation.

4. Provide the basis for the assumed minimum battery voltage that is required to ensure proper operation of all electrical equipment as included in the load profile.

5. Are the batteries serving trains C and D being recharged during and after phase 1?

19.03 Beyond Design Basis External Event (APR1400)-31

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

DCD Section 8.3.2.1.2.1, “Class 1E 125 Vdc Power System,” states in part that the onsite Class 1E 125 Vdc power system is composed of four independent subsystems (trains A, B, C, and D) and supplies reliable power to the plant safety system direct current (dc) loads and essential I&C system loads. DCD Figure 8.3.2-1, “Class 1E DC Power System” shows Class 1E dc power systems for Trains A, B, C, and D. However, for beyond design basis external events (BDBEE) phase 1 coping, the Class 1E batteries in Train C and D are relied on to power loads for up to 16 hours. TR APR1400-E-P-NR-14005-P, Rev. 0, Section 5.1.2.6.1.2, “DC Power,” states in part that both Train A and B batteries have a capacity of 2,800 Ah and can supply dc power up to 2 hours without load shedding and an additional 6 hours with load shedding. Train C and D batteries have a capacity of 8,800 Ah and can supply dc power up to 16 hours without load shedding.

1. Please clarify whether train A and B Class 1E DC power subsystems are used for mitigating strategies during BDBEE and specify for which phase they are credited.

2. Provide the battery duty cycle diagram for Train A and B that depicts the direct current (dc) load profile and the battery division(s) providing power to the corresponding loads along the timeline for the mitigating strategies to maintain core cooling, containment, and spent fuel pool cooling during all modes of operation.

3. Provide the basis for the assumed minimum battery voltage that is required to ensure proper operation of all electrical equipment as included in the load profile.

19.03 Beyond Design Basis External Event (APR1400)-32

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations,

NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

TR, APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.6.1.2, “DC Power” states in part that during Phase 2, a 480 V mobile GTG is connected to either Train A or Train B of the Class 1E load center to supply power and recharge respective batteries to fully charged condition. During battery charging in Phase 2, forced ventilation of battery rooms or racks may be required to prevent an unacceptable buildup of hydrogen released during the charging process. Ventilation of battery rooms may be needed to maintain an acceptable temperature for long-term battery operation. NRC Regulatory Guide 1.128, states that each ventilation system of the Class 1E battery rooms limits hydrogen accumulation to less than 1 percent of the total volume of the battery area. DCD Section 8.3.2.2.2, “Conformance with NRC Regulatory Guides,” states in part that each ventilation system of the Class 1E battery rooms limits hydrogen accumulation to less than 1 percent of the total volume of the battery area. TR, APR1400-E-P-NR-14005-P, Revision 0 does not identify considerations related to the need for battery room ventilation.

1. Explain how APR1400 design mitigation strategies will address ventilation requirements in support of battery charging and operation.

2. Provide a discussion on the hydrogen gas exhaust pathway. Also provide a discussion on how hydrogen concentration in the battery rooms will be maintained below the limits established by national standards and codes (i.e., less than 1% according to the National Fire Code and Regulatory Guide 1.128, “Installation Design and Installation of Vented Lead-Acid Storage Batteries for Nuclear Power Plants,” which endorses IEEE Standard 484, “IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications,” with exceptions) when the batteries are being recharged during Phase 2. Specifically address considerations related to preventing unacceptable buildup of hydrogen and need for ventilation to maintain an acceptable temperature range for long-term battery operation.

3. Explain whether only Train A or Train B Class 1E batteries are recharged or whether there is charging done to the Train C or Train D Class 1E batteries during Phase 2.

19.03 Beyond Design Basis External Event (APR1400)-33

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

DCD Section 8.3.2.1.2.1 states that the Class 1E 125 Vdc power systems, located in a seismic Category I structure, are designed to remain functional in the event of a safe shutdown earthquake, operating basis earthquake, tornadoes, hurricanes, floods, and other design basis events including missile impact and internal accidents. Technical Report (TR) APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.3.1.1.2, explains that during the phase 1, additional cooling in the main control room (MCR), electrical and I&C equipment rooms, and the turbine driven auxiliary feedwater pump (TDAFWP) rooms is found not to be required based on heat-up calculations.

1. Please explain what type of environmental conditions including temperature is in the room housing the Class 1E DC batteries, and whether there are any impacts to the functioning of the batteries during Phase 1 and beyond.

2. In the case of higher than normal temperatures in the battery rooms, please discuss if and how higher than normal temperatures are factored into the analysis to support both functioning and duration of the battery life.

19.03 Beyond Design Basis External Event (APR1400)-34

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

TR, APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.3.1.2, “Phase 2: Coping with Installed Plant Equipment and Onsite Portable Resources (8 to 72 hours)," subsection 5.1.2.3.1.2.1 states that two 480 V, 1,000 kW, mobile GTGs are provided to meet N+1 requirements. One of the 480 V mobile gas turbine generators (GTGs) is connected to the 480 V Class 1E power system Train A or B, and supplies power to the 125 Vdc battery charger, the 480 V load center, and the motor control center (MCC). During this phase, additional cooling in MCR, electrical and I&C equipment rooms, turbine driven auxiliary feedwater pump (TDAFWP) rooms, and auxiliary control panel (ACP) room is not required based on heat-up calculations.

1. Please explain what type of environmental conditions, including temperature, are in the room housing the mobile GTGs, and whether there are any impacts to the functioning of the GTGs during Phase 2 and beyond.

2. Discuss how isolation between Class 1E and non-Class 1E equipment (mobile GTGs) s maintained, in accordance with NEI 12-06, Section 3.2.2, Guideline (13).

19.03 Beyond Design Basis External Event (APR1400)-35

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

TR, APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.3.1.2, “Phase 2: Coping with Installed Plant Equipment and Onsite Portable Resources (8 to 72 hours)," subsection 5.1.2.3.1.2.3 states that the specific storage location, mobilization, and other details for the FLEX pumps and mobile gas turbine generators (GTGs) are combined license (COL) items. TR, APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.3.1.2.3, “Common Strategy to Both the Basic Strategy and Contingency Plan” states that the specific storage location, mobilization, and other details for the FLEX pumps and mobile GTGs are COL items. DCD Section 19.3.4, “Combined License Information,” COL 19.3(4) states that the COL applicant is to address the details of storage location for FLEX equipment.

1. Please specify and provide details associated in the COL item to ensure that the COL applicant is able to provide mobilization and storage to ensure adequate protection of FLEX equipment for the Phase 2 coping strategy.

19.03 Beyond Design Basis External Event (APR1400)-36

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

NEI 12-06, Revision 0 guidance states that “unlike 50.54(hh)(2), the intention of this guidance is to have permanent, installed connection points for portable fluid and electrical equipment. Electrical diversity can be accomplished by providing a primary and alternate method to repower key equipment and instruments utilized in FLEX strategies. At a minimum, the primary

connection point should be an installed connection suitable for both the on-site and off-site equipment. The secondary connection point may require reconfiguration (e.g., removal of valve bonnets or breaker) if it can be shown that adequate time is available and adequate resources are reasonably expected to be available to support the reconfiguration. Both the primary and alternate connection points do not need to be available for all applicable hazards, but the location of the connection points should provide reasonable assurance of at least one connection being available." TR, APR1400-E-P-NR-14005-P, Revision 0, Table 5-9, "Conformance with NEI 12-06," Rev. 0, states that the appropriate standard mechanical and electrical connections need to be specified and the COL applicants are responsible to establish a means to ensure the necessary resources are available from offsite. Table 5-9 (8 of 20) also states that connections for primary and secondary FLEX pumps, and mobile GTGs, are provided on the outside of the exterior wall of the auxiliary building, thereby providing reasonable assurance of the accessibility of personnel and equipment.

1. Provide the COL item that will be used by the COL applicant to ensure the appropriate connection points for the electrical equipment, including voltages and classification.

2. Section 5.1.2.6.1.1 states that the provisions to connect these GTGs are incorporated into the design. Please discuss what the provisions are.

19.03 Beyond Design Basis External Event (APR1400)-37

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

TR, APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.6.1.2, "DC Power" states in part that the safety-related batteries that are extended for use longer than 8 hours, with reduced discharge rate through load shedding, are not required to be additionally qualified for FLEX profiles since the NRC endorsed the NEI White Paper with clarifications in September 2013 (References 10 and 11).

DCD Section 8.3.2.1.2.6, "System Capacity and Capability," states in part that the battery is sized based on the duty cycle of the respective subsystems. Each battery is capable of supplying power to the worst-case operating loads for a period of the battery duty cycle. The sizing of the battery is performed in accordance with the IEEE Std. 485 (Reference 52). Class 1E battery loads and duty cycles are shown in the Table 8.3.2-1 and the battery rating is shown in Table 8.3.2-4. The Class 1E batteries are qualified in accordance with IEEE Std. 535.

NEI White Paper with clarifications in September 2013 (ML13241A188), TR, APR1400-E-P-NR-14005-P, Revision 0, Reference 10, states in part that the industry does not believe that the Institute of Electrical and Electronics Engineers Standard 535 (IEEE 535) is applicable to beyond design basis events and that battery qualification for an extended loss of ac power event is not intended. NRC staff's position is that IEEE 535 is an acceptable approach for overall integrated plans (OIPs), although the alternative described in the white paper is also acceptable provided that licensees are able to demonstrate that the manufacturer discharge curves support the duty cycle duration assumed as part of the OIPs.

1. Provide analysis to demonstrate that the batteries have the capacity and capability for 8 hours and beyond based on the loading requirements for BDBEE during Phase 1 coping and beyond, or provide manufacturer discharge curves to support the duty cycle duration.

19.03 Beyond Design Basis External Event (APR1400)-38

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

DCD Tier 2 Section 9.5.3.1, "Design Bases," states in part that the emergency lighting system is composed of emergency ac and emergency dc lighting systems. Emergency ac lighting is supplied from Class 1E buses. Emergency dc lighting system is composed of the lighting powered from the non-Class 1E 125 Vdc station battery and the lighting powered by an individual 8 hours rated self-contained battery pack units in accordance with NRC RG 1.189. TR, APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.6.1.3, "Emergency Lighting," states in part that emergency lighting in areas such as the main control room (MCR) and technical support center (TSC) / operational support center (OSC) is provided from the Class 1E batteries during Phase 1.

1. Please clarify where the emergency lighting system is being powered from (emergency ac, emergency dc, or combination) during phase 1 of the BDBEE for areas such as MCR, TSC/OSC, and other areas requiring lighting for operator actions.

19.03 Beyond Design Basis External Event (APR1400)-39

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12–06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

TR, APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.6.1.4, “Communications,” states in part that portable communication devices will be used.

1. Please discuss how the portable communications equipment are recharged.