
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.: 333-8397
SRP Section: 19.03 – Beyond Design Basis External Event
Application Section: 19.03
Date of RAI Issue: 12/14/2015

Question No. 19.03-9

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

In SECY 12-0025, the staff provided the Commission with proposed orders requiring mitigation strategies for beyond-design-basis external events to be issued to all power reactor licensees and holders of construction permits. In the paper, the staff indicated that for New Reactors that are currently under active staff review, the staff plans to ensure that the Commission-approved Fukushima recommended actions are addressed prior to licensing. On March 12, 2012, the NRC issued Orders EA-12-049 requiring operating nuclear plants to develop and implement strategies that will allow them to cope without ac power for an indefinite amount of time. The strategies must ensure that the reactor core and spent fuel pool are adequately cooled, and containment function is maintained.

The technical report, APR 1400-E-P-NR-14005-P Rev. 0, states that the COL applicant is responsible for the FLEX equipment protection, storage, and deployment. It is not clear what the FLEX equipment is composed of and what design parameters the FLEX equipment must satisfy to support the mitigation strategies as described in DCD Tier 2, Section 19.3. The NRC staff believes that the DCD should provide sufficient guidance based on the proposed mitigation strategies for COL applicants to follow.

In DCD Tier 2 Section 19.3.3, COL 19.3(5) states that site-specific strategies to mitigate beyond design basis external events (BDBEEs) are specified in the NRC Order EA-12-049. DCD Tier 2 Section 19.3.2.3.4 briefly addressed the above statement, but is insufficient in specifying the interface for COL to follow.

Specifically, KHNP is requested to provide the following clarification in the DCD or in the technical report:

- a) Identify all the on-site and off-site FLEX equipment that COL applicant is responsible for
- b) For each of the FLEX equipment, KHNP is requested to specify the following:
 - (1) Functional and capability requirements for the FLEX equipment, and
 - (2) Interface design parameters that COL applicants are required to satisfy
For example, the COL applicant is to provide ___ number of FLEX pumps for the emergency containment spray backup subsystem (ECSBS) containment spray at ___ gpm flow rate and ___ psia pressure head. The pump is to take water from RWT.
- c) The COL applicant is to address the requirement of reasonable protection and accessibility for all the on-site FLEX equipment and the connections of the equipment. Technical Report Section 6.2.9 provides the guidance for the COL applicant that the storage structures for the FLEX equipment will withstand the BDBEES and meet GDC 2.
- d) If the clarification information is only in the technical report, the report must be incorporated by reference (IBR). Clarify whether the Technical Report APR 1400-E-P-NR-14005-P Rev. 0 is IBR.

Response

- a) and b) Tables for the On-site and off-site FLEX equipment that the COL Applicant is responsible for will be added to Technical Report APR1400-E-P-NR-14005-P/NP as indicated in Attachment 1. The Tables also contain equipment descriptions, quantity, interface parameters, and the functional requirements for the corresponding FLEX equipment. References to DCD Tier 2 and the Technical Report (TeR) are also included for traceability.
 - c) COL 19.3(4) in DCD Tier 2 Subsections 19.3.2.3.4 and 19.3.4, and Technical Report APR1400-E-P-NR-14005-P/NP Section 6.2.9 will be revised to provide detailed guidance for storage of FLEX equipment for COL applicant as indicated in Attachment 2. The guidance of COL 19.3(4) includes that the COL applicant is to address reasonable protection and accessibility for all the on-site FLEX equipment.

COL information item which requires the COL applicant to ensure reasonable protection and accessibility for the connections of the FLEX equipment is provided in the revised response to RAI 407-8447 Question 19.03-26.
 - d) The Technical Report APR1400-E-P-NR-14005-P/NP is provided as IBR per DCD Tier 2 Table 1.6-2.
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Impact on DCD

COL 19.3(4) in DCD Tier 2, Subsections 19.3.2.3.4 and 19.3.4 will be revised as indicated in the 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

Technical Report APR1400-E-P-NR-14005-P/NP will be revised as indicated in the Attachment 1 and the Attachment 2.

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6.0 DESIGN FEATURES AND PROGRAMS TO ADDRESS BDBEE

This chapter compiles design enhancements and programs that are incorporated into the APR1400 design to cope with the lessons learned from the accidents at TEPCO's Fukushima Dai-ichi Nuclear Power Station, and satisfy the requirements/recommendations issued after the disaster by the U.S. NRC. Design features and program descriptions, design basis, and compliance with NRC recommendations are described herein.

6.1 Overall Description

- On-Site and Off-Site FLEX equipment are summarized in Table 6-3 and Table 6-4, respectively, with cross references to the DCD.

The following is the overall description:

- Fukushima issues are described in DCD Chapter 19.3.
- Compliance with NRC guidance is described in DCD Tier 2, Section 1.9.
- COL information is described in DCD Chapter 19.3.
- Connection points for FLEX equipment are incorporated in the system figures along with Table 6-1, which identifies the external connection components.

6.2 Specific Design Enhancements and Programs

6.2.1 Beyond Design Basis Seismic and Flood Protection

BDB seismic and flood protection is a COL item.

6.2.2 Primary Side FLEX Pump(s) and Connections

6.2.2.1 Design Description

One primary side FLEX pump connection has been provided into the SIS, downstream of the safety injection pump (SIP) no. 1 discharge line connection to the direct vessel injection (DVI) nozzle on the reactor vessel (RV) in the RCS, as shown in Figure 6-1. The primary side FLEX pump connection can be used by the high-head or low-head FLEX pump, depending on their necessity. The primary side high-head FLEX pump suction is the IRWST, while the low-head FLEX pump suction is the RWT. The connector size to the hose screw connector upstream of the primary FLEX pump suction is designed as 6.35 cm (2.5 in) diameter in accordance with the fire industry standard, while the primary FLEX pump suction line is designed as 10.16 cm (4 in) diameter. The connection for FLEX pump will not introduce new failure during normal plant operation by keeping the RCS pressure boundary through manual isolation (Safety Class 1) and blind flange.

6.2.2.2 Design Basis

The IRWST is used as the water source for the ACP, and the primary side high-head FLEX pump. The water volume required for RCS inventory makeup during Phase 2 is approximately 643.52 m³ (170,000 gal). The onsite water sources are sufficient to maintaining the plant in hot standby or hot shutdown condition for 2 weeks without considering consumption for the SFP cooling.

The primary side high-head FLEX pump is designed to supply 189.25 L/min (50 gpm) constantly, regardless of RCS pressure, in order to maintain the RCS inventory and remain in the hot shutdown condition, if the event occurs during full-power operation or lower mode of operation with SGs available. Alternatively, the low-head FLEX pump is designed to have a TDH of 160.02 m (525 ft) (17 kg/cm² A [243

Table 6-1 (2 of 2)

Component	DCD Chapter and/or Section	Function
V2204A	Figure 9.5.4-1	Diesel fuel oil supply line to primary high-head pump isolation
V2204B	Figure 9.5.4-1	Diesel fuel oil supply line to primary high-head pump isolation
V2204C	Figure 9.5.4-1	Diesel fuel oil supply line to primary high-head pump isolation
V2204D	Figure 9.5.4-1	Diesel fuel oil supply line to primary high-head pump isolation
V2205A	Figure 9.5.4-1	Diesel fuel oil supply line to primary low-head pump isolation
V2205B	Figure 9.5.4-1	Diesel fuel oil supply line to primary low-head pump isolation
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V2205D	Figure 9.5.4-1	Diesel fuel oil supply line to primary low-head pump isolation
V2203C	Figure 9.5.4-1	Diesel fuel oil supply line to AF FLEX pump isolation
V2203D	Figure 9.5.4-1	Diesel fuel oil supply line to AF FLEX pump isolation
V2206A	Figure 9.5.4-1	Diesel fuel oil supply line to SFP pump isolation
V2206B	Figure 9.5.4-1	Diesel fuel oil supply line to SFP pump isolation
V2207A	Figure 9.5.4-1	Diesel fuel oil supply line to SFP spray pump isolation
V2207B	Figure 9.5.4-1	Diesel fuel oil supply line to SFP spray pump isolation
Circuit Breaker of Class 1E 4.16 kV Switchgear 01A (1-823-E-SW01A)	Figure 8.1-1 (1 of 2)	Provision for connecting to 4.16 kV mobile generator
Circuit Breaker of Class 1E 4.16 kV Switchgear 01B (1-823-E-SW01B)	Figure 8.1-1 (2 of 2)	Provision for connecting to 4.16 kV mobile generator
Circuit Breaker of Class 1E 480 V Load Center 01A (1-825-E-LC01A)	Figure 8.1-1 (1 of 2)	Provision for connecting to 480V mobile generator
Circuit Breaker of Class 1E 480 V Load Center 01B (1-825-E-LC01B)	Figure 8.1-1 (2 of 2)	Provision for connecting to 480V mobile generator
Battery	9.5.2.1	The communication systems are powered from one of the two dedicated 16-hour-rated non-safety-related batteries (normal and standby) in case of either AAC GTG failure during a LOOP or SBO condition.

Insert "A".

A (1/3)

Table 6-3 (1 of 2)

List of on-site FLEX Equipment for BDBEE

Item No	Description	Quantity	Interface Design parameters ^(Note)	Functional Requirements	Reference
1	Primary side high-head FLEX pump	Two (2)	<ul style="list-style-type: none"> • Diesel driven • Flowrate: 189.25 L/min (50 gpm) • Operating Pressure: 105.46 kg/cm²A (1,500 psia) • Water Source: IRWST 	Supply makeup water to RCS when ACP is not available.	DCD Tier 2 Subsection 19.3.2.3.1.1 TeR Sections 5.1.2.3.1.2.2 & 6.2.2.2
2	Primary side low-head FLEX pump	Two (2)	<ul style="list-style-type: none"> • Diesel driven • Flowrate: 2,839 L/min (750 gpm) • TDH: 160 m (525 ft) • Water Source: RWT 	Supply makeup water to RCS during Phase 2 when SGs are not available.	DCD Tier 2 Subsection 19.3.2.3.1.2 TeR Sections 5.1.2.3.3.2 & 6.2.2.2
3	Secondary side FLEX pump	Three (3)	<ul style="list-style-type: none"> • Diesel driven • Flowrate: 1,174 L/min (310 gpm) • TDH: 160 m (525 ft) • Water Source: AFWST and RWT 	Supply cooling water to SGs when TDAFWP is not available.	DCD Tier 2 Subsection 19.3.2.3.1.1 TeR Sections 5.1.2.3.1.2.2 & 6.2.5.2
4	SFP Makeup FLEX pump	One (1)	<ul style="list-style-type: none"> • Diesel driven • Flowrate: 1,893 L/min (500 gpm) • Discharge Pressure: 32 m (105 ft) • Water Source: RWT 	Supply makeup water to SFP.	DCD Tier 2 Subsection 19.3.2.3.2 TeR Sections 5.1.2.4.1.2 & 6.2.3.2

A (2/3)

Table 6-3 (2 of 2)

Item No	Description	Quantity	Interface Design parameters ^(Note)	Functional Requirements	Reference
5	SFP Spray FLEX pump	One (1)	<ul style="list-style-type: none"> • Diesel driven • Flowrate: 757 L/min (200 gpm) • Discharge Pressure: 32.6 m (107 ft) • Water Source: RWT 	Supply makeup water to SFP.	DCD Tier 2 Subsection 19.3.2.3.2 TeR Sections 5.1.2.4.1.2 & 6.2.3.2
6	ECSBS FLEX Pump	One (1)	<ul style="list-style-type: none"> • Diesel driven • Flowrate: 2,839 L/min (750 gpm) • Discharge Pressure: 200 m (656 ft) • Water Source: RWT 	Supply water to containment atmosphere to prevent containment overpressurization during low mode operation.	DCD Tier 2 Subsection 19.3.2.3.3 TeR Sections 5.1.2.5
7	480 V mobile GTG	Two (2)	1000 kW each	Supply power to 480 V load center, motor control center, and 125 Vdc battery charger via 480 V Class 1E power system Train A or B during Phase 2.	DCD Tier 2 Subsection 19.3.2.3.1.1 TeR Sections 5.1.2.6.1.1, 6.2.6, and Table 5-5

A (3/3)

Table 6-4

List of off-site FLEX Equipment for BDBEE

Item No	Description	Quantity	Interface Design parameters	Functional Requirements	Reference
1	4.16 kV mobile GTG	One (1)	5,000 kw	Supply power to 4.16 kV switchgear and etc., and restore Train A or B of the 4.16 kV Class 1E power system during Phase 3.	DCD Tier 2 Subsection 19.3.2.3.1.1 TeR Sections 5.1.2.6.1.1, 6.2.6, and Table 5-5

APR1400 DCD TIER 2

RAI 354-8416 - Question 19.03-12

RAI 333-8397 - Question 19.03-9

Table 1.8-2 (29 of 29)

Item No.	Description
COL 19.3(1)	The COL applicant is to perform site-specific seismic hazard evaluation and seismic risk evaluation as applicable in accordance with NTTF Recommendation 2.1 as outlined in the NRC RFI.
COL 19.3(2)	The COL applicant is to address the flood requirements for wet sites
COL 19.3(3)	The COL applicant is to develop the details for offsite resources.
COL 19.3(4)	The COL applicant is to address the details of storage location for FLEX equipment.
COL 19.3(5)	The COL applicant is to address site-specific strategies to mitigate BDBEES as specified in the NRC Order EA-12-049.
COL 19.3(6)	The COL applicant is to address SFP level instrumentation maintenance procedure development and perform training as specified in NRC Order EA-12
COL 19.3(7)	The COL applicant is to address development of EOPs, SAMGs, and EDMGs that incorporate lessons learned from TEPCO's Fukushima Dai-Ichi nuclear power plant accident as addressed in SECY-12-0025.
COL 19.3(8)	The COL applicant is to address enhancement of the offsite communication system as specified in the NRC Request for Information pertaining to NTTF Recommendation 9.3.
COL 19.3(9)	The COL applicant is to address staffing for large-scale natural events as specified in the NRC RFI pertaining to NTTF Recommendation 9.3.

selecting suitable storage locations for FLEX equipment that provide reasonable protection during specific external events as provided in NEI 12-06 guidance Section 5 through 9.

, and the details of the guidance for storage of FLEX equipment provided in the Technical Report (Reference 5) Section 6.2.9.

APR1400 DCD TIER 2

RAI 354-8416 - Question 19.03-12

RAI 333-8397 - Question 19.03-9

COL applicant is to address details of ~~the storage location for FLEX equipment~~ (COL 19.3(4)).

selecting suitable storage locations for FLEX equipment that provide reasonable protection during specific external events as provided in NEI 12-06 guidance Section 5 through 9.

Also, the COL applicant is to address site-specific strategies to mitigate BDBEEs as specified in NRC Order EA-12-049 (COL 19.3(5)), including but not limited to the following:

- a. Evaluation of site-specific external hazards
- b. Determination and protection of portable equipment
- c. Providing means for acquisition, staging, and installation of equipment
- d. Establishing means for maintaining and testing of portable equipment
- e. Establishing procedures and guidance on mitigation of BDBEEs
- f. Establishing training of personnel to the developed strategies and procedures

, and the details of the guidance for storage of FLEX equipment provided in the Technical Report (Reference 5) Section 6.2.9.

19.3.2.4 Recommendation 7.1 – Reliable Spent Fuel Pool Instrumentation

The APR1400 employs reliable indication of the water level in the SFP capable of supporting identification of the following pool water level conditions:

- a. Level that is adequate to support operation of the normal fuel pool cooling system
- b. Level that is adequate to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck
- c. Level at which fuel remains covered and actions to implement makeup water addition should no longer be deferred

The APR1400 SFP water level instrumentation is consistent with the guidelines addressed in NRC EA-12-051, NEI 12-02 (Reference 8), and JLD-ISG-2012-03 (Reference 9).

The primary instrument channel provides level indication through the use of guided wave radar (GWR) technology using the principle of time domain reflectometry (TDR).

APR1400 DCD TIER 2

RAI 354-8416 - Question 19.03-12

RAI 333-8397 - Question 19.03-9

- COL 19.3(3) The COL applicant is to develop the details for offsite resources.
- COL 19.3(4) The COL applicant is to address the details of ~~storage location for FLEX equipment.~~
- COL 19.3(5) The COL applicant is to address the details of ~~storage location for FLEX equipment.~~ selecting suitable storage locations for FLEX equipment that provide reasonable protection during specific external events as provided in NEI 12-06 guidance Section 5 through 9.
- COL 19.3(6) The COL applicant is to address SFP level instrumentation maintenance procedure development and perform training as specified in NRC Order EA-12-051. , and the details of the guidance for storage of FLEX equipment provided in the Technical Report (Reference 5) Section 6.2.9.
- COL 19.3(7) The COL applicant is to address development of EOPs, SAMGs, and EDMGs that incorporate lessons learned from TEPCO's Fukushima Dai-ichi nuclear power plant accident as addressed in SECY-12-0025.
- COL 19.3(8) The COL applicant is to address enhancement of the offsite communication system as specified in the NRC Request for Information pertaining to NTTF Recommendation 9.3.
- COL 19.3(9) The COL applicant is to address staffing for large-scale natural events as specified in the NRC RFI pertaining to NTTF Recommendation 9.3.

19.3.5 References

1. SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," U.S. Nuclear Regulatory Commission, February 2012.
2. Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," U.S. Nuclear Regulatory Commission, March 12, 2012.
3. Order EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," U.S. Nuclear Regulatory Commission, March 12, 2012.

6.2.8 Emergency Procedures

The emergency communication system/enhancement, staffing large-scale natural events, and revisions to EP for ELAP are COL items.

6.2.9 Storage of FLEX Equipment

~~In accordance with NEI 12-06 (Reference 8), the FLEX equipment is stored in dedicated building/structure that will withstand the BDBEs and meet the requirements of 10 CFR 50, Appendix A, GDC 2. The N+1 equipment is stored in separate buildings.~~

← Insert "A".

A (1/2)

The COL applicant is responsible for addressing the details of the following guidance for the storage and deployment of the FLEX equipment:

1. The FLEX equipment is stored in dedicated buildings/structures that will provide reasonable accessibility and withstand the BDBEEs and meet the requirements of 10 CFR 50, Appendix A, GDC 2. The N+1 equipment is stored in separate buildings.
2. Suitable storage locations that provide reasonable protection during specific external events are selected in accordance with guidance provided in NEI 12-06 (Reference 8) Section 5 through 9.
3. A technical basis should be established for the storage for the FLEX equipment that provides the inputs, assumptions, and documented basis that the mitigation strategy and support equipment will be reasonably protected from applicable external events such that the equipment could be operated in place, if applicable, or moved to its deployment locations. This basis should be auditable, consistent with generally accepted engineering principles, and controlled within the configuration document control system.
4. The FLEX equipment should be stored in storage locations chosen for the equipment that provide protection from external events as necessary to allow the equipment to perform its function without loss of capability such that no one external event can reasonably fail the site FLEX capability.
5. Storage locations must include considerations of a suitable and convenient means to bring the equipment to the connection points in time to initiate the strategy prior to expiration of the estimated capabilities to maintain core and spent fuel pool cooling, and containment functions in the initial response phase. Consideration should be given to the transport from the storage areas following the external event, recognizing that external events can result in obstacles restricting normal pathways for movement.
6. If the FLEX equipment is pre-staged such that it minimizes the time delay and burden of hook-up following an external event, then the equipment should be evaluated to not have an adverse effect on existing SSCs and the primary connection point should be as close to the intended point of supply as possible.
7. The FLEX equipment should be stored and maintained in a manner that is consistent with assuring that it does not degrade over long periods of storage and that it is accessible for periodic maintenance and testing.
8. If 50.54(hh)(2) equipment is credited in the FLEX mitigating strategies, it should meet the above storage requirements in addition to the 50.54(hh)(2) requirements.

A (2/2)

9. Storage of debris removal equipment (if needed) should provide reasonably protection from the applicable external events such that it remains functional and deployable to clear obstructions from the pathway between the FLEX equipment's storage location and its deployment location(s).
10. Deployment of the FLEX equipment or debris removal equipment from storage locations should not depend on offsite power or onsite emergency ac power (e.g., to operate roll up doors, lifts, elevators, etc.).