
REVISED 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.: 140-8139
SRP Section: 09.05.01 – Fire Protection Program
Application Section: 09.05.01
Date of RAI Issue: 08/07/2015

Question No. 09.05.01-32

GDC3, “Fire Protection,” states, in part, that “[s]tructures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions.

Regulatory Guide 1.189, “Fire Protection for Nuclear Power Plants,” Section 7.4, “Diesel Fuel Oil Storage Areas,” states that diesel fuel oil tanks with a capacity greater than 4,164 L (1,100 gal) should not be located inside buildings containing equipment important to safety.

DCD Tier 2, Table 9.5.1-1, “Fire Protection Program Conformance with NRC RG 1.189,” sheet (31 of 34) item 7.4, “Diesel Fuel Oil Storage Areas,” states that the APR1400 design conforms with the requirement that “diesel fuel oil tanks with a capacity greater than 4,164 L (1,100 gal) should not be located inside buildings containing equipment important to safety.”

DCD Tier 2, Table 9.5.1-2, “APR1400 Fire Protection Program Conformance with NFPA 804,” sheet (66 of 70) item 10.10, “Diesel Fuel Storage and Transfer Areas,” states that the APR1400 design conforms with the NFPA 804 requirement that “diesel fuel oil storage tanks shall not be located inside buildings containing other nuclear safety-related equipment.”

However, in DCD Tier 2, Section 9.5.4, “Emergency Diesel Engine Fuel Oil System (EDEFOS),” the applicant states that “[t]he emergency diesel engine fuel oil system EDEFOS has four diesel fuel storage structures, two in the auxiliary building (AB) ...” DCD Tier 2, Table 9.5.4-1,

“Emergency Diesel Engine Fuel Oil System Component Data,” indicates that each emergency diesel fuel oil storage tank has a capacity of 96,000 gallons.

The staff finds the above assertions contradictory since the auxiliary building houses safety-related equipment required to provide safe shutdown capability.

The applicant is requested to reconcile the above noted discrepancies. If applicable, the applicant is requested to provide justification for having two emergency diesel fuel oil system

storage tanks, each with a capacity greater than 1100 gallons, located inside a building that houses safety-related equipment required to provide safe shutdown capability.

Response - (Rev. 1)

The APR1400 consists of four emergency diesel generators (EDGs). Two EDGs are located in the emergency diesel generator building (EDGB) adjacent to the auxiliary building (AB) as shown on DCD Tier 2, Figure 1.2-1. The other two EDGs are installed in separate compartments located on opposite sides of the AB as shown on DCD Tier 2, Figure 1.2-13.

Each EDG area in the AB contains one EDG and one diesel fuel oil day tank (less than 1,100gal) as shown on DCD Tier 2, Figure 1.2-15 and 1.2-20, respectively. Since the capacity of each diesel fuel oil day tank located in the AB is less than 1,100 gal, the APR1400 design conforms to the Section 7.4 of NRC RG 1.189 as described in DCD Tier 2, Table 9.5.1-1 (31 of 34) item 7.4.

The emergency diesel engine fuel oil system (EDEFOS) has four diesel fuel storage vaults, which are designed for aboveground tanks in accordance with NFPA 30. Two vaults are in the AB and the other two vaults are in diesel fuel oil tank (DFOT) building. Each diesel fuel storage tank is installed in the separated, reinforced, missile-protected vaults of the AB and the DFOT building El. 63'-0" as shown on DCD Tier 2, Figure 1.2-20. Although vaults of two trains of EDEFOS are built on the same building foundation in the AB, the fire protection features to provide prevention of fire propagation and confinement of fire within a fire area affected are ensured the same level of fire barrier capabilities that these are separated from the AB. In addition, since the access points to enter the vaults are located outside of the AB, there is no direct connection between these vaults and the AB. Thick walls (four feet) separate these vaults from other areas of the AB which house safety-related equipment required to provide safe shutdown capability. Penetrations are minimized and sealed. The penetration between the vaults and the AB is only for diesel fuel oil piping from the diesel fuel oil transfer pump to the diesel fuel oil day tank in train C and D, respectively. Also, the vault of each building is separated into an oil storage bay and an equipment area containing diesel fuel oil transfer pumps by a wall to the height of oil spill upon tank rupture. Each vault has a dedicated HVAC system that is not interfaced with the AB as described in DCD Tier 2, Subsection 9.4.5.2.1.3.

Each EDEFOS is located in a seismic category I structure, which provides protection from the effects of natural phenomena and missiles. The areas containing the diesel fuel storage tanks are separated by 3-hour rated fire barriers from the AB and the EDGB. The locations of these structures are shown in DCD, Tier 2, Figure 1.2-10, 1.2-13, and 1.2-20. Also, these areas do not contain equipment important to safety.

Therefore, the APR1400 design conforms to the Section 7.4 of NRC RG 1.189 and Section 10.10 of NFPA 804 as described in DCD Tier 2, Table 9.5.1-1 (31 of 34) item 7.4 and Table 9.5.1-2 (66 of 70) item 10.10, respectively. DCD Tier 2, Table 9.5.1-1 and 9.5.1-2 will be revised.

DCD Tier 2, Subsection 9.5.4.2.1 will be revised as follows:

Current description : The EDEFOS has four diesel fuel storage structures, two in the auxiliary building (AB) and the other two in emergency diesel generator building (EDGB). The EDEFOS is located in a seismic

Category I building, which provides protection from the effects of natural phenomena and missiles.

Revised description : The [four trains of EDEFOS are located in](#) four diesel fuel storage vaults, two in the auxiliary building (AB) and the other two [in the diesel fuel oil tank building. The diesel fuel storage vaults are designed as seismic Category I](#), which provides protection from the effects of natural phenomena and missiles. Each diesel fuel storage vault is separated by 3-hour rated fire barriers from the AB and the [emergency diesel generator building \(EDGB\)](#), respectively.

Impact on DCD

DCD Tier 2, page 9.5-43, [Table 9.5.1-1](#), and [Table 9.5.1-2](#) will be revised as indicated on the attached markup.

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.

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- h. The EDEFOS is designed to be capable of detecting and controlling system leakage by putting appropriate monitors and confining fuel oil leaks and spills in and around the system, components and structures.
- i. The EDEFOS is capable of being filled with fuel oil from an external source within 7 days following a DBA, without interruption of diesel engine operations.

9.5.4.2 System Description9.5.4.2.1 General Description

Each diesel fuel storage structure is separated by 3-hour rated fire barriers from the AB and the EDGB, respectively.

The EDEFOS is shown in Figure 9.5.4-1. The system is intended to operate during and after a DBA and is designated as safety Class 3, seismic Category I, and electrical Class 1E. The EDEFOS and components conform with the requirements of NFPA 30 (Reference 53) and 37 (Reference 54) for fire protection.

~~beside~~ The EDEFOS has four diesel fuel storage structures, two in the auxiliary building (AB) and the other two in emergency diesel generator building (EDGB). The EDEFOS is located in a seismic Category I building, which provides protection from the effects of natural phenomena and missiles.

~~Each diesel fuel storage structure is a reinforced, missile-protected underground vault separated into an oil storage bay and an equipment area. The oil storage bay is separated from the equipment area by 3-hour rated fire barriers to the height of oil spill upon tank rupture. The oil storage bay contains a diesel fuel oil storage tank and necessary piping.~~

~~The diesel fuel storage structure is designed to allow personnel access for maintenance, inspection, and testing of components located within the structure during various modes of plant operation.~~

Each diesel fuel oil storage tank has a fill connection with a locking cap that is locked to prevent entry of moisture. The fill connection terminates in a box allowing replenishment of diesel fuel from outside supply sources without stopping operation of diesel generators. The fill connection is located above flood level to prevent floodwater from entering the EDEFOS.

The vault of each building is a reinforced, missile protected, and separated into an oil storage bay and an equipment area.

"A"

The four trains of EDEFOS are located in four diesel fuel storage vaults, two in the auxiliary building (AB) and the other two in the diesel fuel oil tank building. The diesel fuel storage vaults are designed as seismic Category I, which provides protection from the effects of natural phenomena and missiles. Each diesel fuel storage vault is separated by 3-hour rated fire barriers from the AB and the emergency diesel generator building (EDGB), respectively.

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There are two motor-driven fuel oil transfer pumps for each EDG set and each pump is capable of transferring oil from the diesel fuel oil storage tank to its corresponding day tank at sufficient pressure and flow to cover the maximum demand. The fuel oil transfer pumps take suction from the fuel oil storage tanks through duplex fuel oil strainers, and they are located in the fuel oil storage tank ~~structure~~ in such a way that sufficient net positive suction head (NPSH) is available under all design conditions, including a pump runout.

vault

9.5.4.2.2 Component Description

9.5.4.2.2.1 Diesel Fuel Oil Storage Tanks

Each diesel fuel oil storage tank is designed for a 7-day supply to its associated EDG, without relying on the associated fuel oil day tank inventory, plus a margin for periodic testing of the associated EDG. The diesel fuel oil storage tanks are designed and fabricated in accordance with ASME Section III (Reference 49).

Fittings are provided for tank level instrumentation, venting, sampling, and water removal. Flanged openings are provided as manholes for access to the tank interior and the tank bottom is constructed so that a low-point sump exists for collection and drainage of any water or sediment that may be present.

vault

Each diesel fuel oil storage tank is located inside a concrete ~~structure~~ to contain oil spills, and it is equipped with a vent line with a flame arrester and a level transmitter. A sufficient space around each diesel fuel oil storage tank is provided for inspection, maintenance, and repair of the system.

Each diesel fuel oil storage tank has a fill connection with a locked-closed isolation valve and is capped and locked to prevent entry of moisture. The fill connection is to allow replenishment of fuel from an outside supply source without interrupting operation of the EDG. The fuel oil storage tank fill connection is located above flood level to prevent flood water from entering the EDEFOS.

The sample connection is capped and locked to prevent entry of moisture. Access is provided for taking oil samples, venting of the diesel fuel oil storage tank when being filled, and maintaining a simplex strainer associated with the fill line.

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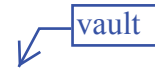
An emergency fill connection is provided in each train to allow diesel fuel oil to be pumped directly from truck into the diesel fuel oil day tank, bypassing the diesel fuel oil storage tank and the diesel fuel oil transfer pumps.

In the event that the operating transfer pump fails to stop at day tank “high” level, the flow rate delivered by the transfer pump is greater than the fuel consumption rate of the diesel generator, so that the surplus diesel fuel oil is returned to the diesel fuel oil storage tank by gravity through a day tank overflow line.



9.5.4.4 Safety Evaluation

With the exception of the fill and vent connections, the EDEFOS is located inside the EDGB and AB.

- a. The EDEFOS consists of four redundant and independent trains. The trains are physically and electrically separated so that any sharing of systems or components important to safety does not exist. This provides reasonable assurance that even if a single active failure occurs in a train, it does not prevent other systems or components in other trains from performing their intended safety functions.
- b. The safety-related portions of the EDEFOS are designed to remain functional after an SSE. They are powered from Class 1E sources. In the event that a station blackout (SBO) takes place, all ac powers are out at the plant, including Class 1E emergency power generated by emergency diesel generators, and the EDEFOS is also shut down. To cope with this situation, a non-Class 1E AAC GTG is provided as a standby power source and used to meet the load requirements for coping with SBO.
- c. Portions of the EDEFOS outward from the fuel oil storage ~~structures~~ are designed to withstand the effects of manmade mistakes and natural phenomena. The fuel oil storage tanks and day tanks have one fill line and one vent line that are exposed to the outside air, respectively. The design considers sufficient features and administrative controls to be taken on these lines to protect against possible damage from vehicles, tornadoes, hurricanes, tsunamis, missiles, floods, extreme cold temperatures, and accidental contaminations.



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- d. The fill and sample lines of fuel oil storage tanks are locked-closed with isolation valves, and their connections are capped and locked to prevent entry of moisture. The fuel oil storage tanks are vented to atmosphere, and the end of the vent lines is placed at an elevation higher than the maximum flood level.
- e. The vent lines of fuel oil storage tanks and day tanks are fitted with a flame arrester to protect the tanks from an external open fire. The end of the goose-necked vent is covered with a fine-meshed screen to prevent insects and debris from entering the vent. The seismic Category I portions of EDEFOS fuel oil piping, located between the diesel fuel storage ~~structure~~ and the AB and EDGB, are routed in concrete pipe chases to prepare for any possible contamination arising from fuel oil leakage, and a protective coating is applied to the fuel oil storage tanks and day tanks to avoid any corrosion. 
- f. The capacity of each fuel oil storage tank is sufficient for at least 7 days of EDG operation at its continuous rating.
- g. An overflow line is mounted on each fuel oil storage tank, and this overflow line has a valve that is normally closed, except for during filling operations, when it is open. In addition, a level indicator is located near the fill connection to permit the operator to monitor tank levels during filling operations. This provides reasonable assurance that fuel oil does not flow out of the tanks during filling operations.
- h. Prior to adding or refilling fuel oil to fuel oil storage tanks, the fuel oil storage ~~structures~~ are heated up and maintained at a suitable temperature above the cloud point of fuel oil. The heatup is done by using electric unit heaters, and the overall maintenance process is described in the fuel oil program. 
- i. Each train is provided with an emergency fill connection to allow fuel oil to be directly pumped from an outside fuel source into the day tank, bypassing the fuel oil storage tank and transfer pump.

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Table 9.5.1-1 (31 of 34)

Position Number	Regulatory Position	Conformance	Remarks
7.2.2 Hydrogen System	Turbine generators may use hydrogen for cooling. Hydrogen storage and distribution systems should meet the guidelines in Regulatory Position 7.5 of this guide [NRC RG 1.189].	Conform	
7.2.3 Smoke Control	Smoke control should be provided in the turbine building to mitigate potential heavy smoke conditions associated with combustible liquid and cable fires. Regulatory Position 4.1.4 provides specific guidance.	Conform	Turbine building roof is used for smoke vents.
7.3 Station Transformers	Transformers installed inside fire areas containing systems important to safety should be of the dry type or insulated and cooled with noncombustible liquid. Transformers filled with combustible fluid that are located indoors should be enclosed in a transformer vault. NFPA 70 offers additional guidance. Outdoor oil-filled transformers should have oil spill confinement features or drainage away from the buildings. Such transformers should be located at least 15.2 m (50 ft) distant from the building, or building walls within 15.2 m (50 ft) of oil-filled transformers should be without openings and have a fire-resistance rating of at least 3 hours.	Conform for transformers located indoors. Outdoor transformers to be addressed by the COLA.	COL Item 9.5(2)
7.4 Diesel Fuel Oil Storage Areas	Diesel fuel oil tanks with a capacity greater than 4,164 L (1,100 gal) should not be located inside buildings containing equipment important to safety. If aboveground tanks are used, they should be located at least 15.2 m (50 ft) from any building containing equipment important to safety, or if located within 15.2 m (50 ft), they should be housed in a separate building constructed with materials having a minimum fire-resistance rating of 3 hours. Potential oil spills should be confined or directed away from buildings containing equipment important to safety. Totally buried tanks are acceptable outside or under buildings. (See NFPA 30 for additional guidance.)	Conform	Diesel fuel oil tanks are located in a diesel fuel oil structure, which has reinforced, missile-protected underground vaults separated by 3-hour fire-rated barriers.
7.5 Flammable Gas Storage and Distribution	Bulk gas storage (either compressed or cryogenic) should not be permitted inside structures housing equipment important to safety. Storage of flammable gas such as hydrogen should be located outdoors or in separate, detached buildings so that a fire or explosion will not adversely affect any systems or equipment important to safety.	Conform / COL	COL Item 9.5(2)

The capacity of each diesel fuel oil day tank located inside buildings is less than 4,164L (1,100 gal). Diesel fuel oil storage tanks (greater than 4,164L (1,100 gal)) are located in the separated vaults, which do not contain equipment important to safety.

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Table 9.5.1-2 (66 of 70)

Diesel fuel oil storage tanks are located in the separated vaults, which do not contain other nuclear safety-related equipment.

Paragraph	Standard Requirement	Conformance	Remarks
10.9 Standby Emergency Diesel Generators and Combustion Turbines (cont.)	5 A day tank shall be permitted in standby emergency diesel generator and combustion turbine rooms if the day tank is located in a diked enclosure that has sufficient capacity to hold 110 percent of the contents of the day tank or is drained to a safe location.		
10.10 Diesel Fuel Storage and Transfer Areas	<p>1* Diesel fuel oil storage tanks shall not be located inside buildings containing other nuclear safety-related equipment, and the following criteria also shall apply:</p> <p>(1) If aboveground tanks are used, they shall be located at least 50 ft (15.2 m) from any building, or if within 50 ft (15.2 m), they shall be separated from the building by a fire barrier having a minimum 3-hour rating.</p> <p>(2) Potential oil spills shall be confined or directed away from buildings containing safety-related equipment.</p> <p>2 Aboveground tanks shall be provided with automatic fire suppression systems.</p>	<p>Conform</p> <p>N/A</p>	<p>The APR1400 design does not have aboveground diesel fuel oil storage tanks.</p>
10.11 Nuclear Safety-Related Pump Rooms	<p>Nuclear safety-related pump rooms shall be protected by fire detection systems, and the following criteria also shall apply:</p> <p>(1) Automatic fire suppression systems shall be provided unless the fire hazards analysis determines that fire suppression is not required.</p> <p>(2) Fire hose stations and fire extinguishers shall be readily accessible.</p>	Conform	Refer to Appendix 9.5A.
10.12 New-Fuel Area	<p>1 Fire extinguishers shall be located within the new-fuel area, and the following criteria also shall be met:</p> <p>(1) Fire hose stations shall be located as determined by the fire hazards analysis to facilitate access and use for fire-fighting operations.</p> <p>(2) Fire detection systems shall be provided.</p> <p>(3) Combustible material shall be limited to the minimum necessary for operation in the new-fuel area.</p>	Conform	Refer to Appendix 9.5A.