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.:	**242-8276**
SRP Section:	**11.04 – Solid Waste Management System**
Application Section:	**11.4**
Date of RAI Issue:	**10/14/2015**

Question No. 11.04-3

10 CFR 50.34a relates to identifying and providing adequate design information on the expected generation rates of waste, and subsequent storage of the waste in the temporary waste storage area.

GDC 60 relates to having the necessary provisions to handle radioactive wastes produced during normal reactor operation.

In DCD section 11.4.2 the applicant states the following:

> "The temporary waste storage area is sized to accommodate the number of drums and HICs generated in a 6-month period of normal operation. The expected and maximum generation volumes, and their shipped volumes, are summarized and presented in Table 11.4-1."

Staff is requesting that the applicant provide the necessary information to verify the statement made in DCD section 11.4.2. Staff is requesting that the applicant provide the necessary information to verify the statement made in DCD section 11.4.2. The NRC staff would like references to plant drawings that contain the necessary information to confirm the expected area for temporary storage within the DCD, and to provide the surface area that would be utilized to store waste in the temporary storage area. NRC staff is also requesting the expected generation rate and maximum generation rate for dry active waste that would be stored in the low-level temporary waste storage area, as is described in section 11.4.2.1.1

Please address the items above and provide a mark-up on the proposed DCD changes.

Response-Rev.1

The plant drawing showing the temporary storage area is provided in DCD Tier 2, Figure 1.2-27 "General Arrangement Compound Building EL 100′-0″". The temporary storage area provides

six (6) months of waste storage with sufficient margin and is divided into two areas, the high activity waste area and the low activity waste storage area.

- The high activity waste storage area is designed with about 49 square meters of space to store 200 liter drums for spent filters and 1,400 liter capacity HICs for spent resin generated during a six month period. The actual storage area considering crane governing area is around 26 square meters of space, which can store up to sixteen HICs with a 2 x 4 arrangement with stacking assuming a 2 inch clearance between HICs with a diameter of 1.42 meters and store up to twenty 200L drums with a 5 x 4 arrangement without stacking assuming a 2 inch clearance between 200 L drums with a diameter of 0.6 meter. The storage area has the capacity with sufficient margin for storing two 200 liter drums for spent filters and seven 1,400 liter capacity HICs for spent resin generated during a six month period.

- The low activity storage area is designed with about 94 square meters of space for storing waste drums including dry active waste (DAW). The actual storage area is about 55 square meters, which can store up to 326 drums with a 13 x 10 arrangement with stacking assuming 2 inch clearance between 200 L drums of diameter 0.6 meter. The storage area has the capacity with sufficient margins for storing 290 drums of DAW, R/O concentrates, and R/O membranes generated during a six month period.

The waste generation volumes or shipped waste volumes are the average and the greatest volume after waste processing and are listed in DCD Tier 2 Table 11.4-1. The volumes have been estimated from ten years of operation data from the 1,000 MWe Korean NPP as indicated in DCD Tier 2 Table 11.4-1, footnote (1). The reference NPP has processed DAW with the similar methods applied in APR1400 DAW treatment such as sorting, segregation, and compaction, as described in DCD Tier 2 subsection 11.4.2.

DCD Tier 2, Section 11.4.2, 11.4.9 and Table 1.8-2 will be updated to add the COL item, which is to describe what to do with generated waste that exceeds the shipment amounts.

The expected generation rate and maximum generation rate for DAW may be calculated from the above shipped waste volume by the ratio of compressible waste, the volume reduction factor of compactor for compressible waste, and packaging efficiency.

The ratio of compressible waste and the volume reduction factor of the compactor can be determined according to IAEA-TECDOC-1492. IAEA-TECDOC-1492 states that the typical generated compressible DAW has the range of 20% to 60% for dry solid waste and the compactors typically have a volume reduction factor ranging from 2 to 6. Based on this reference, it is assumed that 60% of compressible DAW is conservatively generated and volume reduction factor of the compactor is 3 in the estimation of the waste generation rate. In addition, the packaging efficiency of 90% is considered as described in Table 11.4-1. The calculation result of expected and maximum generation rate is as follows;

- Expected Waste Generation Volume

  $W_{shipped} = \{(W_{generation} \times 0.6 / 3) + (W_{generation} \times 0.4)\} / 0.9 = 50.19\ m^3/yr\text{-}unit$

  $W_{generation} = 75.29\ m^3/yr\text{-}unit$

Where,

$W_{generation}$ is expected generation rate

$W_{shipped}$ is expected shipped volume presented in DCD Tier 2, Table 11.4-1.

- Maximum Waste Generation Volume

$W_{shipped}$ = $\{(W_{generation} \times 0.6 / 3) + (W_{generation} \times 0.4)\} / 0.9 = 141.68\ m^3$/yr-unit

$W_{generation}$ = $212.52\ m^3$/yr-unit

Where,

$W_{generation}$ is maximum generation rate

$W_{shipped}$ is maximum shipped volume presented in DCD Tier 2, Table 11.4-1.

Even though the shipped waste volumes are considered to be more reliable than the waste generation rates and correlated with the generation rates as described above, DCD Tier 2 Table 11.4-1 will be updated to add the expected and maximum generation rate including a footnote describing the relationship between the shipped volumes and the generation rates for clarity.

Impact on DCD

DCD Tier 2, Table 11.4-1, Table 1.8-2, Section 11.4.2 and 11.4.9will be revised as indicated in 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.

Table 11.4-1

Estimated Annual Solid Waste Generation

(Unit: m^3/yr-unit)

Waste Stream		Expected Generation	Expected Shipped Volume(1)	Maximum Generation	Maximum Shipped Volume(1)	Waste Classification(2)
Spent Filter	High Activity	0.19	0.21	0.38	0.42	B
	Low Activity	0.15	0.17	0.29	0.32	A
Spent Resin	High Activity	2.72	-	5.43	-	B
	Low Activity	8.64	8.64	17.28	17.28	A
R/O Membrane		3.24	3.6	3.24	3.6	A
R/O Concentrate		4.2	4.2	12	12	A
Dry Active Waste		75.29(5)	50.19	212.52(5)	141.68	A
Total		-	67.01	-	175.30	-

(1) Shipped volume is estimated based upon the following:
- Spent filters are packed in a 200 L (55 gal) drum or HIC. Packing efficiency of 90% is considered.
- Spent resin is packed in HIC.
- High-activity spent resins generated from CVCS are stored in the spent resin long-term storage tank for 10 years. The high-activity spent resin will be shipped after sufficient decay.
- R/O membranes are packed in a 200 L (55 gal) drum. Packing efficiency of 90% is considered.
- Volume of DAWs is estimated using the 1000 MWe plant's average and maximum packaged volume during 10 years. The factor for the increment of electric power generation (1400/1000) is reflected.

(2) Waste classification per 10 CFR 61.55

(3) Generation of mixed waste is prevented and minimized by prohibiting use of hazardous material.

(4) GRS delay bed charcoal is expected to be essentially permanent.

(5) The expected generation rate and maximum generation rate for dry active waste has been conservatively estimated from the shipped waste volume assuming the compressible waste ratio of 60%, compactor volume reduction factor of 3 for compressible waste, and packing efficiency of 90%.

Concentrate waste generated from the R/O membrane separation process is dried by the concentrate treatment system, and then dried concentrate waste is packaged in a 200 L (55 gal) drum or HIC.

Temporary Waste Storage Subsystem

The temporary waste storage subsystem boundary starts at the receipt point of packaged waste from the SWMS subsystems and ends at the truck bay for shipment of waste to the onsite interim storage facility or offsite disposal facility.

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A shielded temporary waste storage area in the compound building is provided to facilitate the interim storage of higher-activity packaged wastes. The temporary waste storage area is sized to accommodate the number of drums and HICs generated in a 6-month period of normal operation. The expected and maximum generation volumes, and their shipped volumes, are summarized and presented in Table 11.4-1. This satisfies the 30-day criteria of ANSI/ANS-55.1 (Reference 14). The processing and temporary waste storage areas include a dedicated overhead crane with direct access to adjacent truck bays with sufficient overhead clearance to facilitate direct trailer loading of waste packages. Crane operation may be performed remotely with the aid of crane-mounted video cameras or locally to provide additional flexibility.

The COL applicant is to determine the number of shipment. If the generated waste exceeds the shipment amounts, the COL applicant is to provide details for how the extra generated waste that exceeds the shipment amounts will be handled. (COL(11.4(13))).

11.4.2.1 Dry Solid Waste

11.4.2.1.1 Dry Active Waste

Dry active waste (DAW) is classified as contaminated and non-contaminated waste at the point of generation by plant personnel. Contaminated waste is sent to a sorting and staging space provided in the SWMS area of the compound building to further sort DAW material for efficient packaging. Filtered hoods are provided to remove airborne contamination during the sorting of DAW.

DAW items such as rags, contaminated clothing, sweepings, and other items are compressed into a waste container by a solid waste compactor. During compactor operation, a fan is used to pull gases through the HEPA filter and exhaust them to the compound building HVAC system. When the container is full, it is manually sealed and

"A"

The plant drawing showing the temporary storage area is provided in Figure 1.2-27 “General Arrangement Compound Building EL 100'-0"”. The temporary storage area provides six (6) months of waste storage with sufficient margin and is divided into two areas, the high activity waste area and the low activity waste storage area.

- The high activity waste storage area is designed with about 49 square meters of space to store 200 liter drums for spent filters and 1,400 liter capacity HICs for spent resin generated during a six month period. The actual storage area considering crane governing area is around 26 square meters of space, which can store up to sixteen HICs with a 2 x 4 arrangement with stacking assuming a 2 inch clearance between HICs with a diameter of 1.42 meters and store up to twenty 200L drums with a 5 x 4 arrangement without stacking assuming a 2 inch clearance between 200 L drums with a diameter of 0.6 meter. The storage area has the capacity with sufficient margin for storing two 200 liter drums for spent filters and seven 1,400 liter capacity HICs for spent resin generated during a six month period.

- The low activity storage area is designed with about 94 square meters of space for storing waste drums including dry active waste (DAW). The actual storage area is about 55 square meters, which can store up to 326 drums with a 13 x 10 arrangement with stacking assuming 2 inch clearance between 200 L drums of diameter 0.6 meter. The storage area has the capacity with sufficient margins for storing 290 drums of DAW, R/O concentrates, and R/O membranes generated during a six month period.

The waste generation volumes or shipped waste volumes are the average and the greatest volume after waste processing and are listed in Table 11.4-1. The volumes have been estimated from ten years of operation data from the 1,000 MWe Korean NPP as indicated in Table 11.4-1, footnote (1). The reference NPP has processed DAW with the similar methods applied in APR1400 DAW treatment such as sorting, segregation, and compaction, as described subsection 11.4.2.

The expected generation rate and maximum generation rate for DAW may be calculated from the above shipped waste volume by the ratio of compressible waste, the volume reduction factor of compactor for compressible waste, and packaging efficiency.

The ratio of compressible waste and the volume reduction factor of the compactor can be determined according to IAEA-TECDOC-1492. IAEA-TECDOC-1492 states that the typical generated compressible DAW has the range of 20% to 60% for dry solid waste and the compactors typically have a volume reduction factor ranging from 2 to 6. Based on this reference, it is assumed that 60% of compressible DAW is conservatively generated and volume reduction factor of the compactor is 3 in the estimation of the waste generation rate. In addition, the packaging efficiency of 90% is considered as described in Table 11.4-1. The calculation result of expected and maximum generation rate is as follows;

a. Expected Waste Generation Volume

$W_{shipped} = \{(W_{generation} \times 0.6 / 3) + (W_{generation} \times 0.4)\} / 0.9 = 50.19\ m^3/yr\text{-}unit$
$W_{generation} = 75.29\ m^3/yr\text{-}unit$
Where, $W_{generation}$ is expected generation rate
$W_{shipped}$ is expected shipped volume presented in Table 11.4-1.

b. Maximum Waste Generation Volume

$W_{shipped} = \{(W_{generation} \times 0.6 / 3) + (W_{generation} \times 0.4)\} / 0.9 = 141.68\ m^3/yr\text{-}unit$
$W_{generation} = 212.52\ m^3/yr\text{-}unit$
Where, $W_{generation}$ is maximum generation rate
$W_{shipped}$ is maximum shipped volume presented in Table 11.4-1.

COL 11.4(9) The COL applicant is also to provide operational procedures to properly ship low-level wastes to external sites in accordance with US NRC and US Department of Transportation (DOT) regulations.

COL 11.4(10) The COL applicant is to prepare the operational procedures and maintenance programs for the SWMS as related to leak detection and contamination control.

COL 11.4(11) The COL applicant is to develop plant-wide RG 4.21 life-cycle planning for minimization of contamination program following the guidance in NEI 08-08A, in which the SWMS procedures and programs are to be integrated.

COL 11.4(12) The COL applicant is to maintain the complete documentation of system design, construction, design modifications, field changes, and operations.

COL 11.4(13) The COL applicant is to determine the number of shipment. If the generated waste exceeds the shipment amounts, the COL applicant is to provide details for how the extra generated waste that exceeds the shipment amounts will be handled.

Nuclear Regulatory Commission, May 1980.

2. Regulatory Guide 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," U.S. Nuclear Regulatory Commission, June 2008.

3. 10 CFR Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment," U.S. Nuclear Regulatory Commission.

4. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control," U.S. Nuclear Regulatory Commission.

5. 10 CFR Part 50, Appendix A, General Design Criterion 63, "Monitoring Fuel and Waste Storage," U.S. Nuclear Regulatory Commission.

6 10 CFR Part 50, Appendix A, General Design Criterion 64, "Monitoring Radioactivity Releases," U.S. Nuclear Regulatory Commission.

Table 1.8-2 (19 of 29)

Item No.	Description
COL 11.4(1)	The COL applicant can incorporate an onsite laundry facility for processing of contaminated clothing.
COL 11.4(2)	The COL applicant is to perform a site-specific cost-benefit analysis following the guidance in NRC RG 1.110.
COL 11.4(3)	The COL applicant is to provide reasonable assurance that the provisions and requirements of ANSI/ANS-40.37-2009 are met. The COL applicant is to provide reasonable assurance that mobile and temporary solid radwaste processing and its interconnection to plant systems conform with regulatory requirements and guidance such as 10 CFR 50.34a, 10 CFR 20.1406, and NRC RG 1.143. The COL applicant is to prepare a plan to develop and use operating procedures so the guidance and information in IE Bulletin 80-10 are followed.
COL 11.4(4)	The COL applicant is to provide P&IDs.
COL 11.4(5)	The COL applicant is to prepare the site process control program and the site radiological environmental monitoring program.
COL 11.4(6)	The COL applicant is responsible for the collection, temporary storage, and shipment of mixed waste for offsite treatment and disposal.
COL 11.4(7)	The COL applicant is responsible for the provision of a site-wide IRSF for interim storage of radioactive wastes.
COL 11.4(8)	The COL applicant is to provide a mobile crane to retrieve a waste package that becomes stuck in the lifted condition or that is dropped.
COL 11.4(9)	The COL applicant is also to provide operational procedures to properly ship low-level wastes to external sites in accordance with US NRC and US Department of Transportation (DOT) regulations.
COL 11.4(10)	The COL applicant is to prepare the operational procedures and maintenance programs for the SWMS as related to leak detection and contamination control.
COL 11.4(11)	The COL applicant is to develop plant-wide RG 4.21 life-cycle planning for minimization of contamination program following the guidance in NEI 08-08A, in which the SWMS procedures and programs are to be integrated.
COL 11.4(12)	The COL applicant is to maintain the complete documentation of system design, construction, design modifications, field changes, and operations.
COL 11.5(1)	The COL applicant is to determine the WARN and ALARM setpoints of the PERMSS based on the site-specific conditions and operational requirements.
COL 11.5(2)	The COL applicant is to develop an annual report that specifies the quantity of each principal radionuclide released to unrestricted areas in liquid and gaseous effluents.
COL 11.5(3)	The COL applicant is to provide site-specific procedures that conform with the numerical guides of 10 CFR 50.34a and 10 CFR Part 50, Appendix I.

COL 11.4(13) The COL applicant is to determine the number of shipment. If the generated waste exceeds the shipment amounts, the COL applicant is to provide details for how the extra generated waste that exceeds the shipment amounts will be handled.