

# US-APR1400 Design Features to Facilitate Decommissioning

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## 1. Introduction

During the long history over 40 years of nuclear power generation, Korea has been experiencing a full lifecycle of nuclear power plants. While Kori Unit 1 had started its decommissioning in June 2017 for the first time in Korea, the Korean export type reactor APR1400 has been being improved to re-enter overseas since the first export to UAE in 2009. Even though Korean history of decommissioning is not so long, many foreign experiences showed that consideration of decommissioning from the design stage is very important for safety and economy of nuclear power plants because decommissioning is a work consuming large amount of both time and cost.

This paper reviews design features on US-APR1400 (APR1400 NRC-DC model) and identifies further works for construction in U.S.A from the decommissioning point of view

## 2. Regulatory Scheme and Application

Since the issuance of decommissioning regulations in 1997, known as LTR (License Termination Rule), lessons learned from real implementations of decommissionings revealed that decommissioning needs to be considered at all stages in the lifecycle of a NPP, especially from the planning and design stages of a NPP, even though it is the last stage. Therefore the final rule for decommissioning, Decommissioning Planning Rule (DPR), was published in 2011 [1].

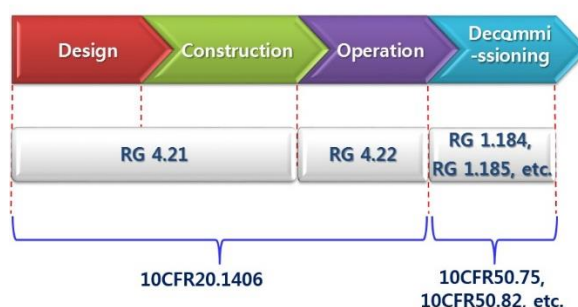


Fig. 1. Application Scope of Decommissioning-related Regulations under U.S. NRC's DPR.

Under DPR, existed or newly established several regulations and guides regarding decommissioning are closely and sequentially related by stages as shown in Fig. 1. Conformance of US-APR1400, currently targeting the standard design certification from U.S. NRC, to the related regulations is indicated in Table 1.

Table 1. Conformance with Regulatory Guides (RGs) on Decommissioning (DC) of US-APR1400

Doc. No.	Subject	Apply
RG 4.21	Minimization of Contamination and Radioactive Waste Generation	SDC <sup>1</sup>
RG 4.22	DC Planning During Operations	COL <sup>2</sup>
RG 1.159	Availability of Funds	COL
RG 1.184	Decommissioning of NPPs	COL
RG 1.185	Standard Format and Content for Post-Shutdown DC Activities Report	COL
RG 1.191	Fire Protection Program	COL
RG 1.202	Standard Format and Content of DC Cost Estimates	COL

<sup>1</sup> SDC: Standard Design Certification

<sup>2</sup> COL: Combined license (for construction and operation)

### 3. Decommissioning Design Features of US-APR1400 [2]

In order to reflect the requirement of facilitation decommissioning according to Reg. Guide 4.21, US-APR1400 design has several physical design features for minimizations of the amount of residual radioactivity/waste generations, and for easy removal during decommissioning. Table 2 shows the categorized representative decommission-related design features and Fig. 2 presents a typical schematic design for piping penetrations and sleeves between buildings in order to prevent unintended contamination to the environment.

Table 2. Decommissioning Design Features to facilitate decommissioning US-APR1400

Design Features	Applied SCs
Minimization of Embedded and/or Buried Piping	Minimal: CSS, etc.(9) None: SCS, CMS, etc.(11)
Piping Sleeve/Tunnel Between Buildings with Leak Detection	SFPCCS, ESWS, CCWS, PPASS, EFDS, etc. (7)
Continuous Water Purification/Sampling/Analysis	RCS, SGBDS (2)
Smooth Surface Finishes	SIS, CSS, MSS, etc. (13)
Accessibility	RCGVs, PPASS (2)
Modular Units/Compartments /Individual Assemblies	PAR, HI, ACUs, AHU, RFFCs, etc

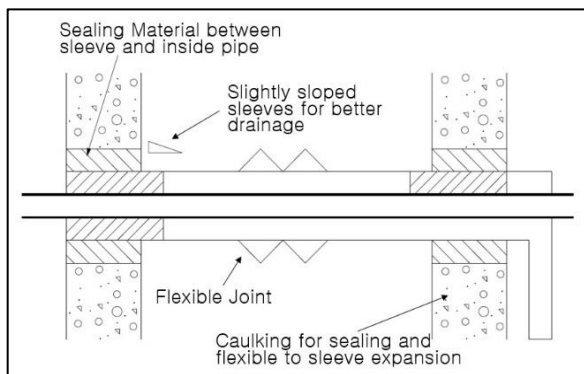


Fig. 2. Typical Design for Building Sleeves Schematic.

### 4. Further works for COL application

For the COL application of US-APR1400 to U.S. NRC, this means another export of APR1400, a full compliance with RG 4.21 is required. Several activities for that purpose have been identified and are indicated in Table 3.

Table 3. COL items regarding facilitation of decommissioning of US-APR1400

No	COL Activities
1	Estimate construction worker doses based on the site-specific information such as the number of operating units, meteorological conditions, etc.
2	Provide operational procedures and programs including a site radiological environmental monitoring program
3	Implement concrete tunnels coated with epoxy and equipped with sumps for piping of the system that may include underground piping
4	Maintain complete documentation regarding decommissioning planning and implementation in a centralized area for ready recovery

### 5. Conclusion

US-APR1400 has the improved design features for facilitation of decommissioning and is ready for an entrance to US nuclear market with the well identified decommission-related activities for the stage of construction.

### REFERENCES

- [1] U.S. NRC, "Decommissioning Planning Rule," Federal Register, Volume 76, Number 117, June 17, 2011, pp. 35512-35575.
- [2] KEPSCO/KHNP, APR1400 DCD Tier 2, Chapter 12, APR1400-K-X-FS-14002-NP, Rev. 3, August, 2018, pp. 12.4-11 to 12.4-16.