



Waste Management Issues on Korean NPPs

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Topics for Presentation

- 1 Introduction
- 2 Waste Management Issues on Decommissioning
- 3 Waste Management Issues on Operation
- 4 Waste Package and Disposal Issues
- 5 Conclusion



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Introduction

Waste issues in Korean NPPs

Waste Generation Issue

- 25 unit in operation and 11 unit under construction or planning
- Assumed 14,500 drums per one NPP for decommissioning
※ Decommissioning of Nuclear Facilities(OECD NEA, 1991)
- About 835,000 drums are assumed until yr 2,100 which is final decommissioning period in Korea

Characteristics of Decommissioning Waste

- Include long half-life nuclides(CI-36, Ni-63, Tc-99, C-14) than operational radioactive waste
- Generate large amounts of waste in a short periods
- Various types and large distribution of radioactivity

Untreated Operational Waste in Interim Storage

- Past radioactive waste before yr 2003
- Untreated waste in interim storage because of improper materials on waste acceptance criteria of disposal site
- Try to clearance to outside of NPPs

Prediction of Radioactivity of Waste in Korean NPPs

Unit : drum

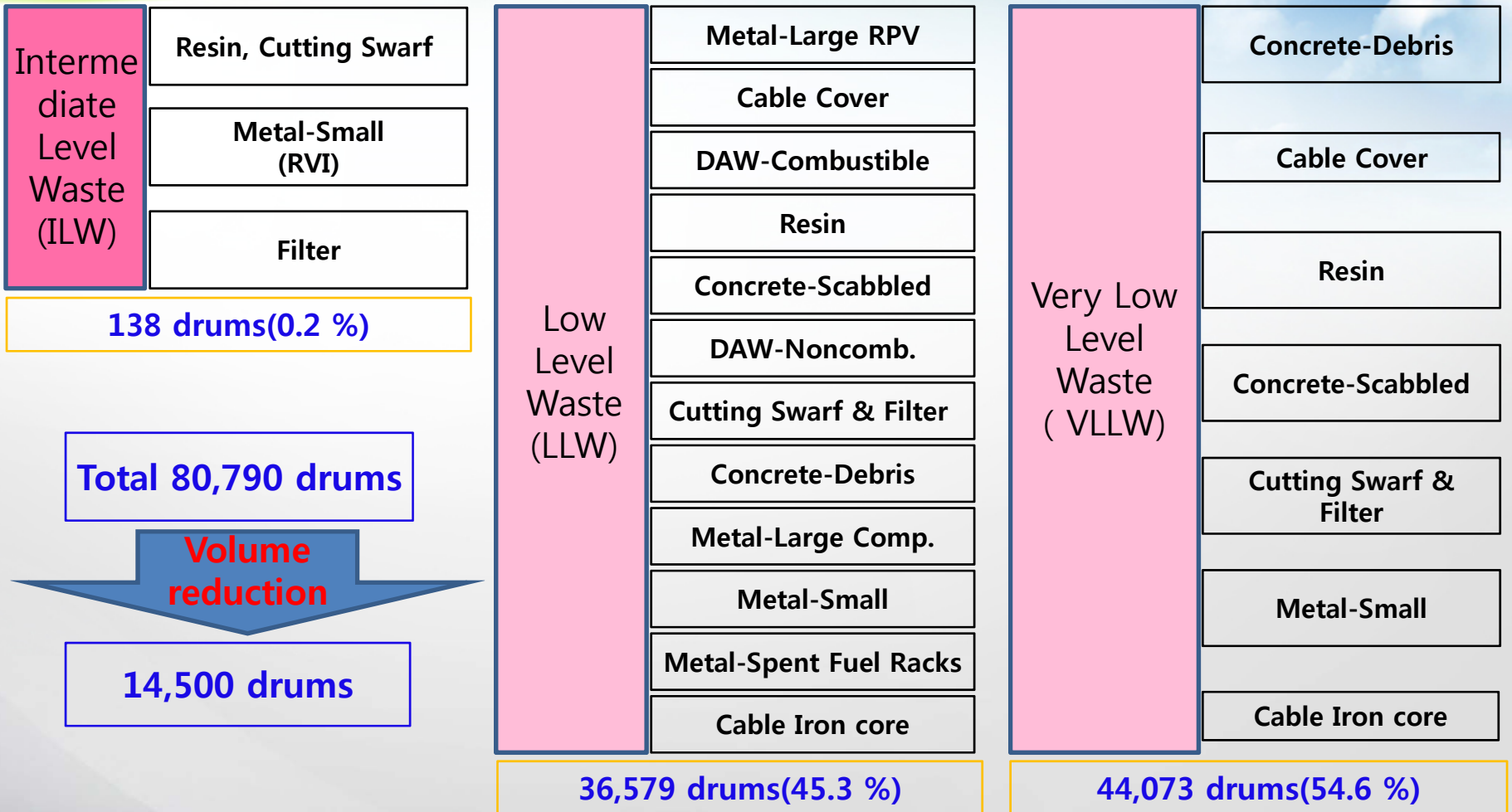
Type	Nuclear Power Plants			Radwaste outside of NPPs	Total
	Operational RadWaste	Decommissioning Radwaste	Sum		
ILW	13,664 (6.3%)	21,924 (4.2%)	35,588 (4.8%)	6,069 (6.3%)	41,657 (5.0%)
LLW	179,582 (82.8%)	149,814 (28.7%)	329,396 (44.6%)	79,762 (82.8%)	409,158 (49.0%)
VLLW	23,641 (10.9%)	350,262 (67.1%)	373,903 (50.6%)	10,500 (10.9%)	384,403 (46.0%)
Total	216,887	522,000	738,887	96,331	835,218



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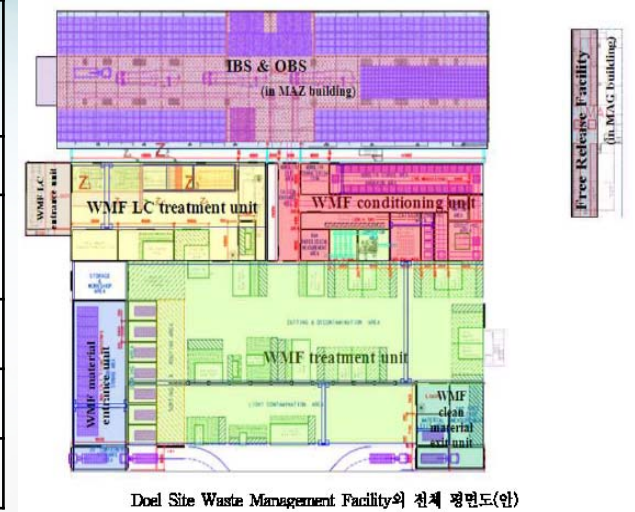
Waste Management Issues on Decommissioning

Category of Decommissioning Radwastes for Kori unit 1



Preliminary Calculations of K-1 RVI Inventory

Plant	Power [MWe]	Operations [years]	Total Activity[Bq]	Remark
Kori-1	587	40	$\sim 9.5 \times 10^{16}$	Total*
Connecticut Yankee	582	28	3×10^{16}	RVI only**
Maine Yankee	900	25	7×10^{16}	Total
Trojan	1095	16	7×10^{16}	Total
Yankee Rowe	167	30	3×10^{16}	RVI only**



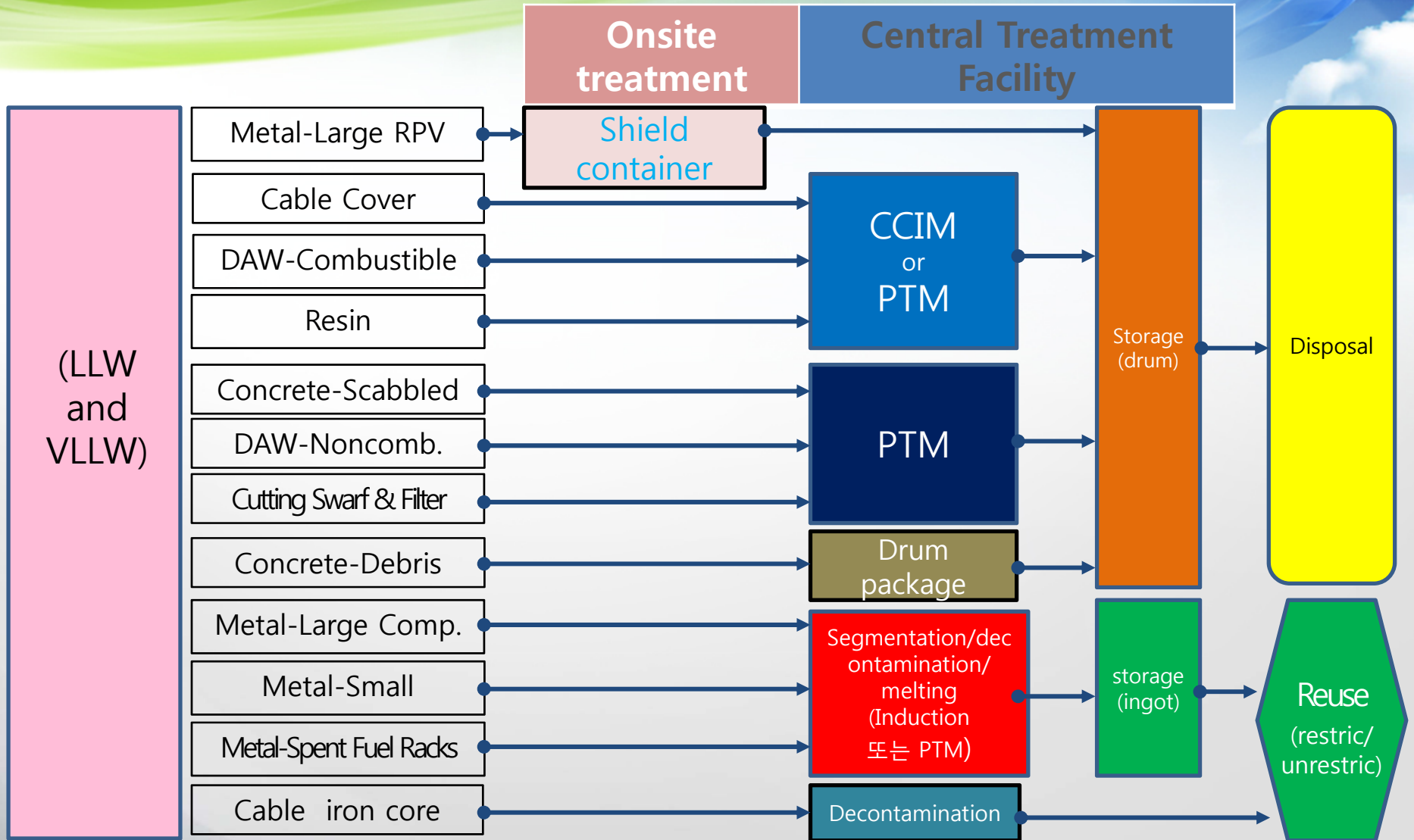
* Total : Reactor Vessel, Reactor Vessel Internals and Bioshield-Concrete

** RVI only : Reactor Vessel Internals

Actions based on K-1 inventory calculation

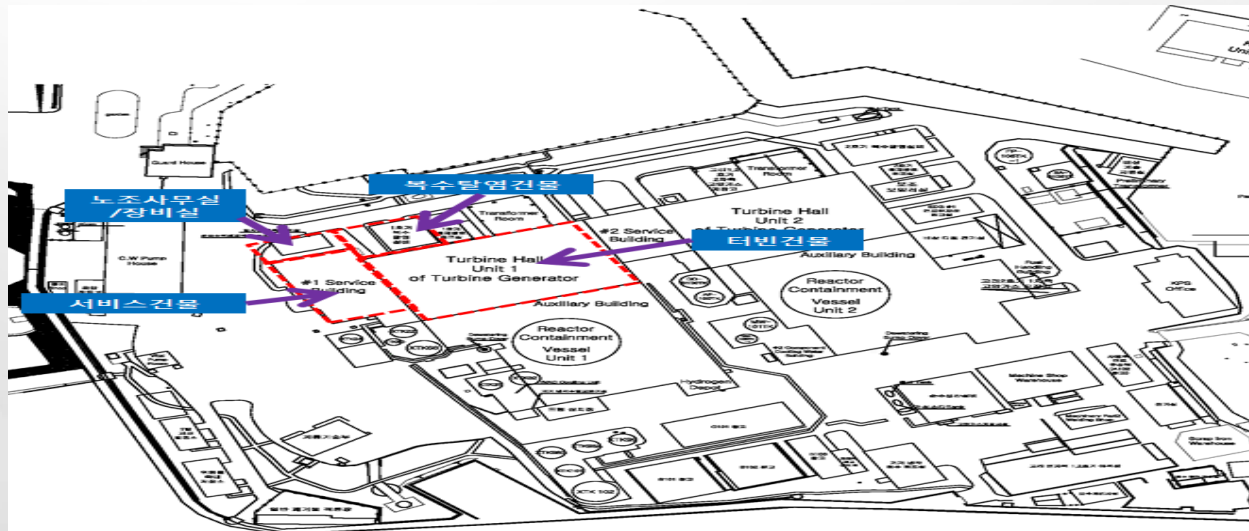
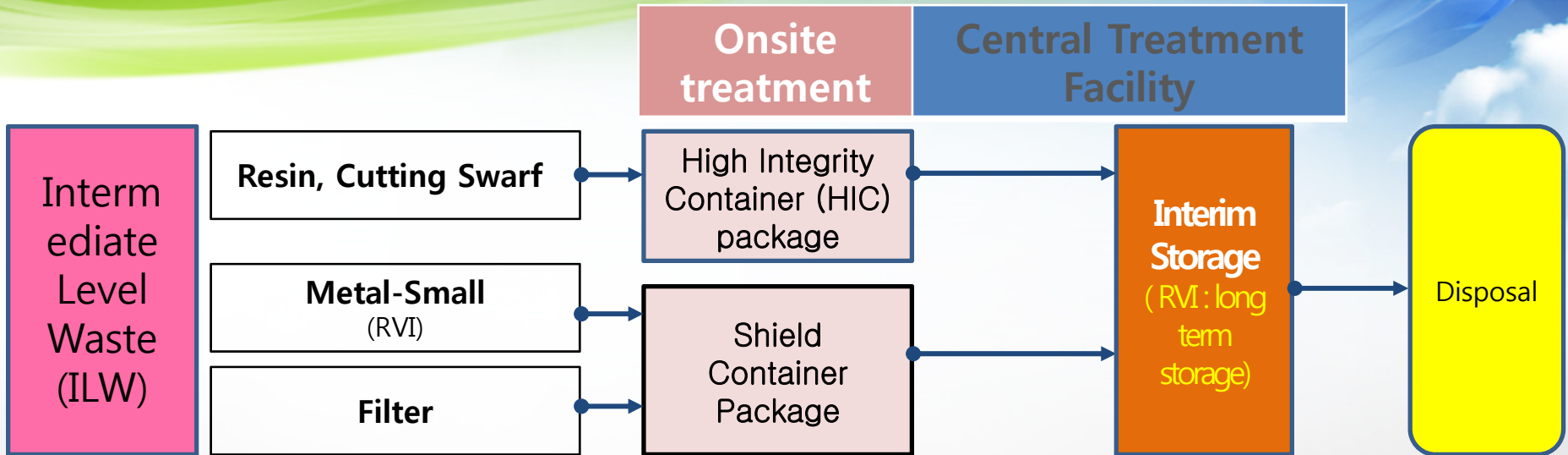
- Specific Cost Estimation, Schedule and License/Environment Activity...
- K-1 Engineering : Characterization(HSA), Segmentation, Waste treatment...
- Concept design for centralized/local radwaste treatment facility
- Request for safety assessment for radioactive waste disposal Center

LLW and VLLW Treatment Plan for Decommissioning



* CCIM : Cold Crucible Induction Melter, PTM : Plasma Torch Melter

Intermediate Level Radwaste Treatment Plan for Decommissioning



Planned Central Treatment Facility for Kori unit 1 (use Turbin building)



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Waste Management Issues on Operation

Past Radioactive Waste generated before 2003 in Operation

구분	Status	Problem
Dry Active Waste	Compaction(30 ton) Super Compaction(2,000 ton)	Free water, filling rate, Hazardous material
liquid Concentrate	Cementation (~'98 year)	Compressive Strength, leaching etc
	Paraffin Solidification ('95~'10 year)	Paraffin and waste separation
Waste Resin	Cementation (~'98 year)	Compressive Strength, leaching etc
	PE-HIC Package ('98year~)	Structural Integrity
Waste Filter	Cementation (~'98 year)	Need to Radiological Assessment
	Steel drum package (~'98 year)	Need to radiological Assessment, and Solidification

Untreated Radwaste on Operation

Waste	Problem
Waste Resin	Above C-14 concentration limit(1Bq/g) for clearance
Adsorbent (Zeolite)	Above H-3 concentration limit(100Bq/g) for clearance
Dry concentrate Powder	Diffusivity
Waste Filter	High Radioactivity, Need to solidification
Organic liquid Waste	Mobility, Flammability
Aluminium	H ₂ gas generation
Sludge	Need to solidification
Oil	Mobility, Flammability



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Waste Package and Disposal Issues

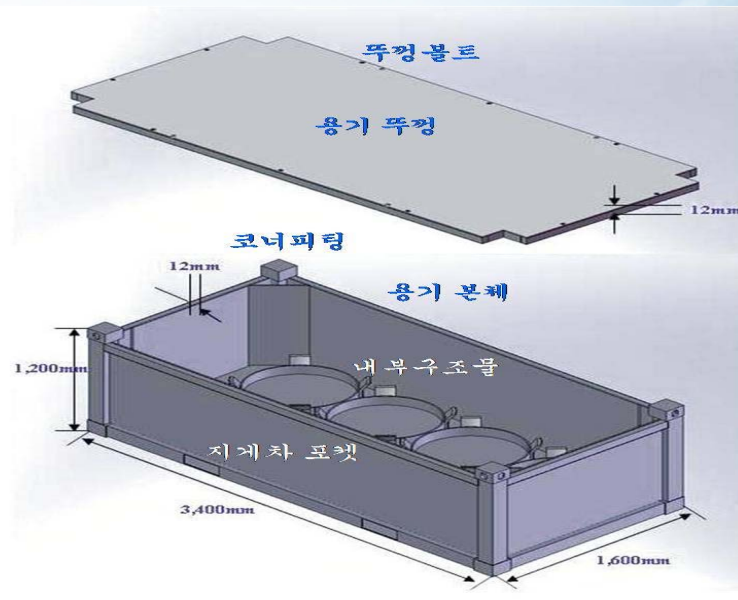
Package Requirement



	Item	Package criteria
General Condition	Surface dose rate	10 mSv/hr
	Waste Type	Solid waste which stabilized in physico-chemical characteristic
	Weight	Concrete package : less than 10ton, Steel Package : less than 1 ton
	Package Dimension	Minimum Rectangular type 0.5m(L)×0.5m(W)×0.8m(H), Cylinder type : 0.5m(D)×0.8m(H) Maximum Rectangular type 1.5m(L)×1.5m(W)×1.5m(H), Cylinder type : 1.5m(D)×1.5m(H)

Standard Transportation Container for 200L drum

Standard Transportation Container (IP type)



3,400(L)×1,600(W)×1,200(H)

Container Weight : 3,657 kg

For 200ℓ drum

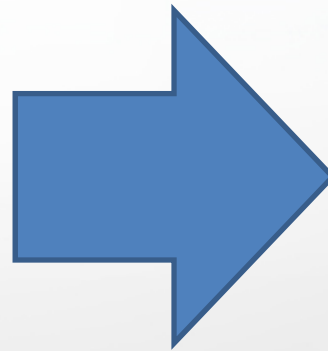
Waste Package for Decommissioning

For successful decommissioning project and waste disposal, It is necessary to develop the new package for ILW, LLW and VLLW

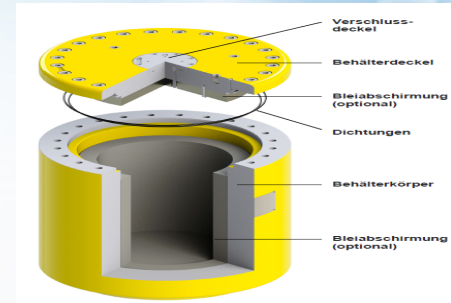
Present



320/200 l drum



Waste Package Development



ILW



LLW or VLLW



VLLW

Transportation for Waste Container

- Waste Transportation Ship
 - Total Weight : 1,365 ton, Crane Capacity : 7.5 ton
 - Container Shipment : Maximum 190 container



- Transportation Truck
 - Loading Capacity : 15 ton, Transportation Container 2 EA,
 - Disposal container 1 EA

LILW Radioactive Waste Disposal Center

Area

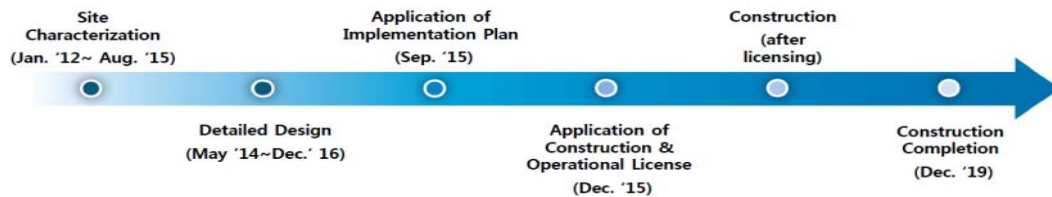
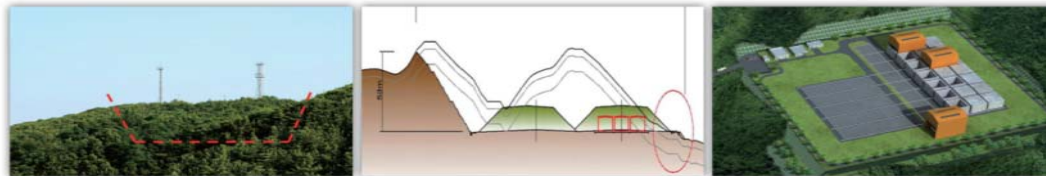
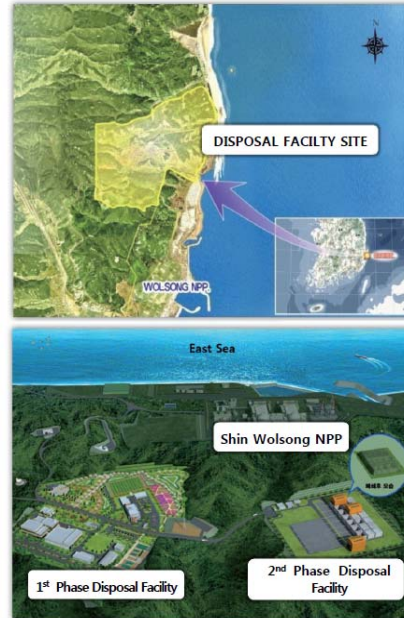
- Approximately 2,100,000 m²(vicinity of Shin-Wolsong unit 1&@)

Disposal Capacity: 800,000 drums

- 1st Phase: 100,000 drums (2014)
- 2nd Phase: 125,000 drums (2019) is followed by additional 125,000 drums
- 3rd Phase: On Planning

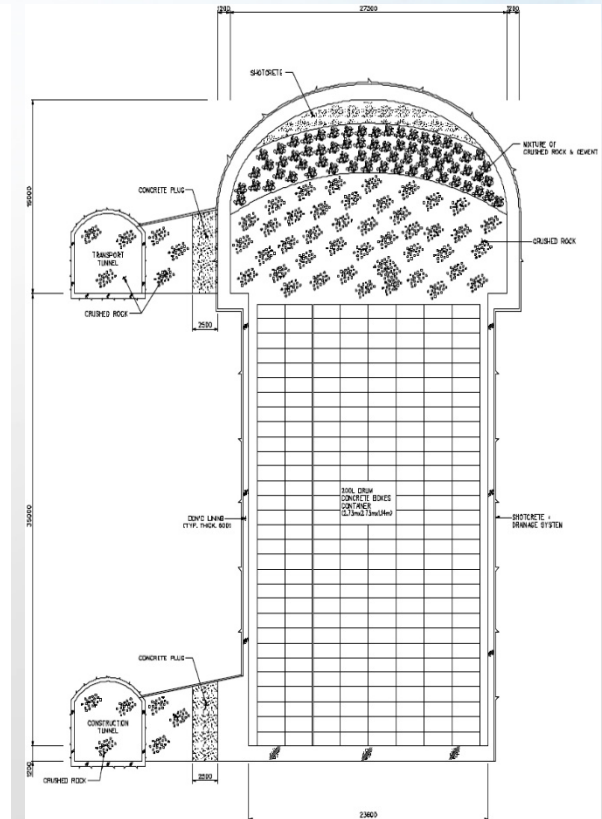
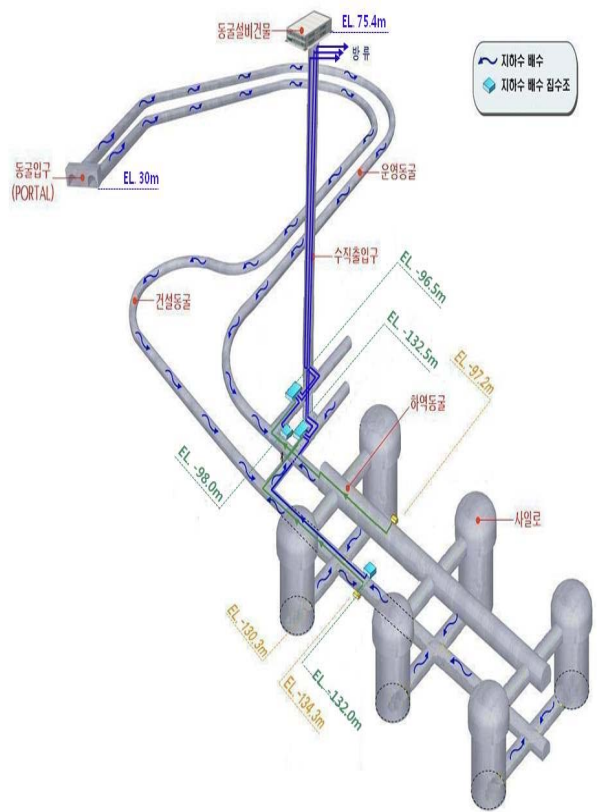
Disposal Type

- 1st Phase: Rock-Cavern Type
- 2nd Phase: Engineered-Vault Type
- 3rd Phase: On Planning



Disposal Facility(Silo) of Korea

- Capacity : 6 silos, about 16,600 drums per each silo
- Diameter : 25m Depth : 50m
- Disposal radioactivity : about 5.63×10^{15} Bq



Container and Crane for Disposal



< Silo Crane >



< Disposal Container >

- Silo Crane : 20 ton/each silo
- Disposal Container
 - 16 pack(for 200L drum), 9-pack(for 320L drum), 1 pack (for HIC)



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Conclusion

Conclusion

❏ Waste issues for Decommissioning Waste

- Needs for Waste Tracking System from generation to disposal
- Radiological detection and measurement needs for various waste stream
- Scaling Factor development for decommissioning
- Development of waste package, transportation container in terms of the disposal facility (In presents only 200L, 320L drum is allowed)
- Reuse and clearance for volume reduction of concrete and metal waste

❏ Waste Issues for Operational Waste

- Need technical development to meet waste acceptance criteria for Disposal on past radioactive waste generated before 2003
- Need technical development for radioactive wastes of difficult treatment in interim storage to meet waste acceptance criteria for Disposal



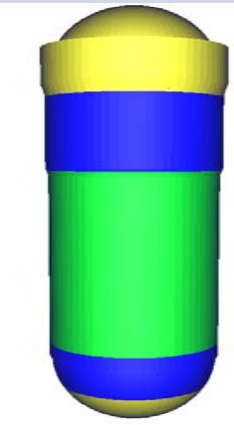
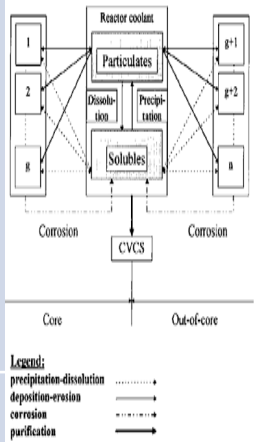
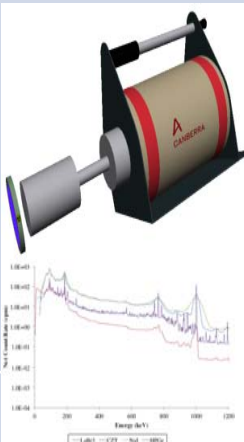

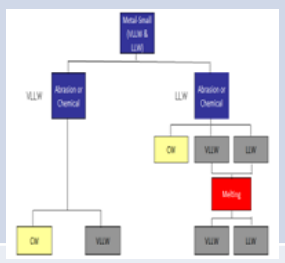
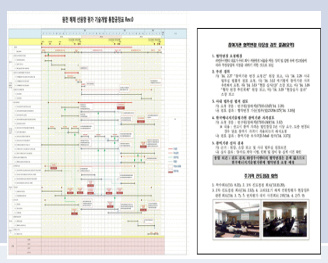
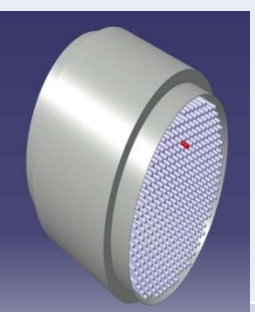
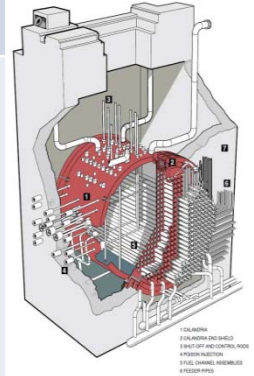



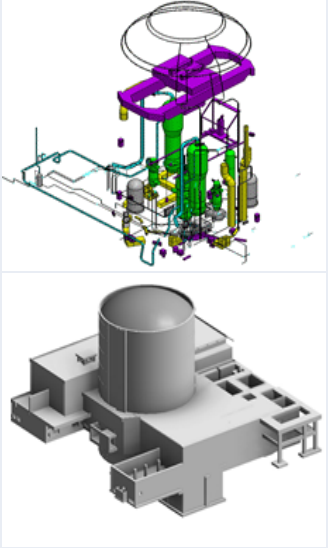
**Thank you very much
for your attentions**

Prediction of LILW in Korean NPPs

Unit : drum

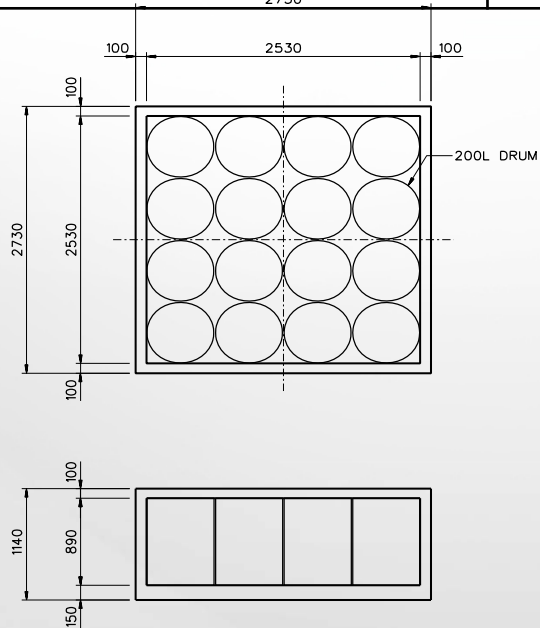
Year	Nuclear Power Plants			Radwaste outside of NPPs	Total
	Operational RadWaste	Decommissioning Radwaste	Sum		
2020	111,787	-	111,787	36,571	148,358
2030	138,187	5,800	143,987	44,041	188,028
2040	160,587	174,000	334,587	51,511	386,098
2050	177,587	243,600	421,187	58,981	480,168
2060	190,287	307,400	497,687	66,451	564,138
2070	202,287	348,000	550,287	73,921	624,208
2080	213,087	348,000	561,087	81,391	642,478
2090	216,887	423,400	640,287	88,861	729,148
2100	216,887	522,000	738,887	96,331	835,218
Portion	26.0%	62.5%	88.5%	11.5%	100%

Assessment of Inventory and Waste for Kori-1

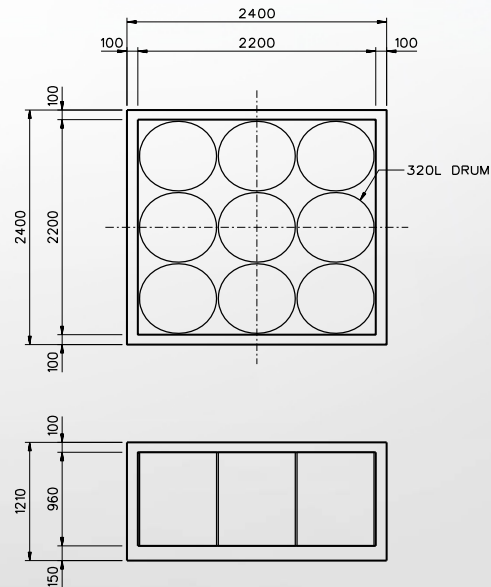
	Inventory Cal. (RV, RVI, Bio-Concrete)	Crud Inventory Calculation	Sampling & Counting	In-situ Counting	Waste(Drum) Based on scenario	Project Leading & Interface (3D modeling)
PWR (K-1)	 <p>(MCNP+FISPACT)</p>	 <p>Legend: precipitation-dissolution: \rightleftarrows deposition-erosion: \rightarrow corrosion: \dashrightarrow purification: \dashleftarrow</p>				
PHWR (W-1)					 <ol style="list-style-type: none"> 1. 폐기물 등급 및 형태 2. 단위체적, 단위중량도 3. 폐기물 방사선양상 4. 폐기물구분 5. 음향도 측정 6. 폐기물 처리 7. 포장, 운송, 처분 계획 	

Category of Disposal Container

Category	Disposal Container		
	16-Pack	9-Pack	1-Pack
Material	Concrete	Concrete	Concrete
규격 (W × L × H) (m)	2.73 × 2.73 × 1.14	2.4 × 2.4 × 1.21	outside: 1.40(Φ)×1.65(H) Inside: 1.24(Φ)×1.35(H)
Maximum Weight (ton)	7.0	5.8	2.34
Density (ton/m ³)	2.5	2.5	2.5



200L DRUM DISPOSAL CONTAINER



320L DRUM DISPOSAL CONTAINER

