

ISOE 2014 Asian ALARA Symposium

The-K Hotel Gyeongju, Republic of Korea, 23-25 September 2014

Occupational Radiation Protection in Radioactive Waste Management



24 Sept., 2014

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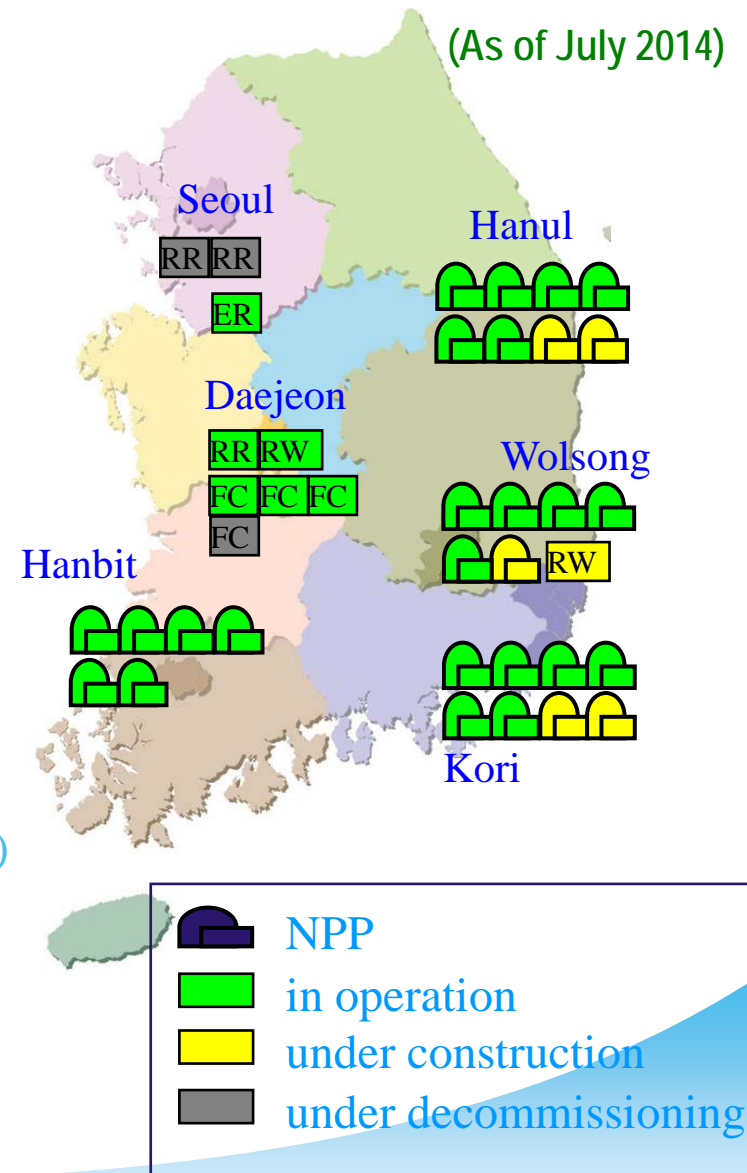
1. More Concern for RW in Korea

- Distance from Fukushima-1 NPP to Republic of Korea
 - Seoul, the Capital City : 1250 km
- Korea is geographically nearer to Fukushima than other countries.
 - Korean society has a lot of concern for Fukushima accident.
- Also, More concern for Nuclear Facilities & RW in Korea

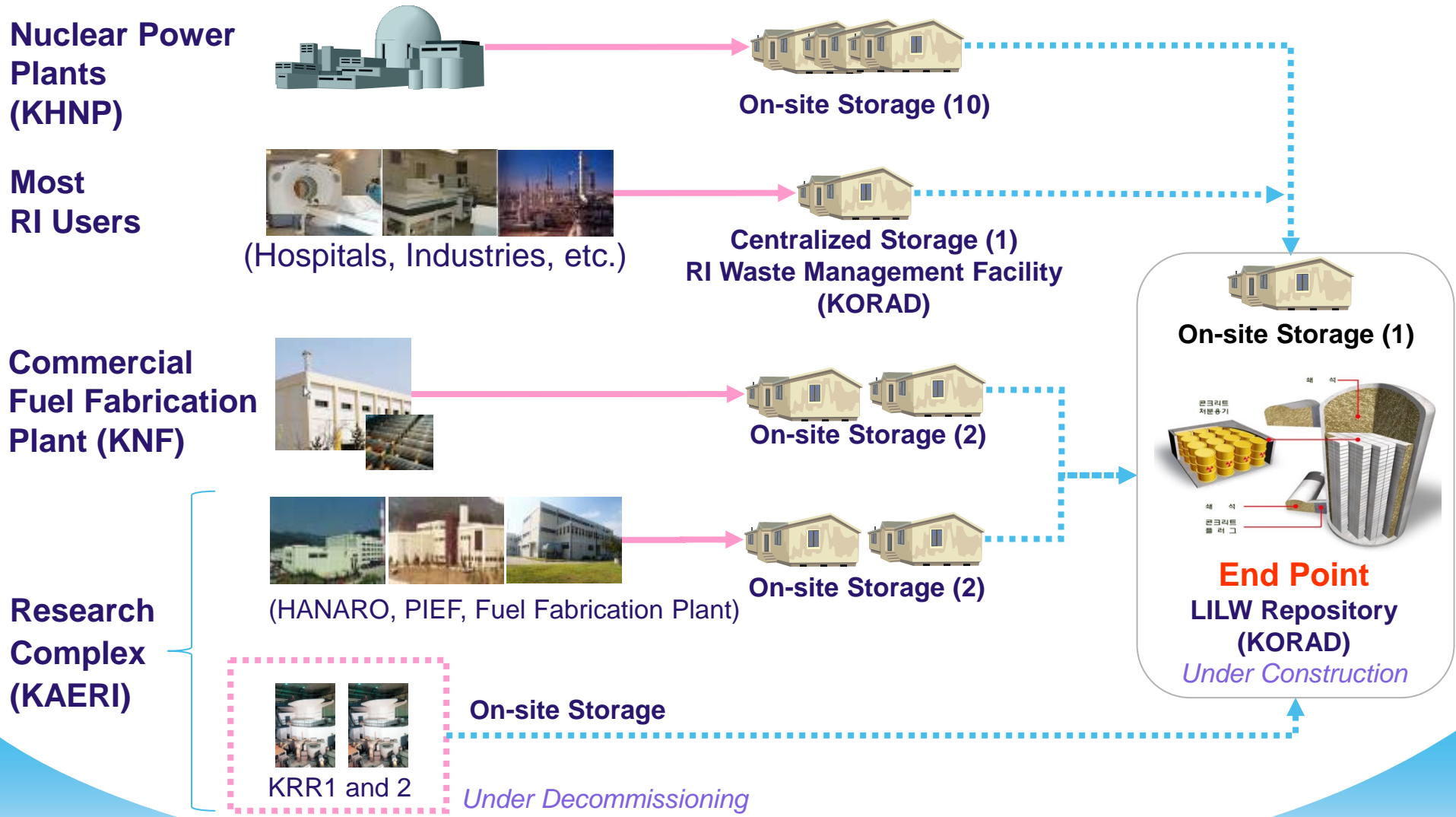


2. Status of Nuclear Facilities in Korea

- ✚ Nuclear Power Plant (NPP)
 - 23 in Operation and 5 under Construction
- ✚ Research Reactor (RR) / Education Reactor (ER)
 - HANARO (RR)
 - KRR 1 and 2 (RR, under decommissioning)
 - AGN (ER)
- ✚ Nuclear Fuel Cycle Facility (FC)
 - Fuel Fabrication Plant for NPP
 - Fuel Fabrication Facility for RR
 - Post-Irradiation Examination Facility
 - Uranium Conversion Facility (released from regulation due to completion of decommissioning)
- ✚ Radioactive Waste Management Facilities (RW)
 - RI Waste Management Facility
 - LILW Disposal Facility (under construction)



2-1. Framework for LILW management



However, end point of high Level wastes and spent fuels is not yet decided.

3. General Methods for Radiation Protection

- Radiation exposure = External exposure + Internal exposure
- Control of external exposure
 - Time : Double the time, Double the dose
 - Distance : Double the distance, quarter the dose
 - Shielding : Shielding the radiation, reducing the dose
 - Work Planning, Training & Mock-up, Remote control, Shield tools, APD
- Control of internal exposure
 - Preventing radionuclides from entering the body by inhalation, ingestion & absorption
 - Eating, drinking, smoking prohibited in radiation areas
 - If airborne radioactivity exists, protective breathing apparatus used
 - Derived air concentrations (DACs) for airborne radionuclides
 - Wear appropriate protective clothing
- **Radiation Protection Program(RPP) established to all workplaces**
 - Organization, Local rules & task-specific procedures, Monitoring, Training,
 - Protective equipment, Classification of areas, Emergency plan, RWM, etc.

4. Specific Consideration for RP in RWM

- **Characteristics of workplace for RWM**
 - **Dust**, Powder
 - Radioactive waste **drums**
 - **Large amount** of radioactive waste
 - **High** intensity of **radiation**
 - Feasibility of **leak** of contaminated materials (liquids, gas)
 - **Cutting and repackaging** of solid radioactive waste
 - Possibility of **contamination** & exposure
- **Typical task related to RWM**
 - RWM during normal operation of NPP
 - **Process of radioactive waste, Drum storage work**, etc.
 - Large-scale Project
 - **Large Equipment Replacement** (S/G, Heat Exchanger), HLW (such as spent fuel) Disposal & Management
 - **Decommissioning**
 - Nuclear Reactor, Nuclear Fuel Cycle Facilities, Accelerator
- **Careful consideration is necessary to establish RPP**

5. Decommissioning of research reactors

- **Decommissioning of nuclear facilities**
 - **KRR-1 (Research reactor):** 1997 ~ 2009 & 2011~2014
 - **KRR-2 (Research reactor) :** 1997 ~ 2009
 - Uranium conversion facility (to produce UO₂ powder) : 2001 ~ 2011
 - Daegu Tech. (TIG welding rod including thorium): 2004 ~ 2005
 - Taegwang Industrial co. Ltd. (Use of catalyst including uranium): 2006
 - Cyclotron (to produce RI for medical diagnosis) : 2012
- **Difficulties in decommissioning**
 - Identification & removal of **activated materials**
 - Identification & removal of **contaminated soils & concretes**
 - Methods to treat or dispose the **large amount of radioactive waste**
 - Set-up for criteria & various procedures related to decommissioning
- **Safety activities to assure safe & thorough decommissioning**
 - Safety review on decommissioning application & plan documents.
 - Inspection on the facilities during decommissioning
 - Periodic inspection on the storage of RW from decommissioning until the disposal of them

5-1. Decommissioning of KRR-1 & 2



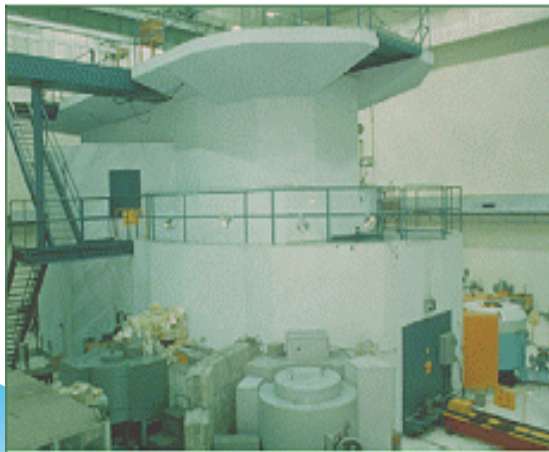
KRR-1



decommissioning



The Inside of KRR-1



KRR-2



decommissioning



Large amount of RW

5-2 RWM in decommissioning of KRR-1 & 2



Keep dust from spreading



Reclassification of RW



Solidification



Cutting metals



Reclassification of Metals



Repackaging

5-3 RP in decommissioning of KRR-1 & 2

- **Establishment of RPP**
 - Organization, Local rules & task-specific procedures, Monitoring, Training, Personal Protective equipment, Classification of areas, Emergency plan, RWM, etc.
- **Operation of ALARA committee & Work management**
 - **ALARA review for some specific tasks**
 - Considered as a task with risk of high radiation
 - e.g. : Re-classification of casks (metal-type RW)
 - Work control by SRWP (Specific Radiation Work Permit)
 - Estimation of collective doses (man-mSv) & Feedback
 - Work management by RWP (ERWP, RRWP, SRWP)
- **Air Monitoring and Wearing Masks**
 - **Possibility of contamination in air by dusts**
 - Monitoring of radioactivity in air in the workplace
 - Wear personal protective equipment such as masks

6. Lessons-learned from experience of RWM

- RWM is being practiced according to RPP established for NPP
 - Long-term experiences in RWM produce feedback items to improve RPP
- From feedback items, Useful to reduce exposure in RWM
 - **Easily disassembling and assembling** of equipment and component parts
 - Useful to reduce exposure of workers at the time of maintenance
 - **Securing stability of radioactive waste storage is done by**
 - Removal of moisture in storage of drums (running dehumidifier or HVAC)
 - High-radiation drums inside the storage & low-radiation drums near outer walls
 - Large-scale RW (old S/G) in the storage with sufficient shielding walls
 - Surfaces of spent resin drums or spent filter drums are **remotely decontaminated** after the drums are filled with RW.
 - Solidification system, where radioactivity of the surface is relatively high, is **operated remotely by using conveyor belts**.
 - **Keep protective coating** of wall, floor and equipment surface **smooth**. The **coating of walls** in aisles or rooms is done **to the height of worker's reach**.
 - To easily remove contaminated materials from surfaces of wall or rooms.

6-1. Lessons-learned from experience of RWM

- **Keep the inside of NPP clean.** Especially clean dusts of pipes & cable trays.
 - To easily remove contaminated materials from the coated surfaces
- **Keep the sump clean.** Especially prevent construction waste from going into sump at NPP construction.
- **Keep drainage facilities of each building well performed** to reduce dose
 - Protect drainage hole at NPP construction
 - Keep floors on a slight slope to facilitate drainage easily
 - Build banks (or hills) in front of tank rooms or sump rooms where liquid RW is stored to prevent overflows of tank or sump from spreading into other regions.
- **Install a post filter at the end part of active charcoal of ACU (Air Cleaning Unit) which uses active charcoal**
 - to prevent charcoal dust from the duct deposition that could result in exposure
- **Items of consideration for ACU (Air Cleaning Unit) design**
 - Capable of replacing the interior light on the outside ceiling surface
 - Installing manifold to sample testing gas, which lets performance test be done without going into the inside of ACU
 - Securing sufficient space between ACU & building wall (reducing working time)

7. Summary

- After Fukushima accident, **more concern** for Nuclear Facilities & Radioactive waste management (RWM) **than any other times** in Korea.
 - So, radiation risk and radiation exposure are often **hot keywords** to people.
- To minimize radiation exposure, **radiation protection program(RPP) should be established** and being operated in all nuclear facilities & Radioactive waste management.
- In addition, consideration of **specific characteristics in RWM**
 - Dust, High radiation, Possibility of RW leak, etc.
 - Necessary to establish RPP to minimize occupational exposure in RWM
- Korea has experiences in RWM of NPP, decommissioning, large-scale project such as S/G replacement.
 - **Much effort to assure radiation protection and ALARA** in these fields.
 - Continued effort is necessary **to feedback the experiences to improve RPP.**

Thank You.