

Dose Reduction through Optimized operation  
method at High Radiation Area

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# 1. Background (1/2)

Ulchin 1 Nuclear  
Power Plant

ISOE ALARA Symposium

- For protecting against from unnecessary radiation exposure or contamination for radiation workers that,
- Operation and maintenance through pre-meeting, providing the radiation information and installing shielder but,
- Optimized ALARA programs are nrrdrd to reduce the radiation field for radiation workers.



Intensified management  
for high radiation field

Prevent of unnecessary  
radiation exposure

**Necessary for improving the  
ALARA program**

Strengthening  
communication means

Minimizing of radiation  
exposure for high  
radiation field workers



### The main status of high radiation area

#### The definition of high radiation area

- ◆ Excess and excess concern area for dose rate of 1mSv/hr from away 30cm at radiation source and shield's surface
  - ◆ The area of installed device for prevent the trespassing and warning sign
- ☞ The definition of high radiation area

#### The definition of high radiation area

- ◆ Controlled area : non-regeneration heat exchanger room[N215] including 29spots

The management status of high radiation area

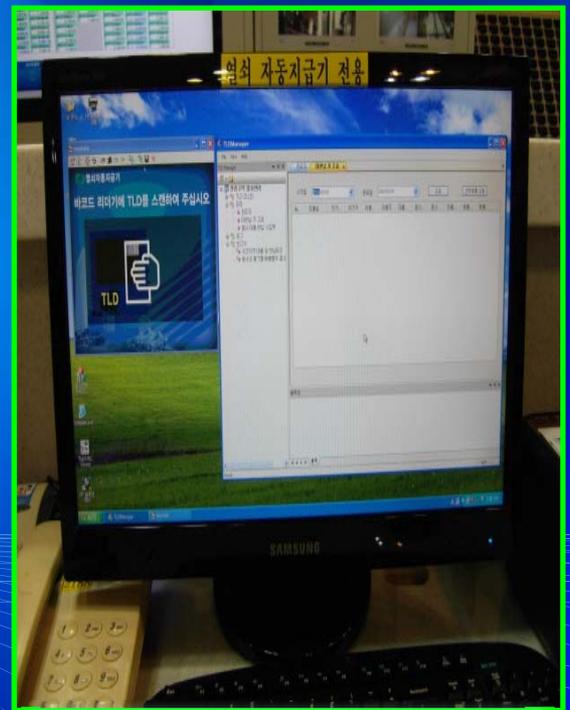
## Access control using door lock system



Lockable door



Automatic providing and returning key system



Exclusive computer for key management

## 2. The main status (3/8)

The management status of high radiation area

Use the radiation(activity) level sign board on entrance



Radiation(activity) measurement

방사선(능) 측정 표지판		
<input type="checkbox"/> 고방사선구역	<input type="checkbox"/> 공기오염구역	<input type="checkbox"/> 표면오염구역
방사선농도	0.86	mSv/h
공기중농도	DAc 이하	Bq/m <sup>3</sup>
표면오염도	3.70	kBq/m <sup>2</sup>
측정자	권희선	측정일 2007년 12월 28일
측정주기	<input type="checkbox"/> 일간	<input checked="" type="checkbox"/> 주간 <input type="checkbox"/> 월간 <input type="checkbox"/> 수시
주의사항		
□번역적 : 보건관리실(☎ 1998)		

Radiation(activity) measurement sign

### The management status of high radiation area

Radiation shielding for high contaminated equipments and piping etc.

- ◆ Shielding after install the direct shield/mobile hanger(equipment/piping etc.)
- ◆ The valve and equipment for frequent O&M exclude from shield



Install direct radiation shield



Mobile hanger shielding



Frequent checking area (not installed)

### The meeting before radiation work

#### The meeting before radiation work in high radiation area

- ◆ Determination and discussion for tasking method/optimized manpower/time sheet
- ◆ Provide information for working area radiation dose rate, hazard factor, etc
- ◆ communication with written form or verbal for compliance items during the rest works



The meeting before radiation work



The meeting before radiation work

### Operating the radiation label

#### Label Operating for daily/weekly/monthly measure point

- ◆ Designation Routine Point for the maximum radiation dose rate point
- ◆ Using the self-adhesive disposable paper products
- ◆ Operating spot : daily(68 spots), Weekly(103 spots) Monthly(27 spots)



The label for daily/weekly/monthly measuring point

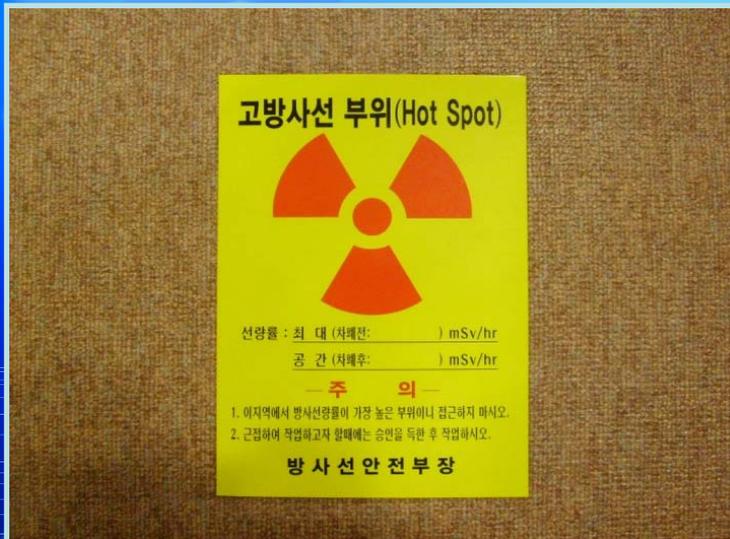


Operating the sticker type label

## Radiation label operation

### Operation the Hot spot label

- ◆ Provide radiation dose rate information for high contaminated equipment / piping
- ◆ Using the self-adhesive disposable paper products



Labeling of Hot spot



Operating the self-adhesive paper for Hot spot

## 2. The main status (8/8)

### Status for radiation exposure history of high radiation area trespassors

The number of admission for high radiation area(2 years average)

site inspection(operator, PM,, etc.) : 24,308 times  
Maintenance etc. : 36,093 times

Radiation exposure dose rate (2 years average)

Division	Radiation exposure dose (man-mSv)	Major work
Normal operation	126.59	site survey maintenance works
Overhaul	1,362.02	main process maintenance works System operation/the rest works

## Zoning control for high radiation controlled area

Operation radiation(activity) label measurement sign on entrance and exit



- ▶ Insufficiency information on entrance and exit sign
  - ☞ Difficulty for grasping on exact maximum radiation dose rate point/location
  - ☞ Unintentional exposure occurrence for fresh operation/maintenance man due to the lack of radiation information

Install and operation the lead shield on high radiation area



- ▶ Difficulty for recognizing equipment/valve type and radiation information after shielding
  - ☞ Site surveying of operator/maintenance man
    - Unintentional exposure occurrence when surveying the equipment
- ▶ Uninstall shield for frequent surveying / operation equipment,, etc
- ▶ Issue of imaging control by direct shielding

# 3. Main Issues(2/4)

## Meeting before work

General proceedings



- ▶ Simply oral/written form notification
  - ☞ Hard to provide a detailed information of radiation dose for the equipment or pipes located in high radiation area
  - ☞ Unexpected additional radiation exposure occurrence during works



Labeling operation for Hot spot and the daily, weekly and monthly

## Attachment and operation of the disposable marks

- ▶ Marks attached at the high temperature parts are decolorized and relaxed.
- ▶ Hard to identify
  - ☞ Complicated area of pipes and equipment

## Self adhesive sticker

- ▶ Hard to eliminate the sticker when adhesive points are changed
  - ☞ Unintentional exposure occurrence
  - ☞ Increasing the difficulty of the sticker detachment

Using the radiation shielded clothes for worker entrance and exit of the high radiation area

**Using the radiation shielded clothes made of a high purity lead plate**



- ▶ Deterioration of activity and wear sensation
- ▶ Deterioration of radiation shield efficiency due to plate gap
- ▶ Lowing of efficiency of workers due to sweat

**Absence of neutron shield clothes during normal operation**



- ▶ Increasing the exposure dose for R/B workers
  - ▶ Percentage of exposure dose by neutron is 77% in comparison with total exposure dose
  - ▶ Needed clothes for the neutron shield to reduce the neutron exposure dose

## 4. Improved subjects (1/15)

Rigid high radiation zoning control

Improvement of meeting proceeding before start-up works

Improving the label operation method for Hot spot, daily, weekly and monthly sign

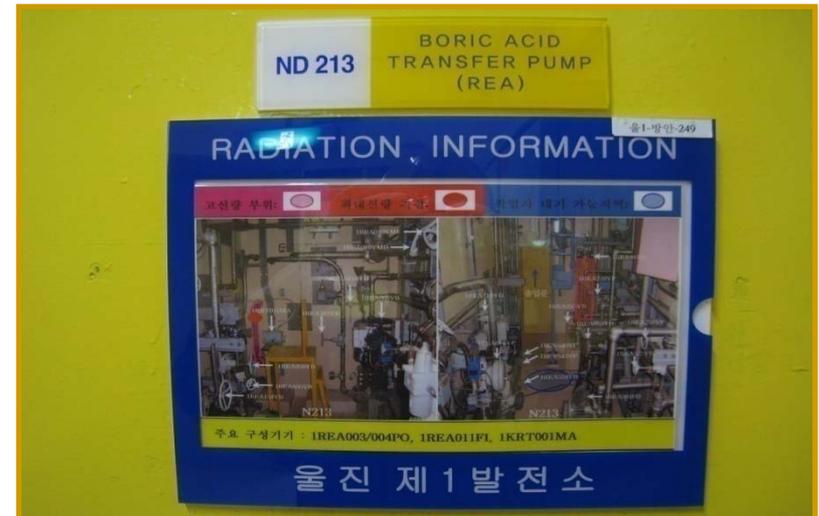
Improving the shield clothes for workers who work in high radiation area



## Reinforcement control of high radiation zone

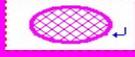
### Operation of showing boards to offer the radiation information

- Marking the radiation dose rate after photographing high radiation field
  - Providing the visual/detailed radiation information
  - Classification of high radiation part by color
- Mark on the main components such as equipment and valves
  - Offering information to new workers working in high radiation field
  - Easy understanding the location of main equipment and valves
- Running information boards to offer the radiation information
  - Area with doors : 29 spot including N215
  - Area without doors : 4 spot including W218  
installation in front of doors with Standing Information Boards

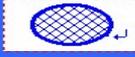


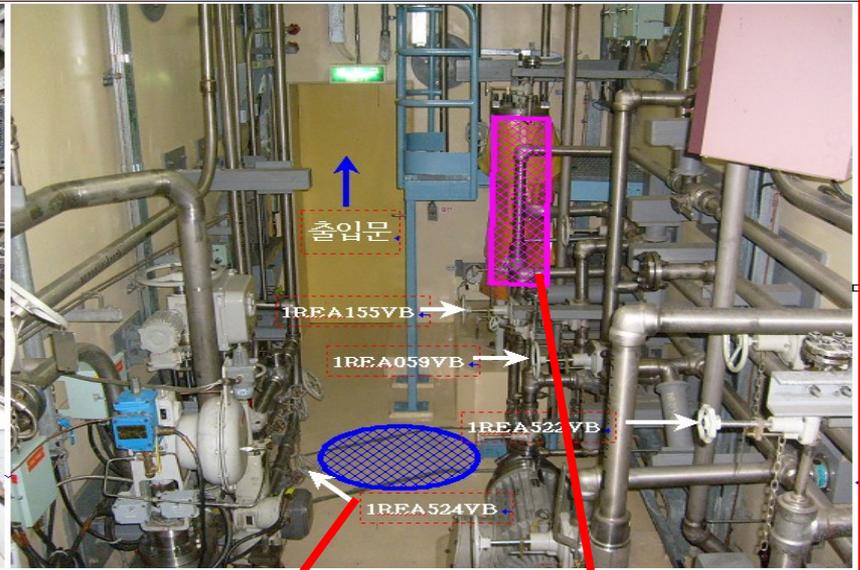
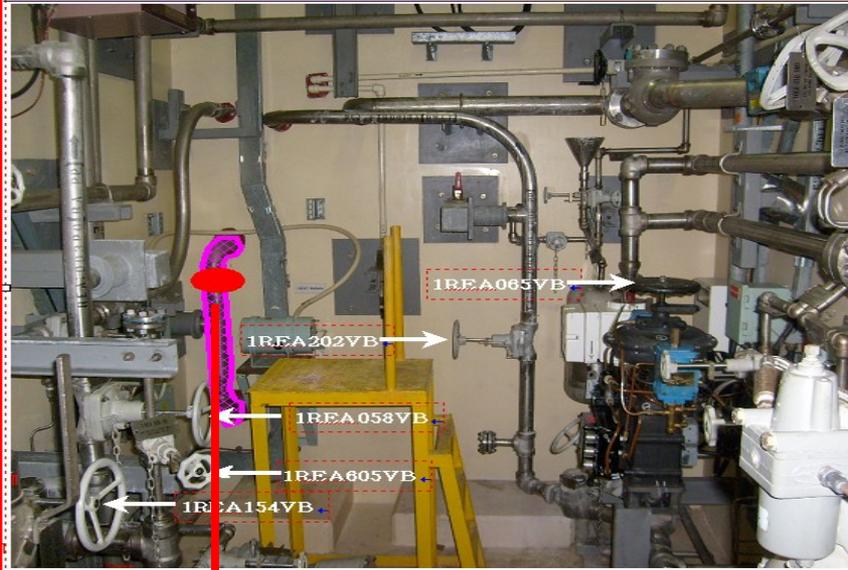
- Size[mm] : 297 X 210[A4 size]
- Material : Acryl plate(1mm)
- Indication methods
  - High radiation spot : Pink color
  - Max. radiation dose rate point : Red color
  - Waiting area : Blue color

# 4. Improved subjects (3/15)

고선량 부위: 

최대선량 지점: 

작업자 대기 가능지역: 



주요 구성기기 : 1REA003/004PO, 1REA011FI, 1KRT001MA





## 가. Rigid enforcement of high radiation area

Improving management methods of radiation shield materials for high radiation area

- ◆ Improving management methods of a frequent inspecting and operating radiation shield materials
  - A sliding door made with a Lead glass(enforced plastics) able to show inside
  - Running Tag to give information if equipment outside of radiation shield materials



Before



After

## 가. Enforcement of high radiation zone control

Improvement of shield applying methods in high radiation area

- ◆ Operation of exclusive radiation radiation shield for permanent using after installing
  - Radiation shield with lead blocks need not to inspect periodically



Before



After

# 4. Improved Subject(7/15)

## ㄱ. Enforcement of high radiation zone control

The improvement of shield for applying in high radiation area

- ◆ Operate after modifying the suitable radiation-shield which are properties of equipment(Glove Box)
  - Upper : Lead-glass able to show inside/Window which is possible open and shut for inspection
  - Side : Recycling of used and useless-lead

Non-installation of the radiation shield



Before

Classification of disposal target lead shield



Recycling of shield



Use the recycled lead on the side



Radiation-shielding from Lead glass on the upper(grip)



After

## ㄱ. Enforcement of high radiation zone control

The improvement of radiation-shield for applying in high radiation field

- ◆ Shielding for damaging spot of shield cover with high temperature
  - Use the thermal resistance material for radiation shielding
  - Infilled frame from using disposal lead blanket

Installation of the radiation shield (lead blanket)

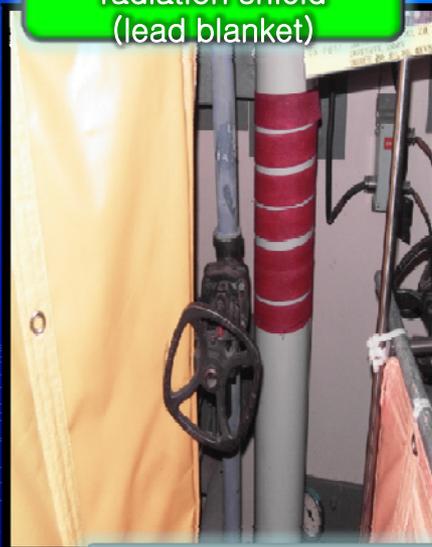


Photo for operation before improving

Damaged lead blanket by high-temp



Recycling of disposal target shield



Photo for operation after improving

Installation on field after assembling



## ㄱ. Enforcement of high radiation zone control

The improvement of radiation-shield for applying in high radiation field

- ◆Rubber radiation shield(including lead) : Fitness for complicated shape target and holds flexibility
- ◆Magneto-radiation-shield : possible to use easily without hanger

Very flexible shield material mixed with resin and lead



Before

After

Installation of Magneto radiation shield on all doors that towards the high radiation field



Before

After

## 가. Enforcement of high radiation zone control

The management for contaminated equipment after shielding

● Photo of unshielding of radiation of high radiation equipment & operate the information board for equipment lists

- Size : 297 X 210(A4)
- Position of the operation : front of the radiation-shield
- Ring form which can be removable easily
- Attach the field-photo for supplying information valve & equipment after even shielding
- contents on the information board
  - The name of equipment for radiation shielding
  - Inside-photo of radiation shield
  - Main valve / the lists of equipment



Unshielded photo & the lists of main equipment



Operation with attaching photo after radiation shielding

# 4. Improved Subject(11/15)

## 가. Enforcement of high radiation zone control

Operation of designated interim storage area for H.R.F

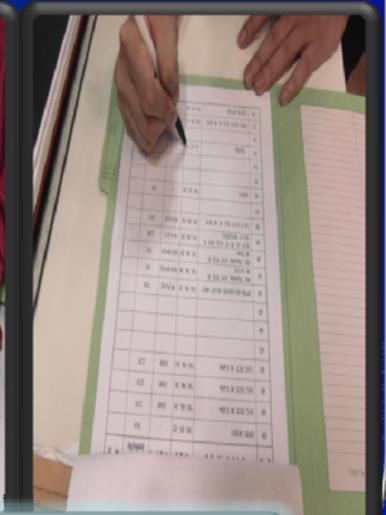
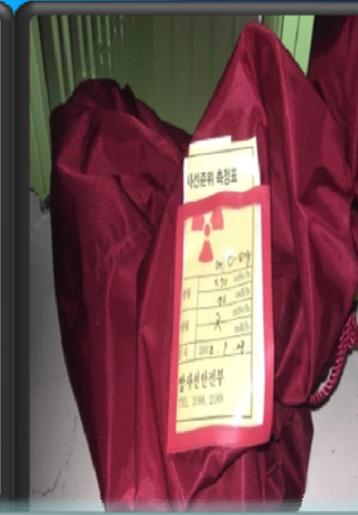
- ◆ Position of the operation : Crane Control Room(N366)
- ◆ 6 month interim storage after choosing with high active waste over 1.0mSv/hr
- ◆ Record the history of the high active wastes (date, field, amount of radiation)



Operation of Interim storage for wastes



Operation of the information board on doors/ management of radiation history



# 4. Improved Subject(12/15)

## 4. Improvement of method of operation from meeting before work

Operation & Connection on large monitor/PC

### ● Operation of movable monitor

- Video recording of High radiation area in reactor building
- Save the Video in the CD and distribute to the maintenance office
- Displaying of video before works meeting

### ● Improvement of method of meeting before work

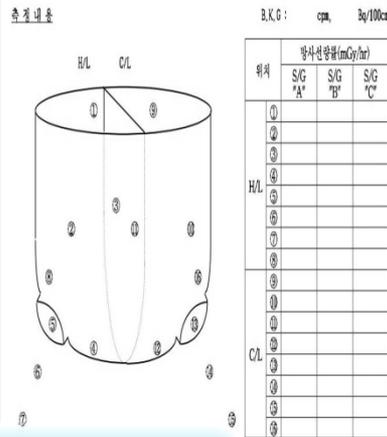
- Providing the information for increasing visual efficiency before works

[Inside video, the information board for information, the method of high radiation equipment and etc.]



Message orally and in written form about do's and don'ts

Use Video of the repair zone



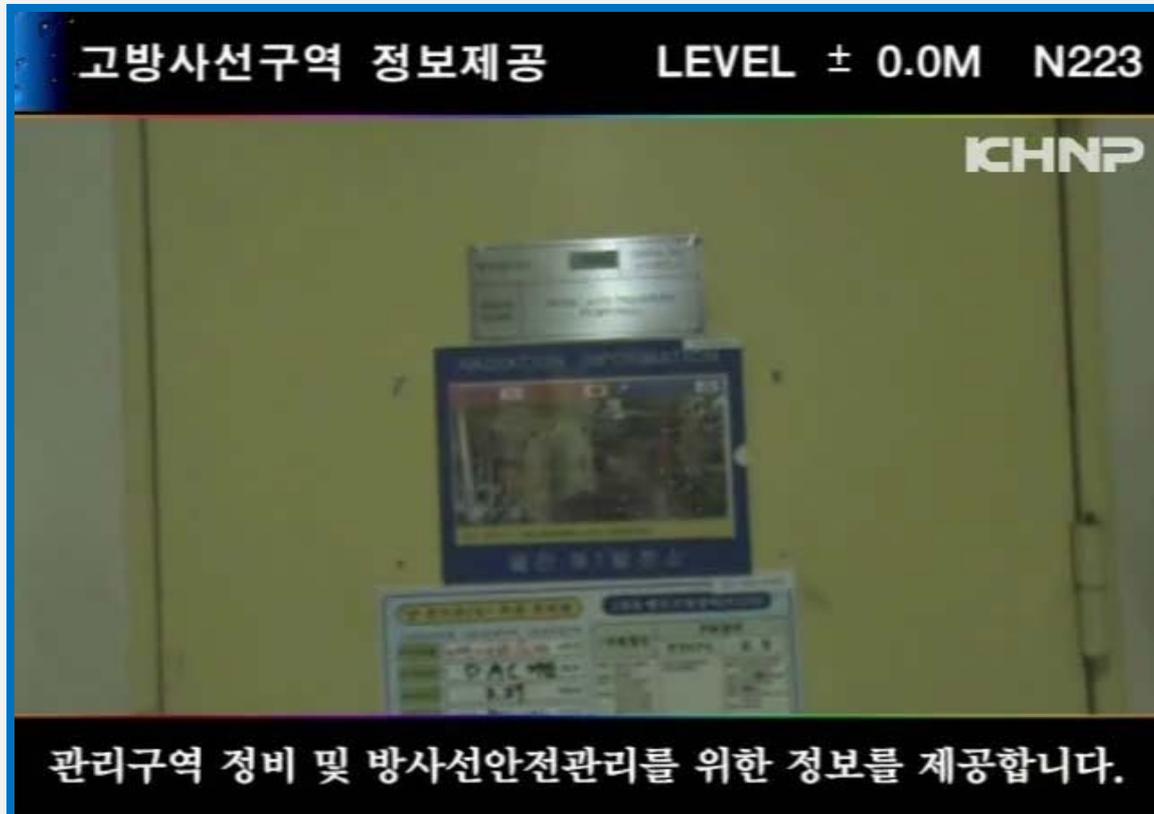
Before

After

## Improvement of method of operation from meeting before work

### Manufacture/Operation of special movable monitor

- Video of high radiation field for supplying the information



- Shooting location
  - N223 [Pump room of boric acid recovery system]
- The information of radiation on the pertinent field
  - Space level of radiation : 0.04 ~ 0.65 mSv
  - Maximum level of radiation : 1.05 mSv
- The method of shooting Video
  - Use camcorder and shoot the high radiation field and valve/equipment with closing up

# 4. Improved Subject (14/15)

Improvement of method of operation of Daily/weekly/monthly & Hot Spot sign

Product with removable easily, possible to recycle, and with striking form

- Product it with removable easily on pipe & equipment
  - Possible to reuse it because of removable things and possible to select banding or magneto depending on the environment
- Form of light acrylic and back part is stainless steel : hardness & light
- Manufacture with recognized type to be showed
  - Possible to do a 360-degree revolution with recognize something easily

The information board for daily, weekly and monthly



Front



Band form



Magneto form

The information board for Hot Spot



Front



Band form



Magneto form



# 4. Improved Subject (15/15)

Operation of improved radiation shield coverall for workers in the high radiation field.

## Rubber & Neutron shield coverall

- Rubber coverall [including lead]
  - Convenient & Flexible, and reduction of weight[12.0 → 6.0 kg]
- Neutron shield coverall
  - The 1st Shielding with PE which is good for diffused efficiency then, The 2nd shielding with



**Before**



**After**



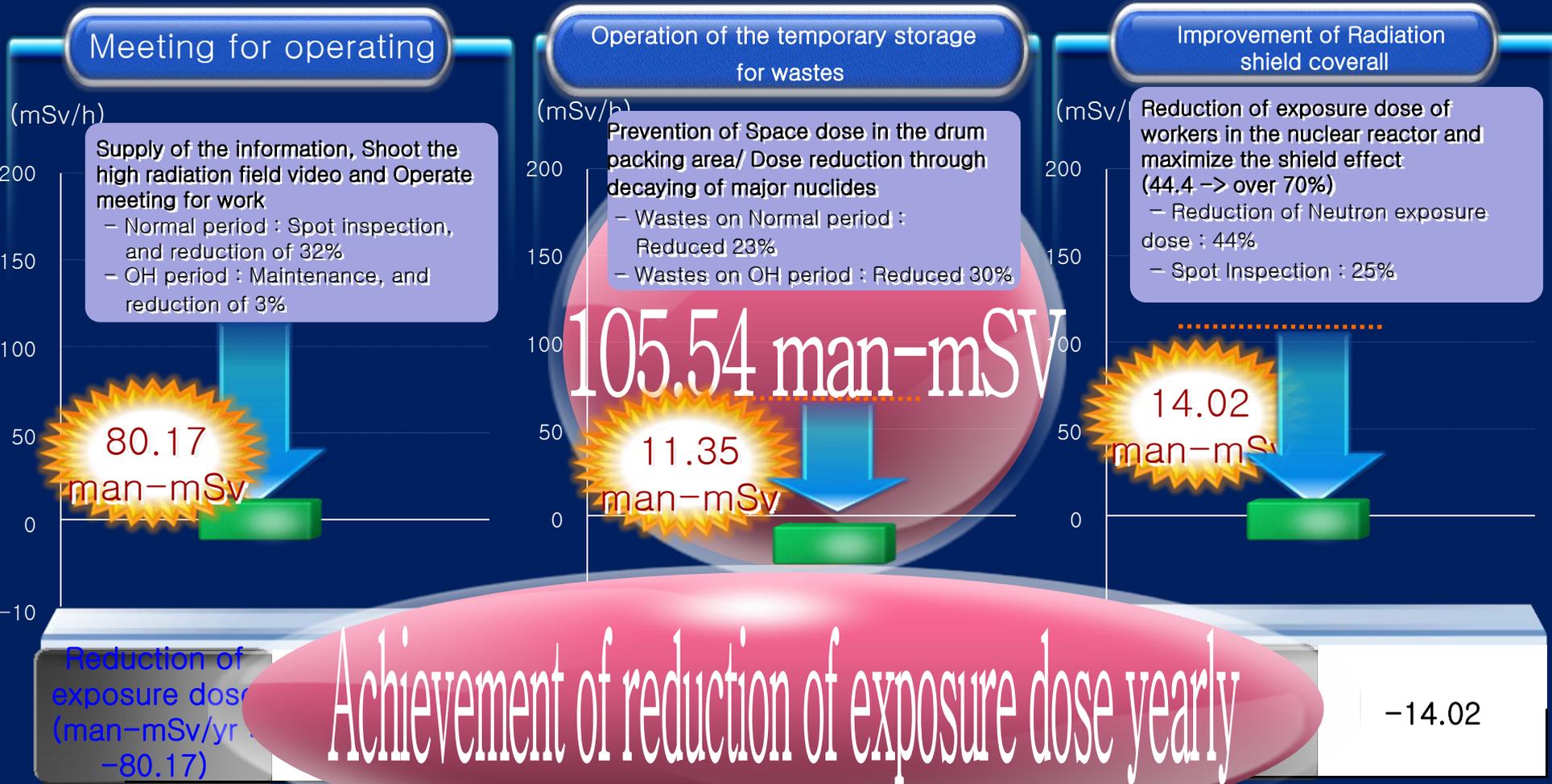
**Operation of Neutron shield coverall**



# 5. The results of Improvement (1/2)

## Typical effect

● Period of time : '09. 01. 01 ~ 12. 31



## Incorporeity effect

Prevent error regarding to wrong and high dose point when operating in the high radiation area

Improvement of Communication & Suppling the information for workers in the high radiation area

Build the advanced radiation safety supervision through exposure dose with the maximizing Sight effect



# 6. Future plans (1/1)



ALARA Symposium  
ALARA Symposium

Present ALARA Symposium

Thank you!

푸른 하늘과 사랑에 빠지다?  
일가 걱정 없는 대한민국의 하늘,  
보단 볼수록 더 후회러집니다  
이제 더 많은 것을 즐기십시오

