

Operation of Remote Monitoring & Video telephony System for Advanced Radiation Protection

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I . Primary Problems of Existing Radiation Protection



. Primary Problems of Existing Radiation Protection

1. Radiation Protection before Operating RMVS

High Radiation Area

- ✓ Entrance Control after Locking Restricted Area
- ✓ Attachment of Radiation Information Directory on Entrance Door
- ✓ Installation of Lead Shield at High Radiation Equipments/Pipings
- ✓ Holding of Pre-job Briefing
- ✓ Routine Survey
- ✓ Attendance of RP Technicians at Field Works in High Radiation Area
 - ☞ Radiation Protection for Simultaneous & Multiple Works
 - ☞ Measurement of Radiation Dose Rate/Surface Contamination Level/Air Contamination Level

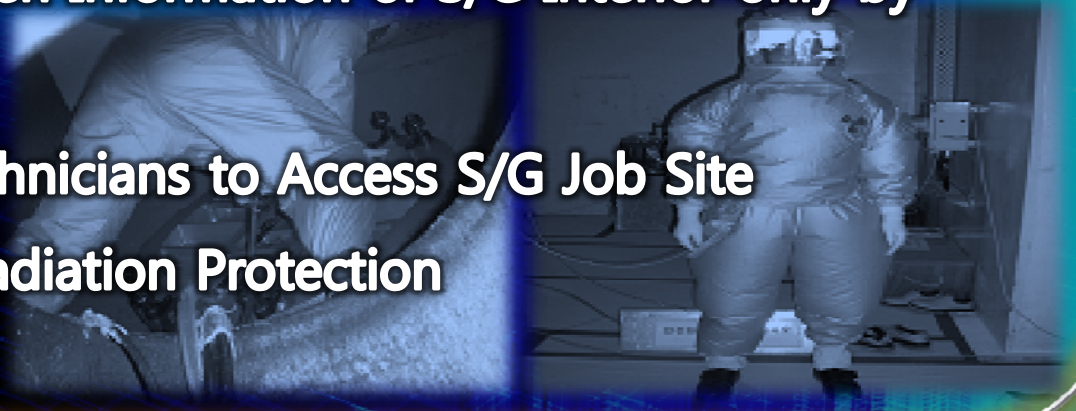


. Primary Problems of Existing Radiation Protection

1. Radiation Protection before Operating RMVS

Installing/Removing Nozzle Dam of Steam Generator

- ✓ Mock-up Training for Rehearsal of Real Works
- ✓ Main Workers Enter inside S/G to Install & Remove Nozzle Dam
- ✓ Supervisors Control Main Workers at the Entrance of S/G Man-Way
- ✓ It's Possible to be given Information of S/G Interior only by Main Workers
- ✓ It's Impossible RP Technicians to Access S/G Job Site for a Long Time for Radiation Protection



. Primary Problems of Existing Radiation Protection

2. Primary Problems

Increase of Radiation Exposure

- ✓ **Increase in Maintenance Quantity in Proportion to Operation Time**
 - ☞ **Increase in Work Load of Workers & RP Technicians**
 - ☞ **Increase in the Number of Entrance to Radiation Area for Maintenance**
- ✓ **Insufficiency of Prompt Response System for Emergency Situation with Rapid Increase of Radiation Dose Rate & Abnormal Facility/ Equipments**
 - ☞ **Management of Majority Job Sites by Minority RP Technicians**
 - ☞ **Absence of Real Time & Remote Monitoring System being able to Measure Radiation Dose Rate**
- ✓ **Insufficiency of Real Time Radiation Protection only by depending Routine Survey of Field RP Technicians**

. Primary Problems of Existing Radiation Protection

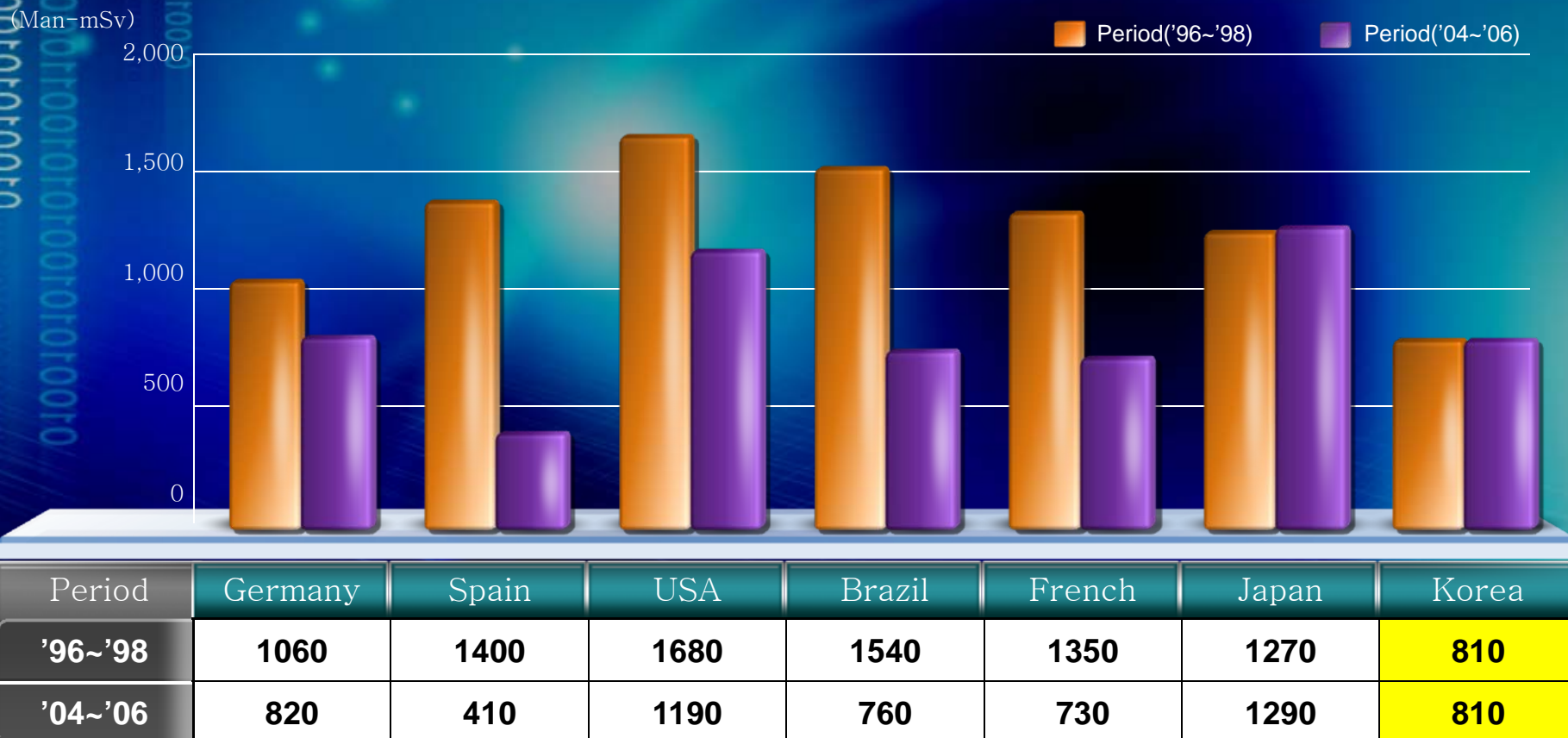
2. Primary Problems

Necessary Access to High Radiation Area & Hot Spot

- ✓ **Impossibility of Direct & Smooth Communication with workers/Supervisors/RP Technicians**
 - ☞ **Use of Page Phone of Convention Type**
 - ☞ **Insufficiency of Telecommunication Devices with Telephones, etc**
- ✓ **Insufficiency of Visual Information Devices with CCTV, etc**
 - ☞ **Installation of CCTV in Minority Areas for Monitoring Plant Operation**
 - ☞ **Absence of Exclusive Monitoring System for Radiation Protection**
- ✓ **Absence of Remote System to minimize Access to Field**
 - ☞ **Field Survey Centered Radiation Protection**

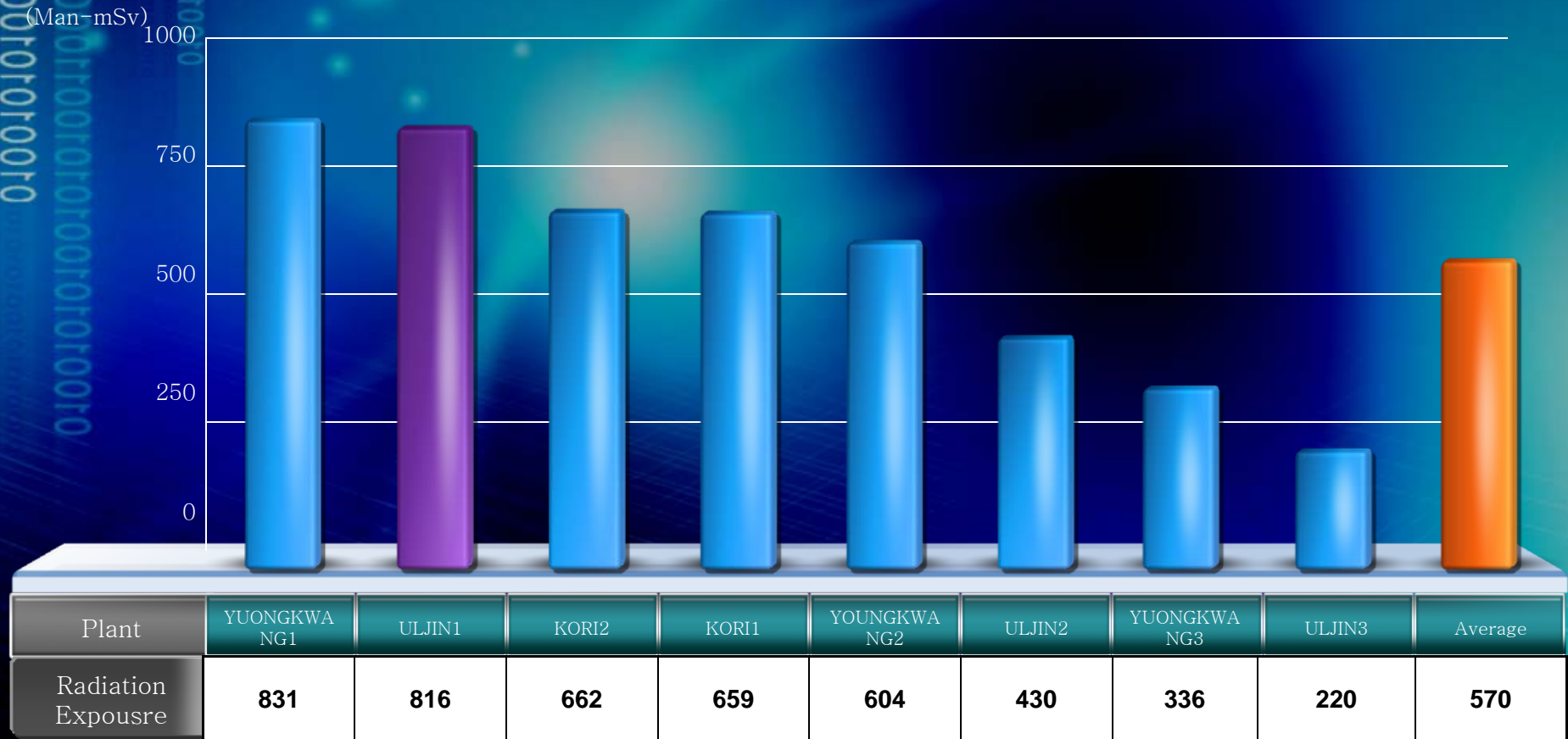
I . Primary Problems of Existing Radiation Protection

Radiation Exposure of Major Country during Outage Period('96~'06)



. Primary Problems of Existing Radiation Protection

Radiation Exposure of Korea NPP for Outage Period(The past 3 years)





II . Features of Operating RMVS



II . Features of Operating RMVS

RMVS ?

Remote Monitoring & Video Telephony System

- ✓ Remote Monitoring
- ✓ Remote Control
- ✓ Video Telephony
- ✓ Continuous Radiation Detection (Telemetry)



**Remote Control System
for Radiation Protection**



II . Features of Operating RMVS



Field



**RMVS Control Center
(Health Physics Room)**



II . Features of Operating RMVS

1. Operation of RMVS in Reactor Building

✓ **Operation Period : Outage(2010.02.26 ~ 2010.04.27)**

✓ **Field RMVS Equipments : 16 EA**

☞ **Location : Primary Radiation Workshop in Reactor Building**

✓ **RMVS Control Center : 2EA**

☞ **Location : Surroundings of Reactor Cavity / Health Physics Room**

|| . Features of Operating RMVS

1. Operation of RMVS in Reactor Building

✓ Field RMVS Equipments : 16 EA

☞ Location : Primary Radiation Workshop in Reactor Building



- ✓ Equipped with Camera
- ✓ Remote Audio Telecommunication
- ✓ Call Signal Transmission to RP Technicians
- ✓ Mobile Installation
- ✓ Easy Control
- ✓ Page Phone Substitute

II . Features of Operating RMVS

1. Operation of RMVS in Reactor Building

✓ RMVS Control Center : 2EA

☞ Location : Side of Reactor Cavity / Health Physics Room



- ✓ 16CH Monitoring
- ✓ Call Signal Transmission to Field Workers/RP Technicians
- ✓ Remote Control for Field RMVS Cameras
- ✓ Real Time Recording
- ✓ Remote Communication with Workers and RP Technician of Field/Health Physics Room

II . Features of Operating RMVS

2. Operation of RMVS in High Radiation Area

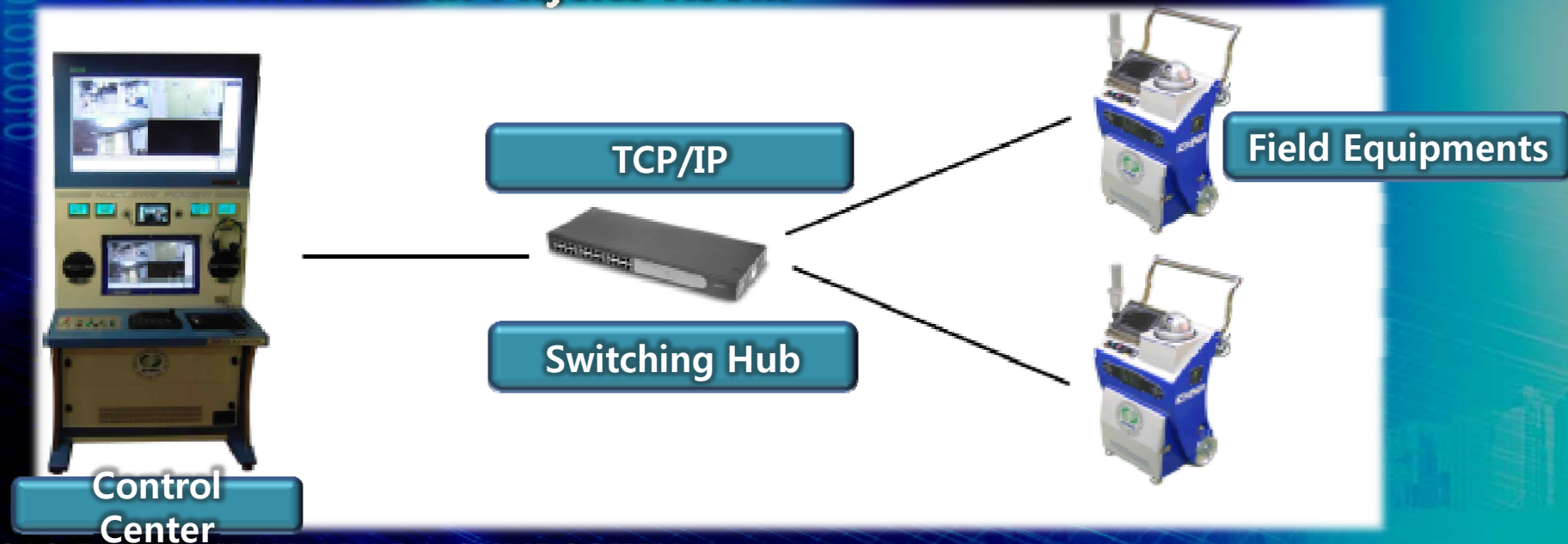
✓ Operation Period : Constant Operation(2010.01 ~)

✓ Field RMVS Equipments : 17 EA

☞ Location : High Radiation Area & Primary Workshop/Passageway

✓ RMVS Control Center : 1SET

☞ Location : Health Physics Room



II . Features of Operating RMVS

2. Operation of RMVS in High Radiation Area

✓ Field RMVS Equipments : 17 EA

☞ Location : High Radiation Area & Primary Workshop/Passageway



- ✓ Equipped with Cameras
- ✓ Video Telephony
- ✓ Continuous Radiation Detection(Telemetry)
- ✓ Call Signal Transmission to RP Technicians by field Workers
- ✓ Mobile Installation
- ✓ Easy Control
- ✓ Page Phone Substitute

II . Features of Operating RMVS



II . Features of Operating RMVS

2. Operation of RMVS in High Radiation Area

✓ RMVS Control Center : 1SET

☞ Location : Health Physics Room



- ✓ 17CH Monitoring
- ✓ Video Telephony
- ✓ Real Time Display of Radiation Dose Rate from Field RMVS Equipments
- ✓ Send Call Signal to Field Workers/RP Technicians
- ✓ Remote Control for Field RMVS Camera
- ✓ Real Time Recording

III. Features of Operating RMVS



Main Monitor

Auxiliary Monitor

Head Set

Mike

Speaker

Auxiliary Monitor

Control Board

II . Features of Operating RMVS

3. Operation of RMVS for Installing/Removing Nozzle Dam of Steam Generator

✓ Operation Period : Installing/Removing Nozzle Dam of S/G Process during Outage

✓ Field RMVS Equipments : 2EA

☞ Location : Inside Hot/Cold Leg of S/G

✓ RMVS Control Center : 1EA

☞ Location : Surroundings of S/G Room



II . Features of Operating RMVS

3. Operation of RMVS for Installing/Removing Nozzle Dam of Steam Generator

✓ Field RMVS Equipments : 2EA

☞ Location : Inside Hot/Cold Leg of S/G



- ✓ Equipped with Camera**
- ✓ Remote Audio Telecommunication(Blue Tooth Head Set)**
- ✓ Moved & Fixed on the Surface of Steep Wall by Caterpillar & Magnetic Wheel**
- ✓ Easy Control**

II . Features of Operating RMVS



**Blue Tooth
Head Set**

Speed Dome Camera



**Caterpillar & Magnetic
Wheel**

II . Features of Operating RMVS

3. Operation of RMVS for Installing/Removing Nozzle Dam of Steam Generator

✓ **RMVS Control Center : 1EA**

☞ **Location : Outside of S/G Room**



- ✓ 2CH Monitoring(Maximum 4CH)
- ✓ Remote Telecommunication(Blue Tooth)
- ✓ Counting Work Time
- ✓ Remote Control for Field RMVS Equipments
- ✓ Real Time Recording

II . Features of Operating RMVS



Large Monitor

**Display Monitor of
Counting Work Time**

Control Button

Control Handle

II . Features of Operating RMVS

Production Cost of RMVS

✓ Reactor Building RMVS



Control Center 1Set



Field Equipments 16EA

≡ *85,800,000 won*

✓ High Radiation Area RMVS



Control Center 1Set



Field Equipments 17EA

≡ *180,000,000 won*

✓ Steam Generator RMVS



Control Center 1Set



Field Equipments 2EA

≡ *140,000,000 won*

Total Production Cost : 495,800,000 won



III. Benefits of Operating RMVS

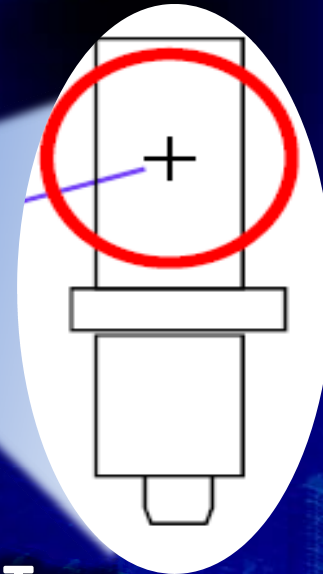


III. Benefits of Operating RMVS

1. Reduction of Radiation Exposure & Advancement of Radiation Protection

✓ Real Time Monitoring of Radiation Dose Rate from Primary Workshop

☞ Equipped with Radiation Detector



✓ GM Type
✓ $0.01\mu\text{Sv} \sim 10,000,000 \mu\text{Sv}$

III. Benefits of Operating RMVS

1. Reduction of Radiation Exposure & Advancement of Radiation Protection

✓ Real Time Monitoring of Radiation Dose Rate from Primary Workshop

☞ Real Time Display of Dose Rate from Field RMVS Equipments



III. Benefits of Operating RMVS

1. Reduction of Radiation Exposure & Advancement of Radiation Protection

✓ Real Time Control for Field Violators of Radiation Protection Regulations

- ➡ Monitoring/Controlling Access of Unauthorized Worker to Restricted Area
- ➡ Remote Assistance of Field Worker in adherence to Plant Procedures
- ➡ Multi & Continuous Radiation Protection by Field RP Technicians & RMVS Control Center Master in Health Physics Room



III. Benefits of Operating RMVS

1. Reduction of Radiation Exposure & Advancement of Radiation Protection

✓ Reduction of Working Time & the Number of People Accessing Workshop

☞ Direct Intervention by Supervisor to Support Repairs & Complex Tasks without Requiring Supervisor to Enter Workshop



III. Benefits of Operating RMVS

1. Reduction of Radiation Exposure & Advancement of Radiation Protection

✓ Reduction of Radiation Exposure by Operating RMVS

Radiation Exposure during Outage

(man-mSv)

1,000

800

600

400

200

0

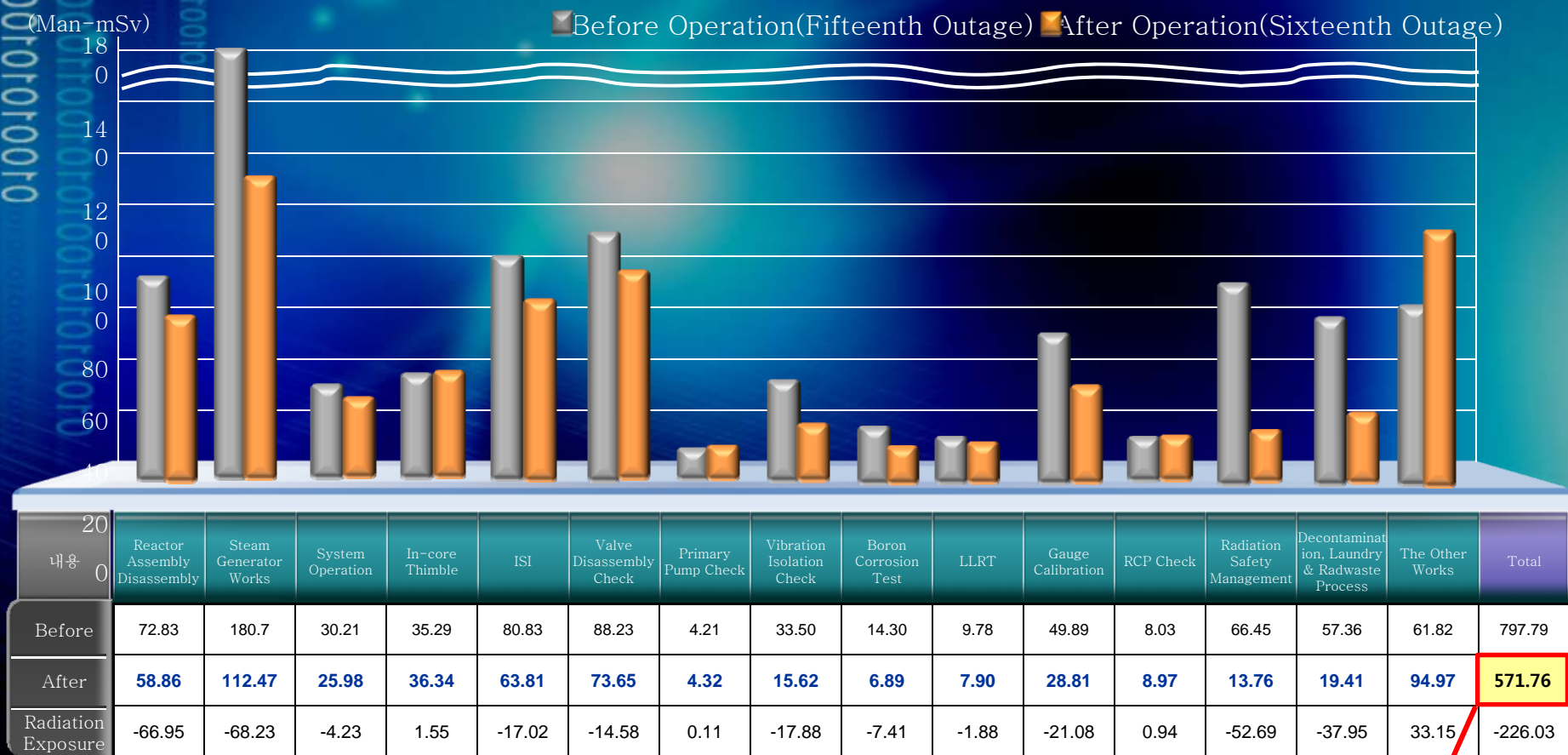


Reduced Radiation Exposure
in comparison with Pre-Operation
226 man-mSv

| Classification | Fifteenth(2008) | Sixteenth(2010) |
|--------------------|-----------------|-----------------|
| Radiation Exposure | 798 | 571 |

III. Benefits of Operating RMVS

1. Reduction of Radiation Exposure & Advancement of Radiation Protection

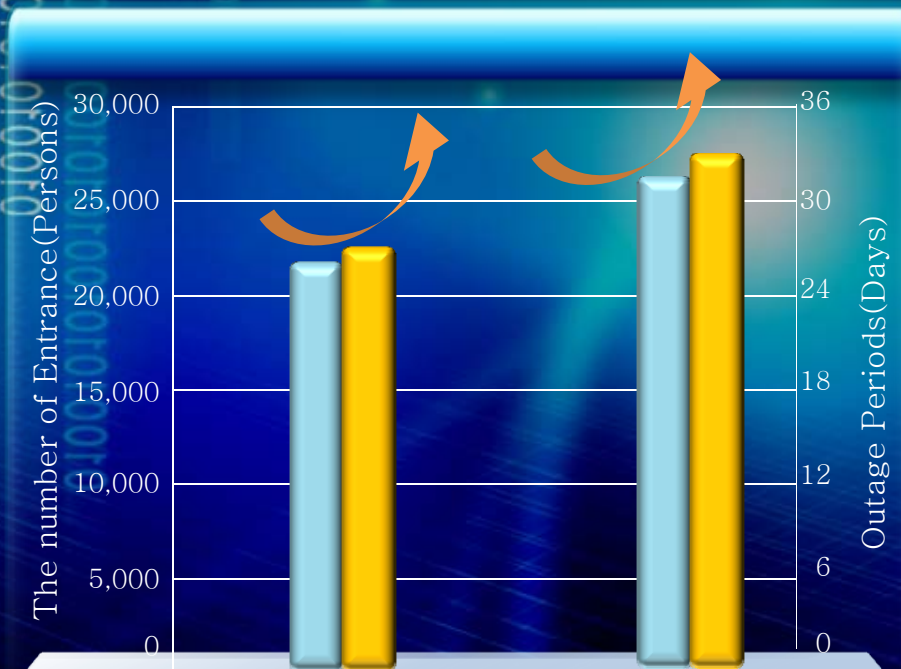


The Lowest Level since the First Operation!!

III. Benefits of Operating RMVS

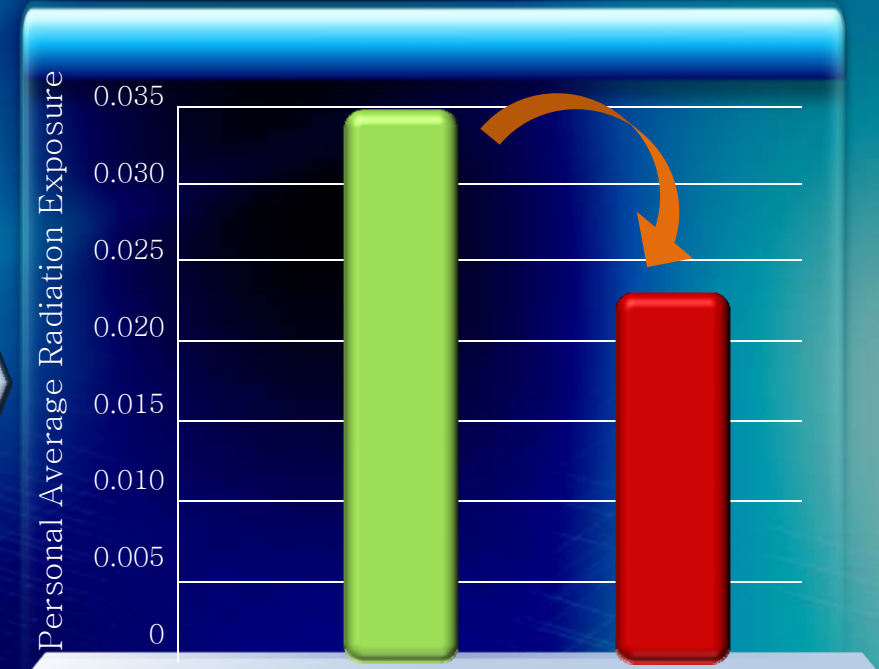
1. Reduction of Radiation Exposure & Advancement of Radiation Protection

■ Before(Fifteenth Outage) ■ After(Sixteenth Outage)



| Outage | Persons | Days |
|--------|---------|------|
| 15th | 22,621 | 31 |
| 16th | 23,842 | 33 |

■ Before(Fifteenth Outage) ■ After(Sixteenth Outage)



| Outage | Personal Average Radiation Exposure(mSv) |
|--------|--|
| 15th | 0.035 |
| 16th | 0.023 |

III. Benefits of Operating RMVS

1. Reduction of Radiation Exposure & Advancement of Radiation Protection

✓ Reduction of Radiation Exposure by Operating RMVS

Radiation Exposure in High Radiation Area

(man-mSv)

100

80

60

40

20

0

Reduced Radiation Exposure
in comparison with Pre-Operation

58.16 man-mSv

구 분

'08.01.01 ~ 03.25

'09.01.01 ~ 03.25

Radiation Exposure

22.08

7.54

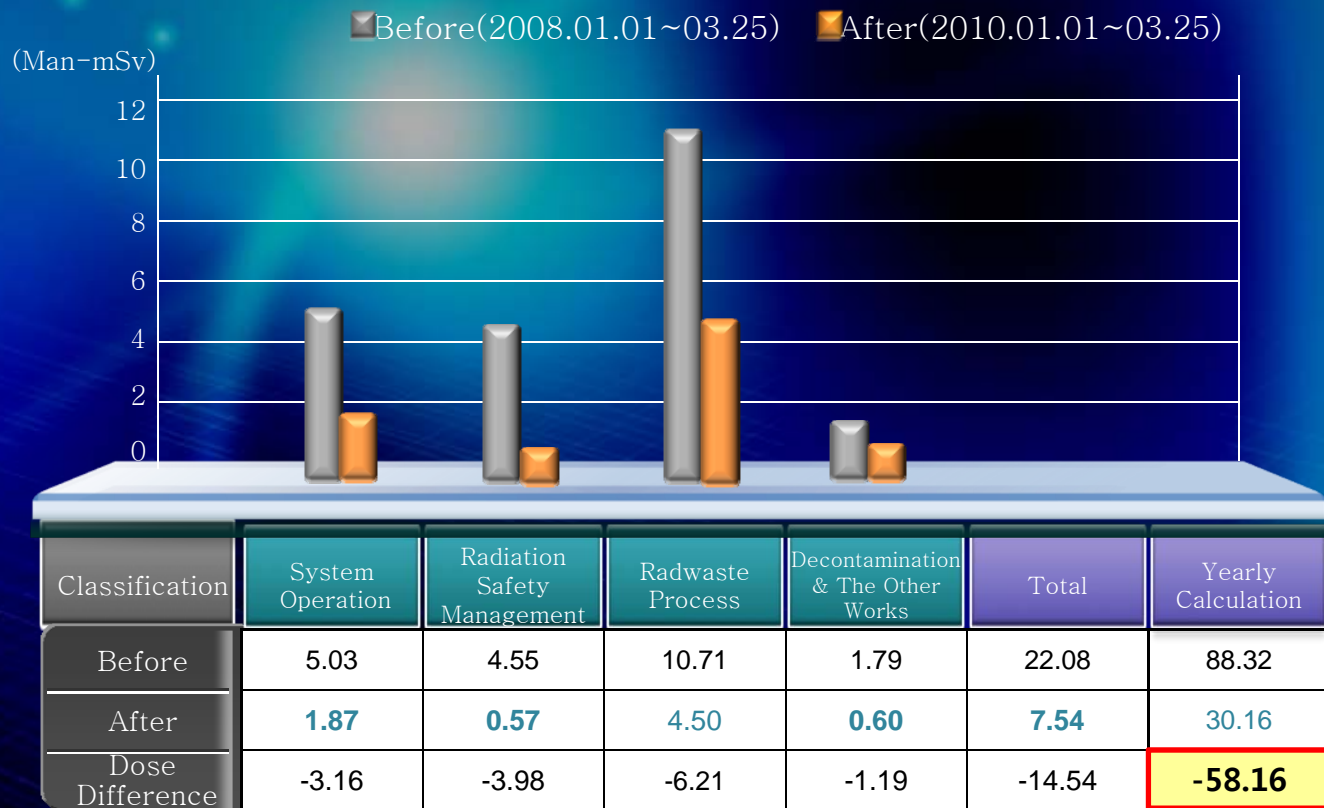
Yearly Calculation

88.32

30.16

III. Benefits of Operating RMVS

1. Reduction of Radiation Exposure & Advancement of Radiation Protection



III. Benefits of Operating RMVS

2. Prompt Response for Emergency Situation

- ✓ Early Detection of Abnormal Radiation, Equipments & Facilities
- ✓ Expansion of RMVS to KHNP Intranet

3. Improvement of Work Efficiency

- ✓ Reference Materials for Pre-job Briefing & Job Training
- ✓ Prompt & Remote Instruction of Supervisor by using RMVS



III. Benefits of Operating RMVS

Information Video for RMVS Operation





Thank You