

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

Weon-Seob Yoon
Manager, Radiation Safety Team

ULCHIN NPP 1

Contents

I

Primary Problems of Existing Radiation Protection

II

Features of Operating RMVS

III

Benefits of Operating RMVS



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

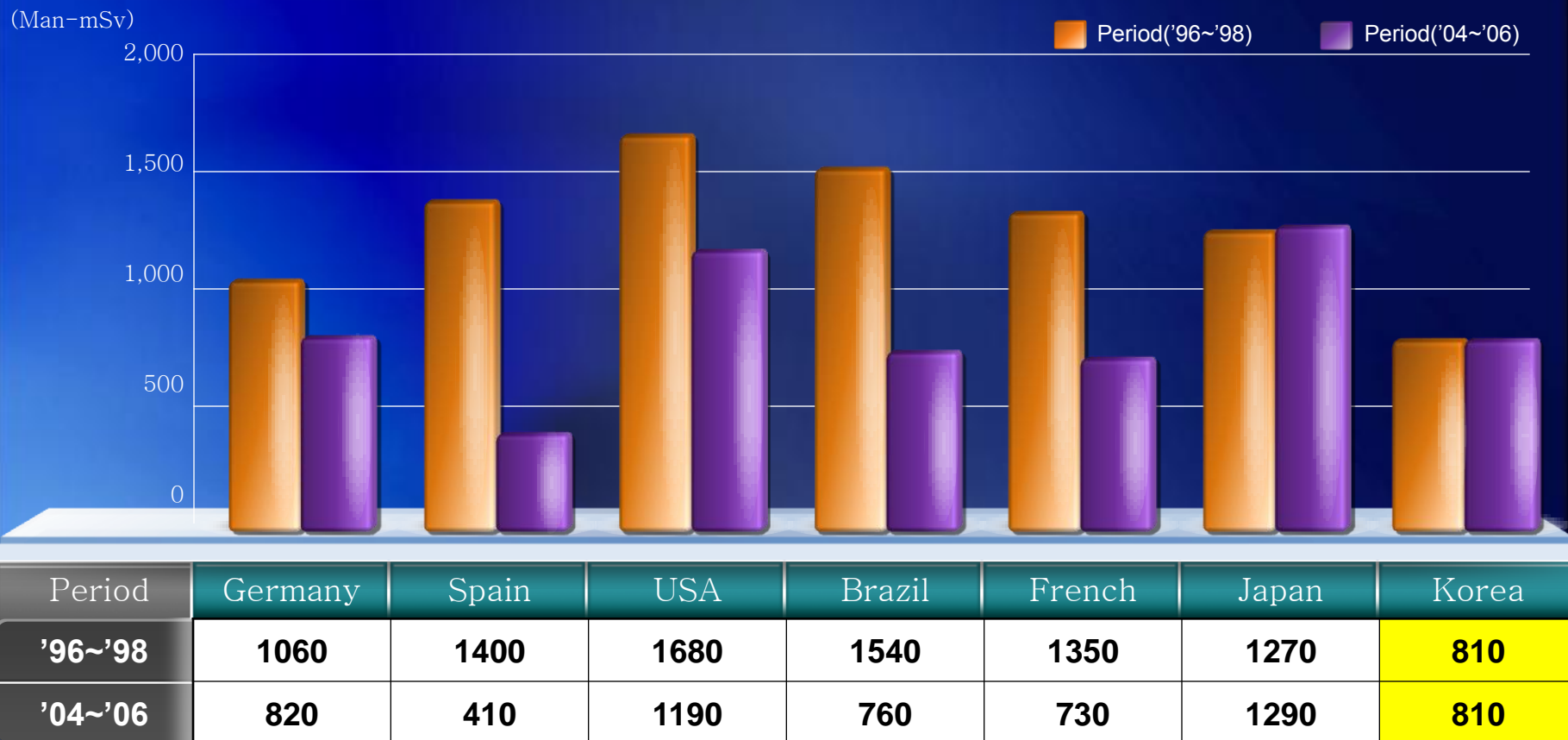
2. Primary Problems

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**

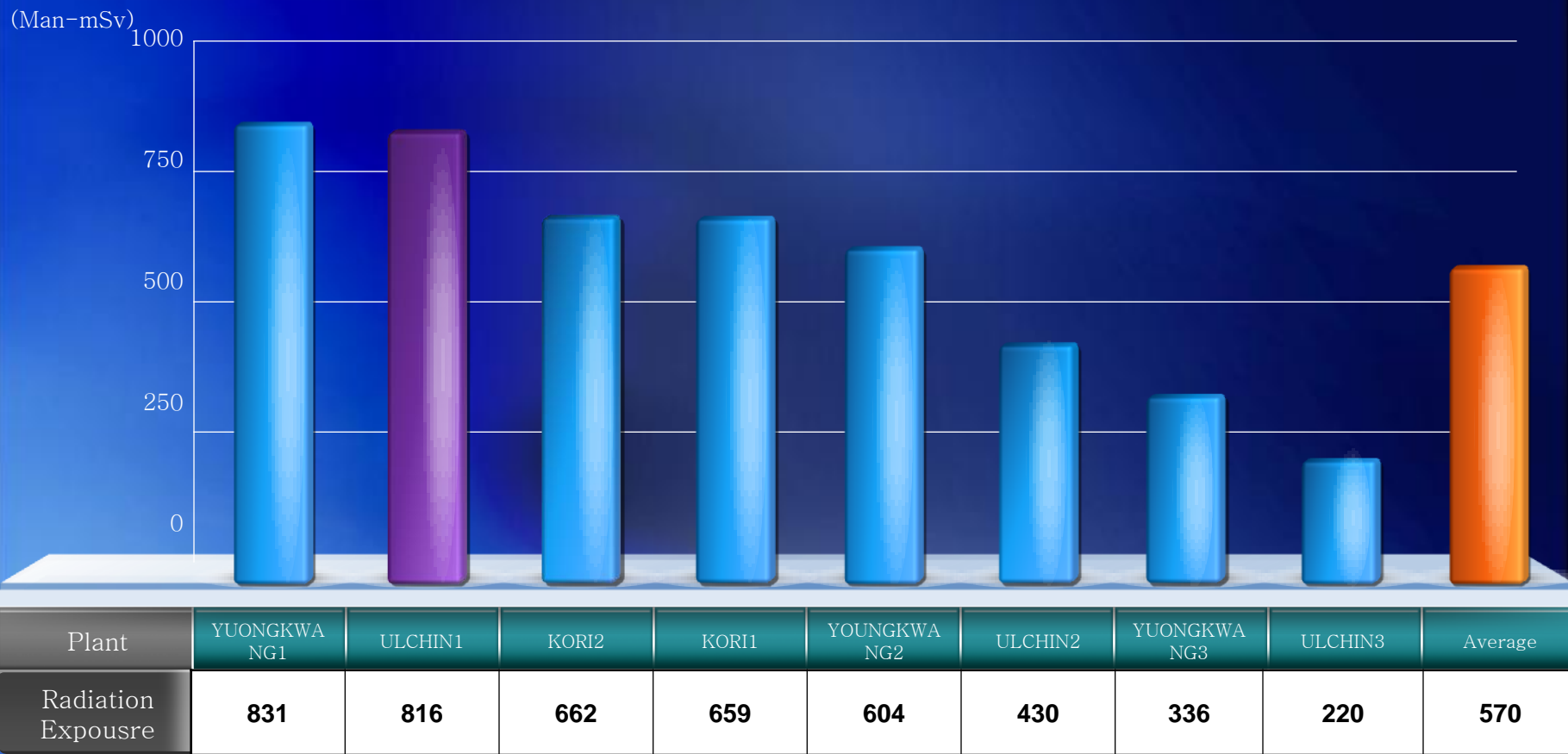
I . Primary Problems of Existing Radiation Protection

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



Fiel



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

II . 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

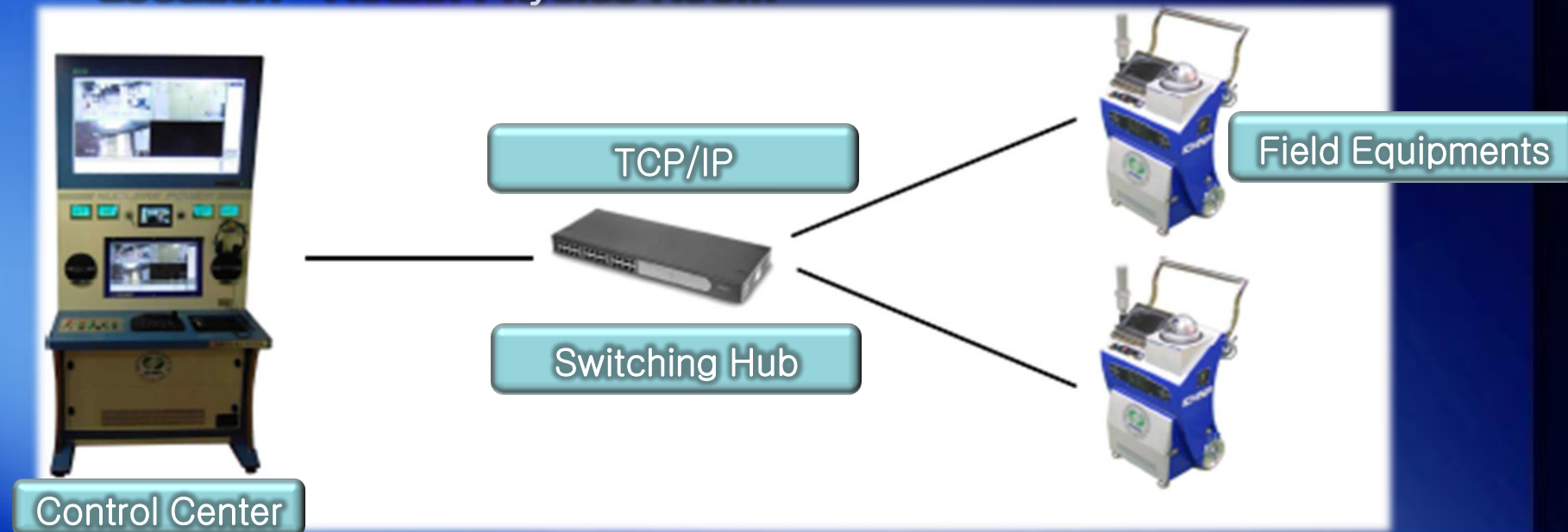
✓ Operation Period : Constant Operation(2010.01 ~)

✓ 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

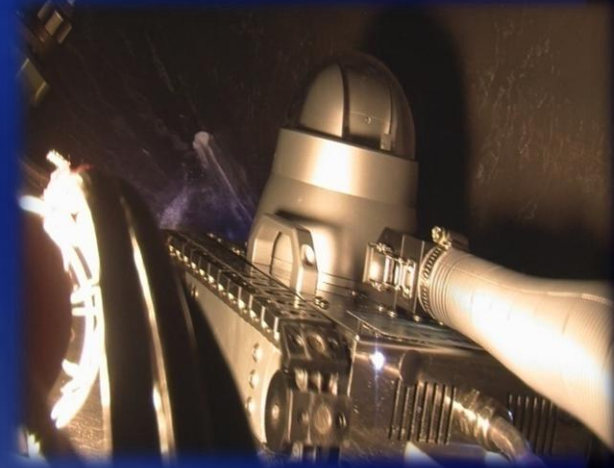
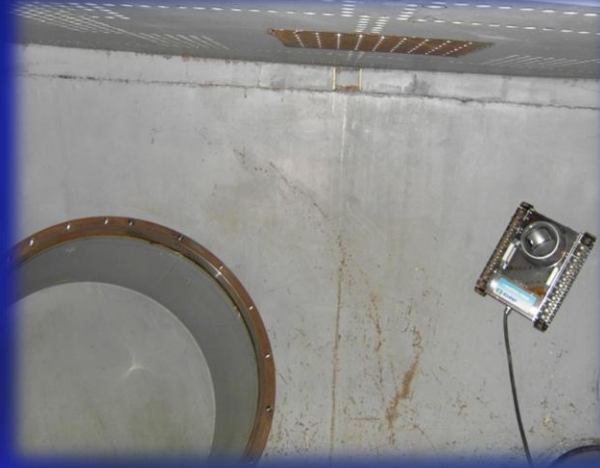


II . Features of Operating RMVS

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

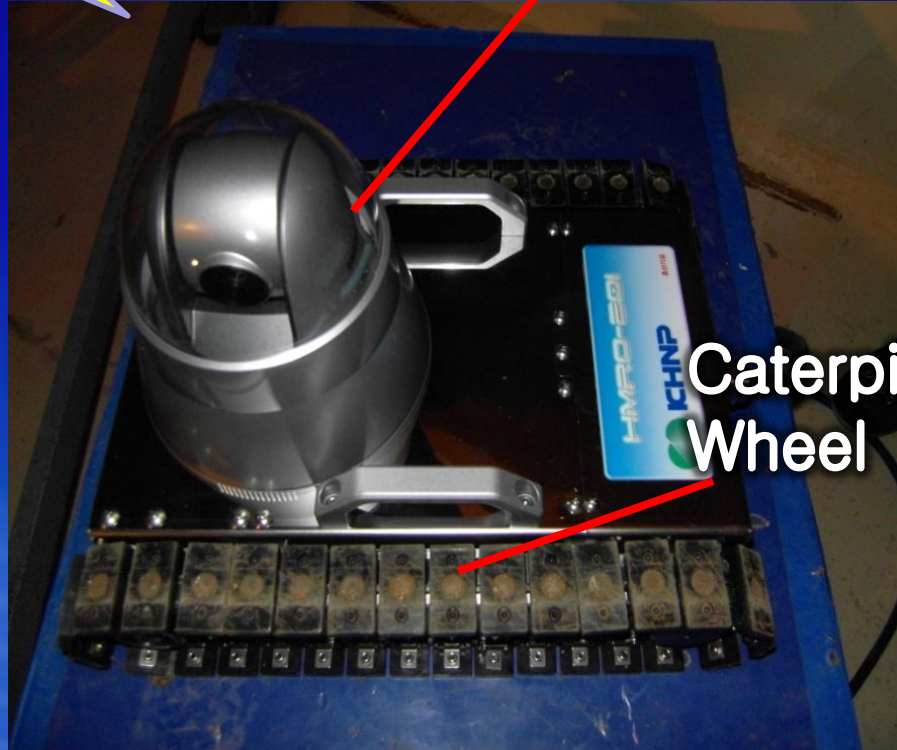
|| . Features of Operating RMVS



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

|| . 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

\equiv 74,615 \$

√ High Radiation Area RMVS



Control Center 1Set



Field Equipments 17EA

\equiv 156,535 \$

√ Steam Generator RMVS



Control Center 1Set



Field Equipments 2EA

\equiv 121,749 \$

Total Production Cost : 352,899 \$



III. Benefits of Operating RMVS

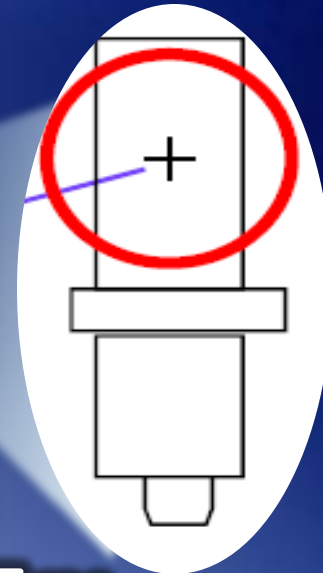


III. Benefits of Operating RMVS

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

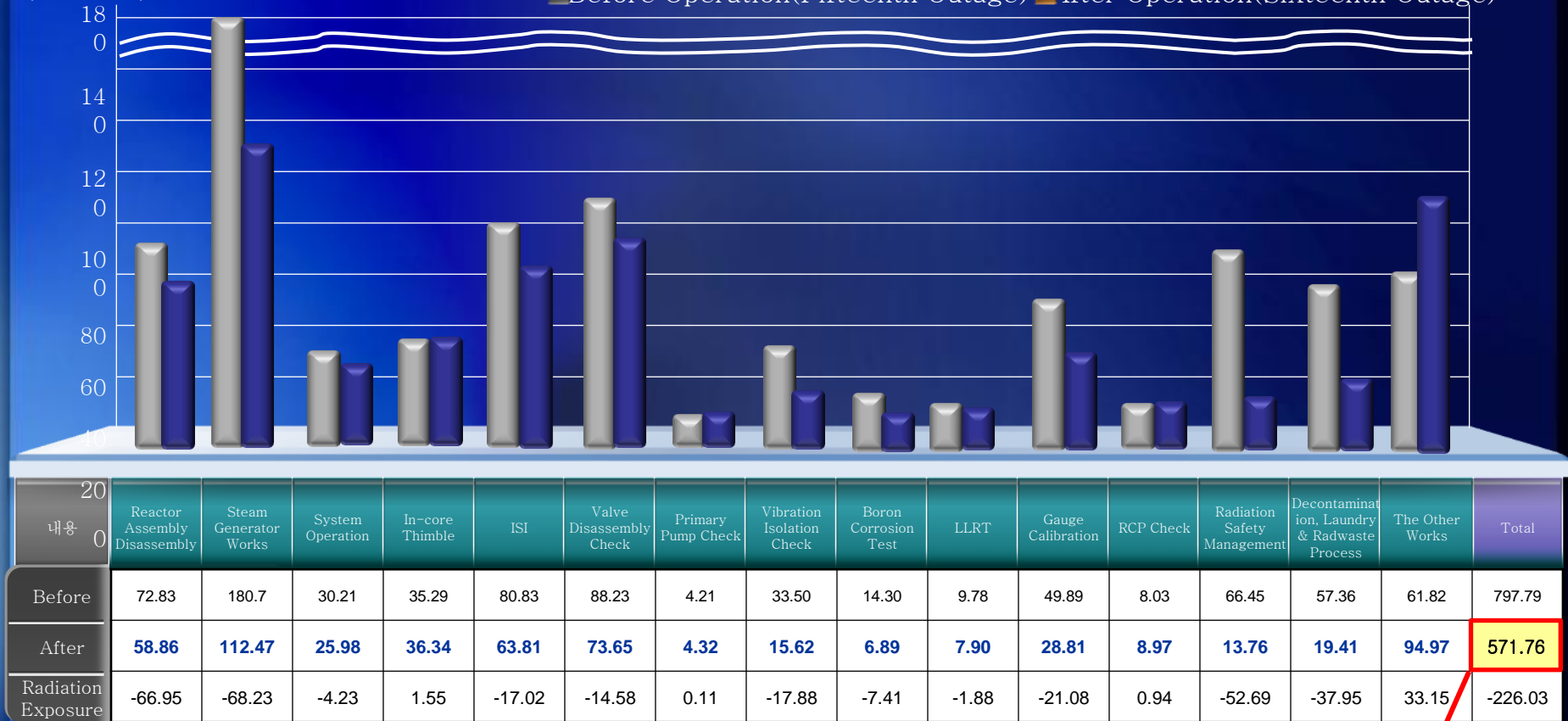
798

571

III. Benefits of Operating RMVS

1. Reduction of Radiation Exposure & Advancement of Radiation Protection

(Man-mSv) ■ Before Operation(Fifteenth Outage) ■ After Operation(Sixteenth Outage)



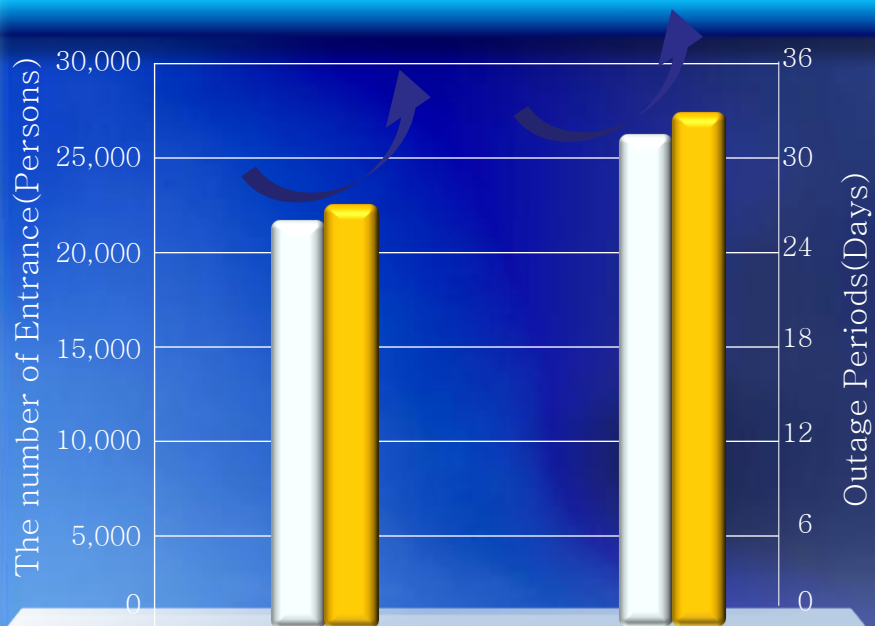
The Lowest Level since the First Operation!!

2012 ISOE INTERNATIONAL ALARA SYMPOSIUM

III. Benefits of Operating RMVS

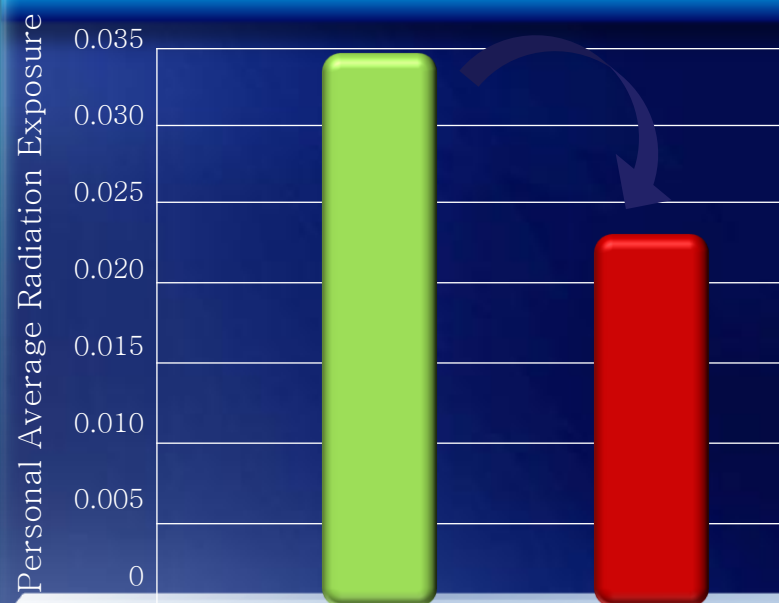
1. Reduction of Radiation Exposure & Advancement of Radiation Protection

■ 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

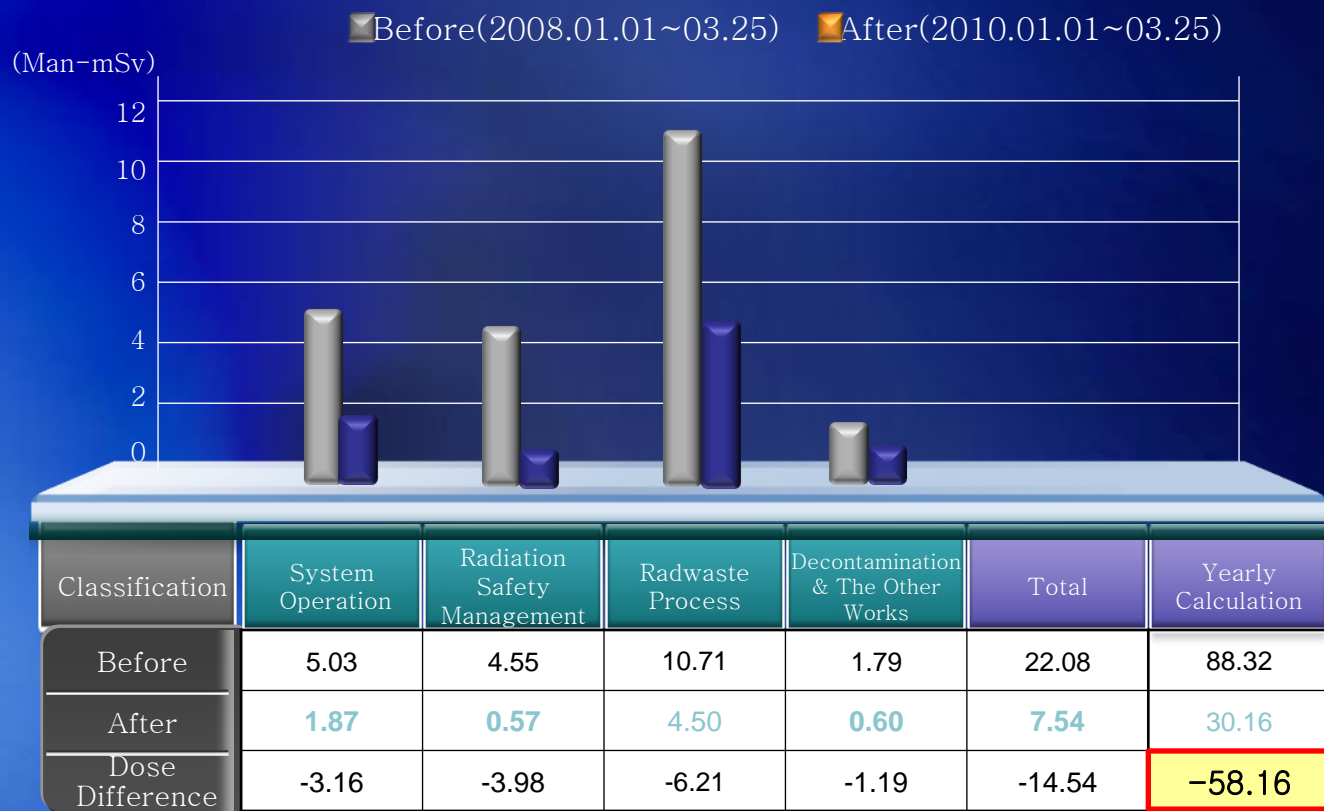
Yearly Calculation

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





e-mail address : yws1234@khnp.co.kr