Dose Rate Reduction Methods at Shimane Nuclear Power Station

Tadashi Kanaoka[1], Hiroyasu Kajitani[1], Tsuneo Sato[1],
Makoto Nagase[2] and Naoshi Usui[2]
[1]The Chugoku Electric Power Company, INC
[2]Hitachi-GE Nuclear Energy, Ltd

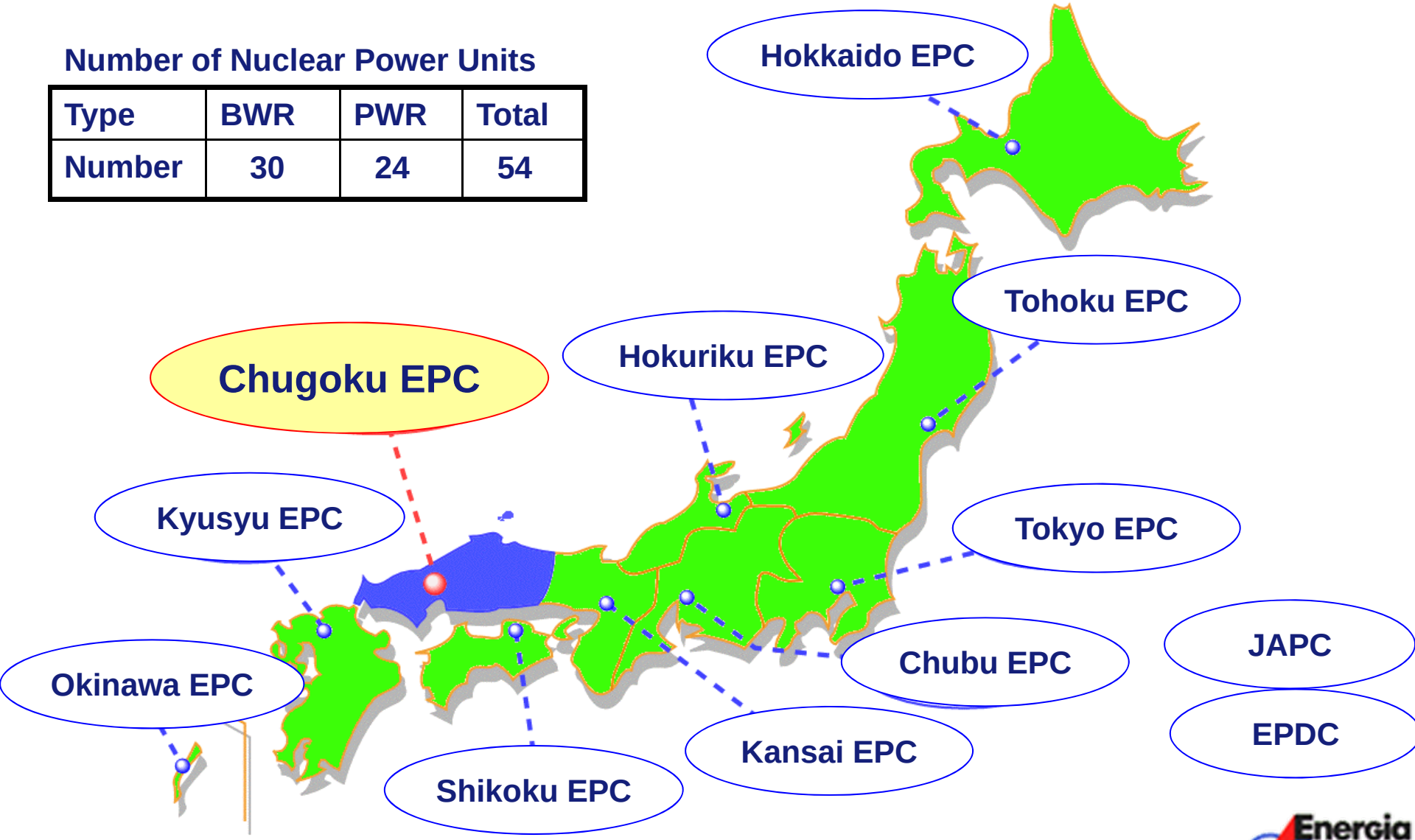
Energia
中国電力株式会社
THE CHUGOKU ELECTRIC POWER CO.,INC

1. Introduction of Chugoku Electric Power Co. and Shimane Nuclear Power Station

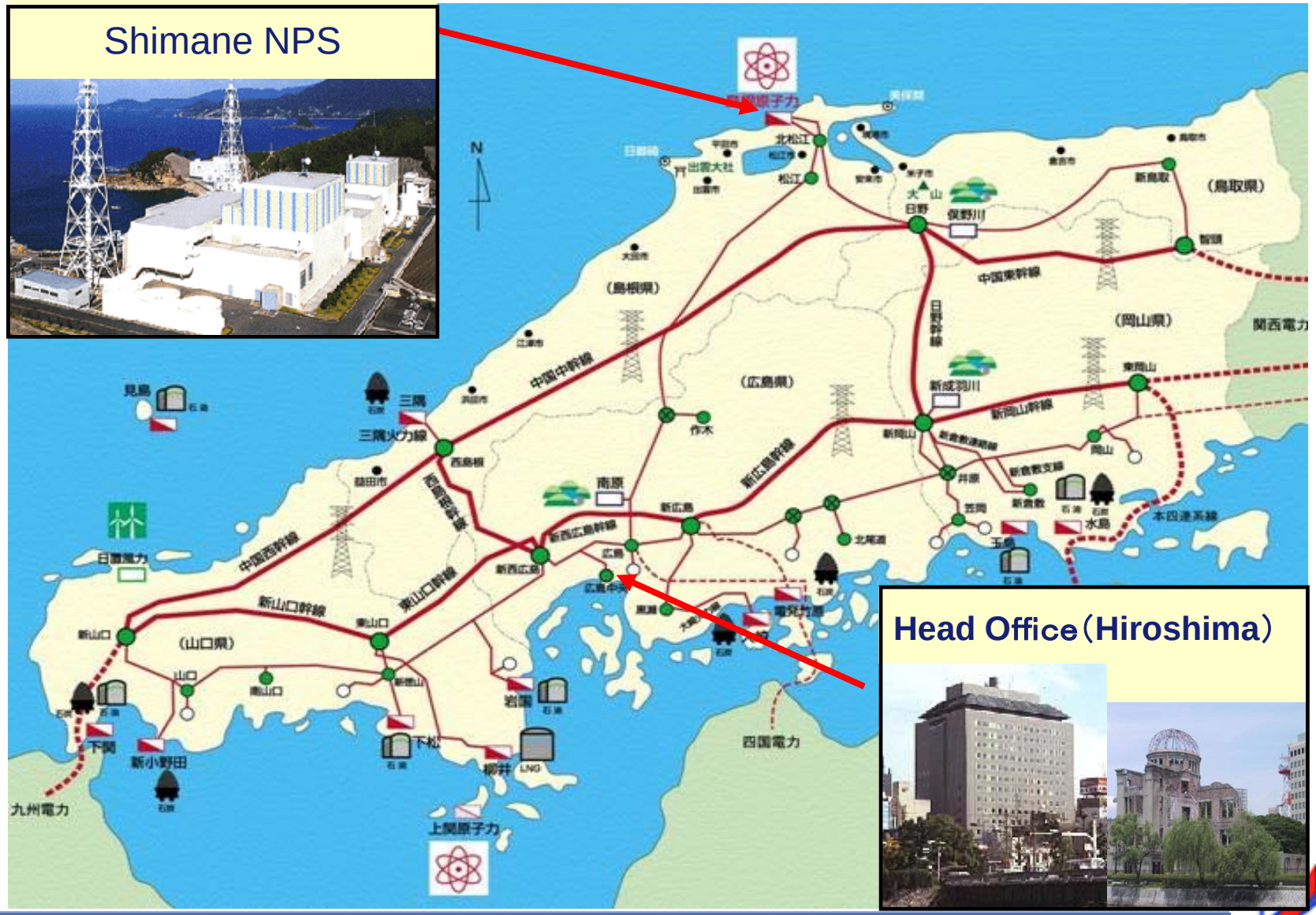
1(1).Electric Power Supply Area of Chugoku Electric Power Co.

Number of Nuclear Power Units

Type	BWR	PWR	Total
Number	30	24	54



1(2).Head Office & Shimane Nuclear Power Station

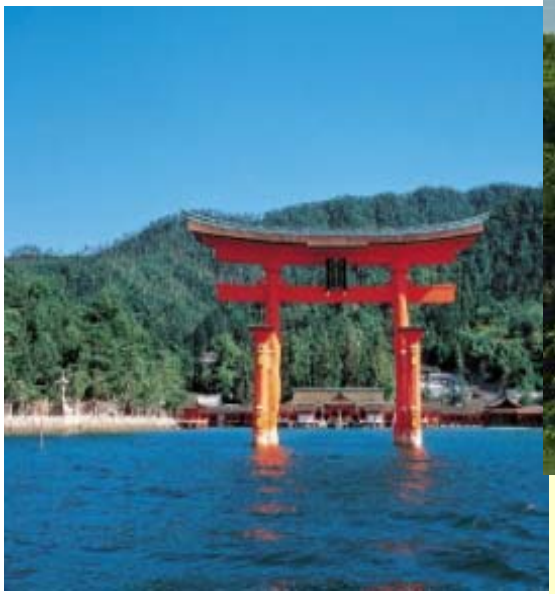


1(3).Peaceful city Hiroshima

An atomic bomb was dropped on Hiroshima at 8:15 a.m. on August 6, 1945, and most of cities collapsed, but revived. Now Hiroshima is the biggest city among the Chugoku district, whose population is about 1.2 million.

1(3).Peaceful city Hiroshima(2)

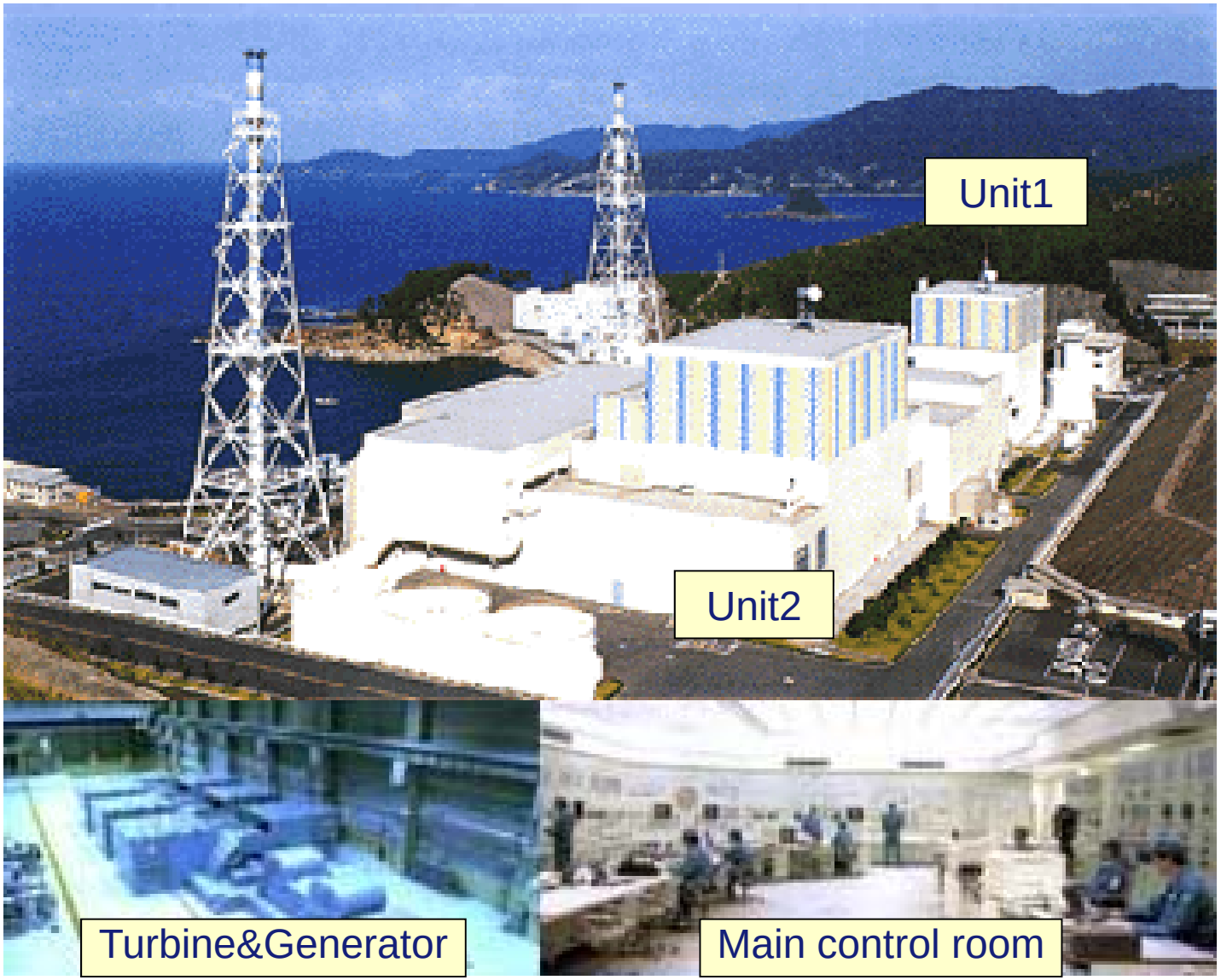
- In Hiroshima, there are two world heritages of Atomic Bomb Dome which shows the tragedy of the atomic bomb and Miyajima which is a rare Shinto shrine to stand in the sea in the suburbs.
- Our head office is located at the city center which is about 10 minutes walk distance from the Atomic Bomb Dome.



1(4).Our Nuclear Power Plants

	Unit 1	Unit 2	Unit 3
Start of commercial operation	March, 1974	February, 1989	December, 2011 (Scheduled)
Electric output	460,000 kW	820,000 kW	1,373,000 kW
Reactor type	Boiling Water Reactor (BWR)	Boiling Water Reactor (BWR)	Advanced Boiling Water Reactor (ABWR)
Number of fuel assembly	400	560	872
Number of control rod	97	137	205

1(5).Shimane Nuclear Power Plant Unit 1 & 2



1(6).Shimane Nuclear Power Plant Unit 3 (Status)

Under construction for a start of commercial operation in December, 2011
Total construction progress rate: 88.8% at the end of September, 2010

2(1).Radiation exposure of the outage

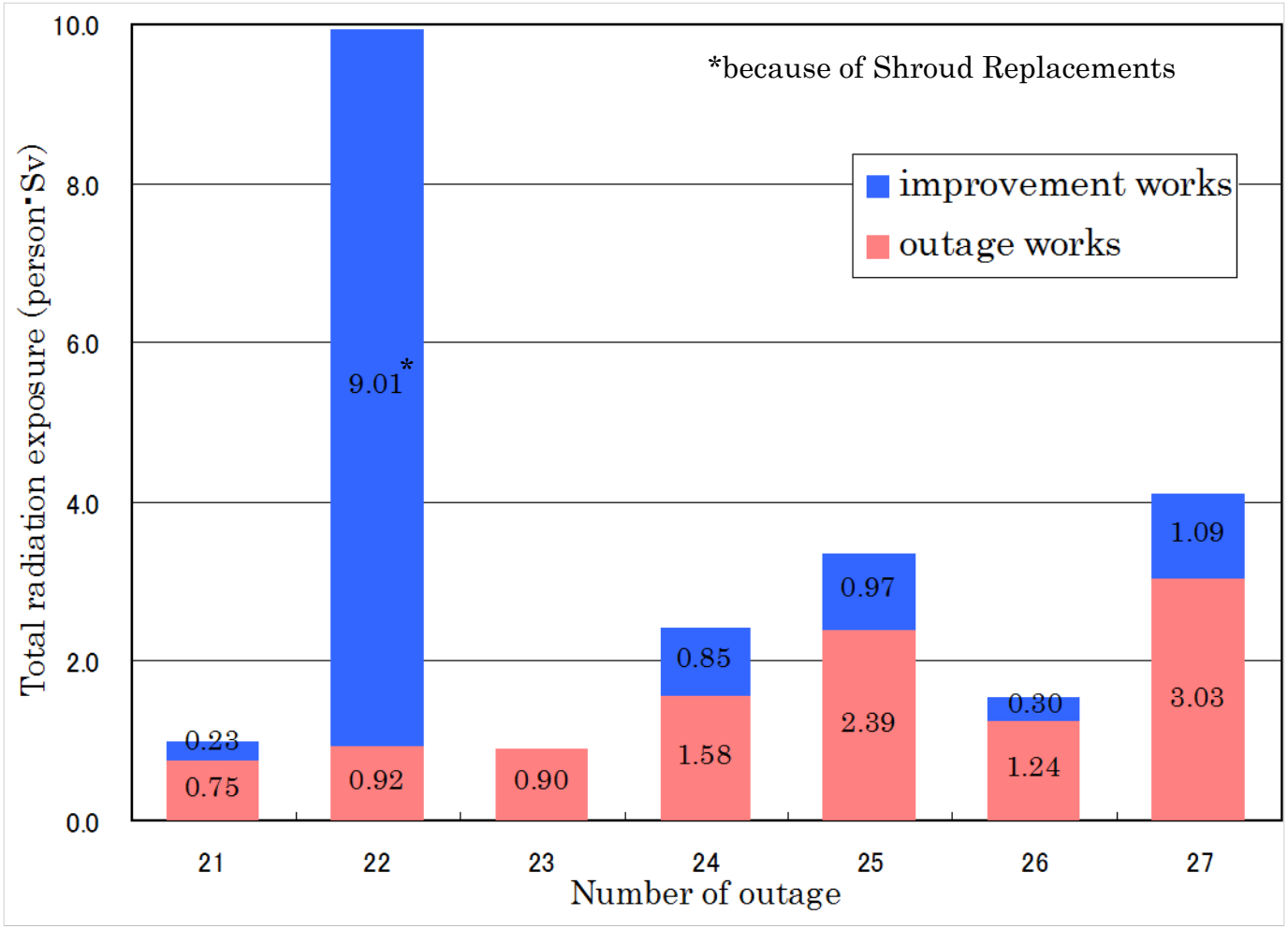


Figure 1 Radiation exposure at Shimane Nuclear Power Station Unit 1 after hydrogen injection

2(2).The dose rate of the RRS piping

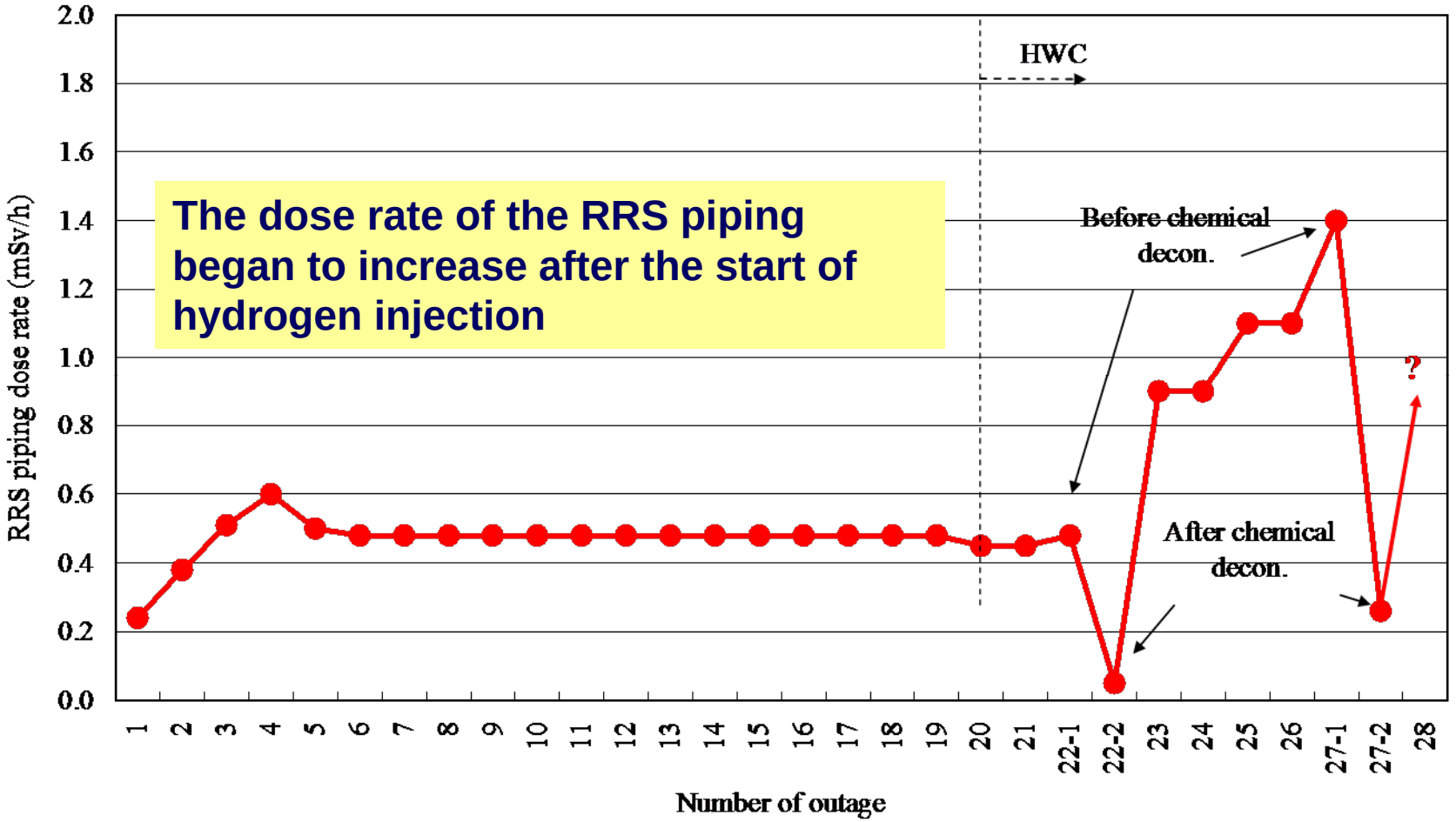


Figure 2 RRS dose rate trend at Unit 1

3.Dose rate reduction committee

- **3WG were settled under the committee.**
- **Maintenance staff and headquarter persons were added to the committee .**

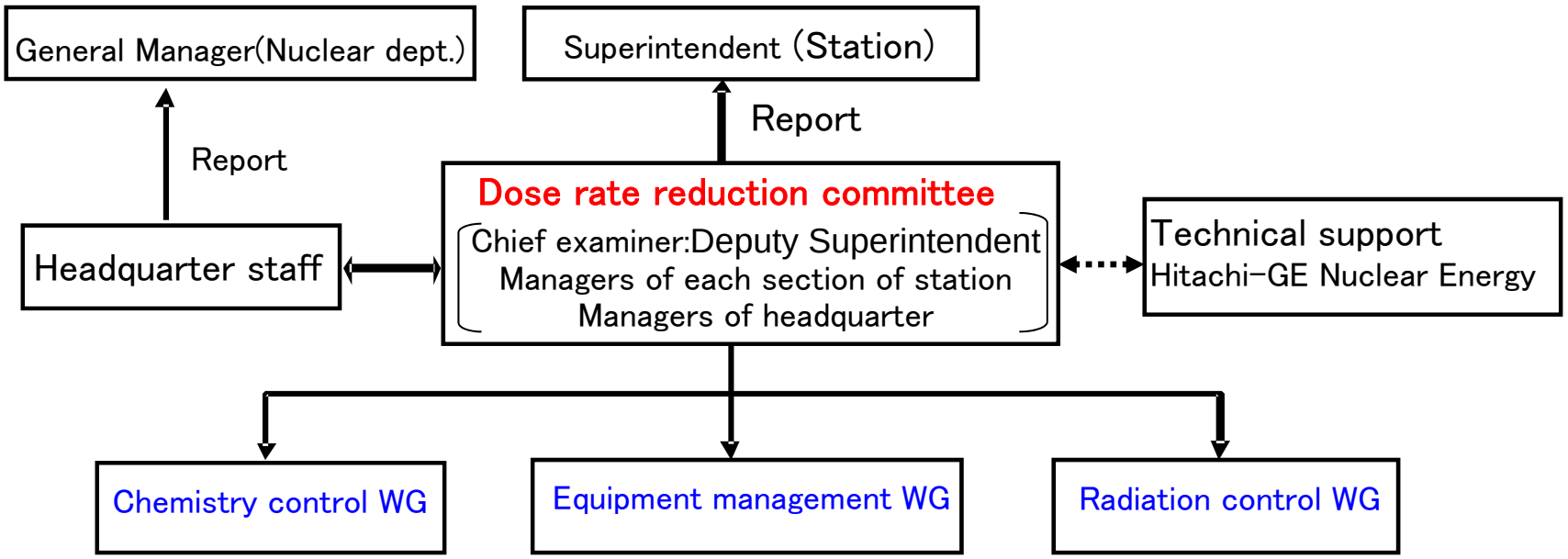


Figure 3 Structure of dose rate reduction committee

4.Examination items of dose rate reduction committee

- Short term target is to lessen the dose rate of 28th outage at Unit 1.
- Middle and long term items aim for permanent dose rate reduction.

Item	Chemistry control WG	Equipment management WG	Radiation control WG
Objectives	Dose rate reduction in PCV	Improvement of work methods and work environment	Improvement of radiation control
Matters	NWC pre-oxidation operation, CF bypass operation, Hi-F Coat, etc	Enlargement of chemical decontamination area ,etc	Piping dose rate prediction method, Temporary shielding, Survey of good practice, etc
Middle and long term matters	Zinc injection, Improvement of water chemistry control, etc	Adjustment of execution timing of inspection to reduce dose rate Chemical decontamination to Valve and PLR-pump impeller , etc	Establishment of piping dose rate prediction method Improvement of mounting method of temporary shielding ,etc

Extension to middle and long term

Figure 4 Examination items at dose rate reduction committee

5(1). Applied countermeasures until 28th outage

- **Hi-F Coat was applied after chemical decontamination at the 27th outage.**
- **NWC pre-oxidation operation of 90 days was conducted at the beginning of the 28th operating cycle to form a fine oxide structure under NWC conditions.**

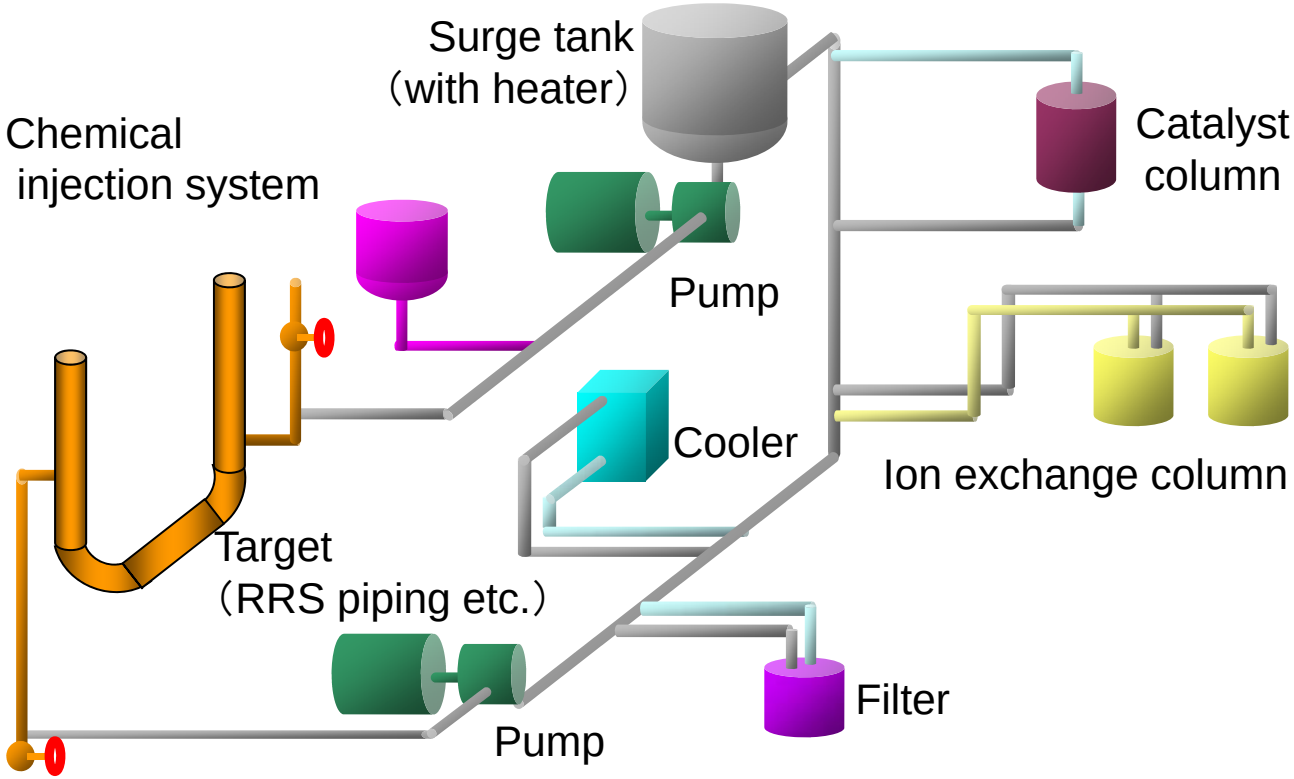
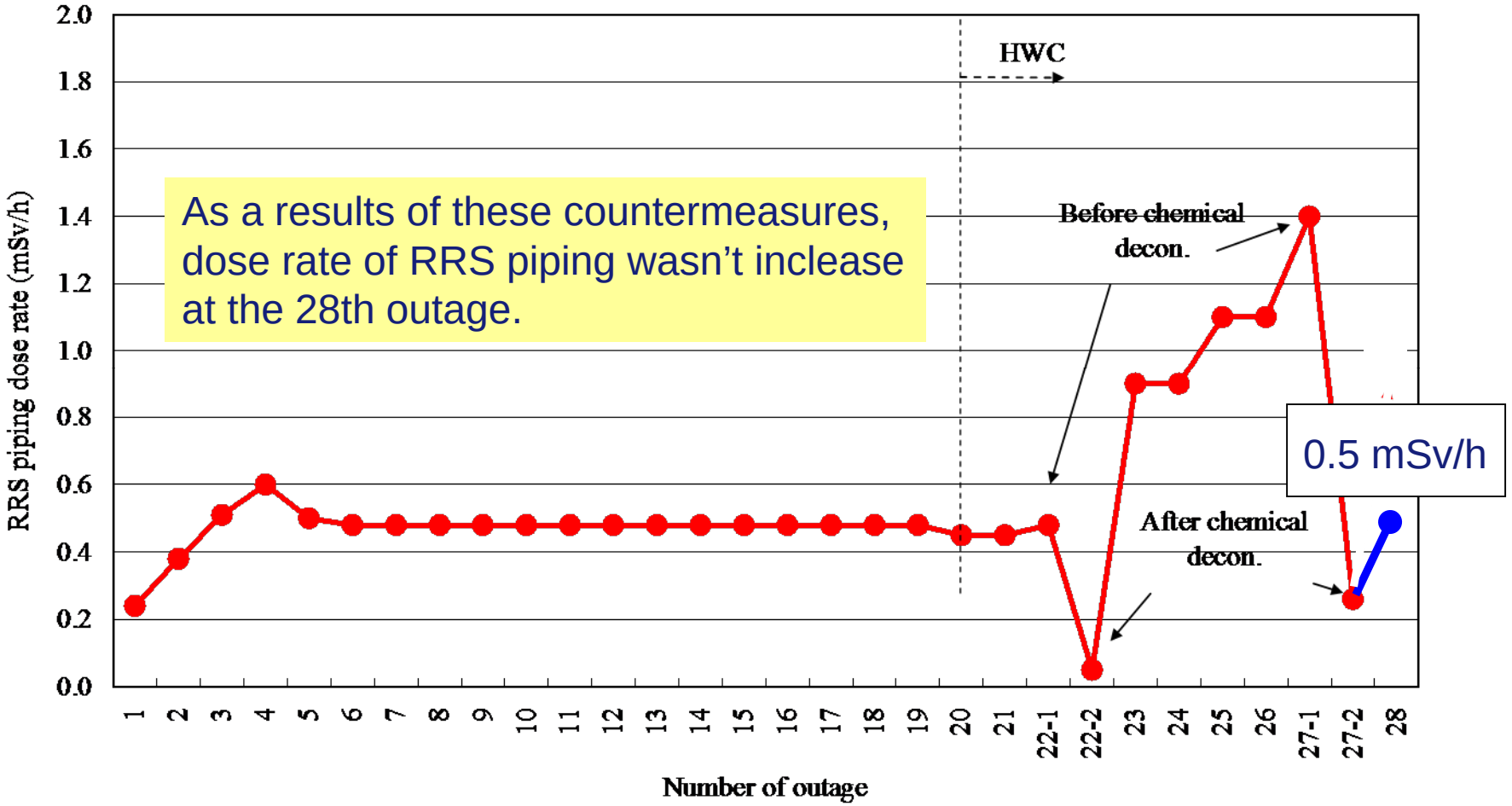


Figure 5 Outline of Hi-F Coat treatment equipments

5(2). Results of countermeasures(1) The dose rate of the RRS piping



As a results of these countermeasures, dose rate of RRS piping wasn't inclease at the 28th outage.

Figure 6(1) RRS dose rate trend at Unit 1

5(2).Results of countermeasures(1) dose rate

- **Dose rate of RRS piping was about 0.5 mSv/h at the 28th outage at Unit 1 and became much lower than that at the 27th outage.**

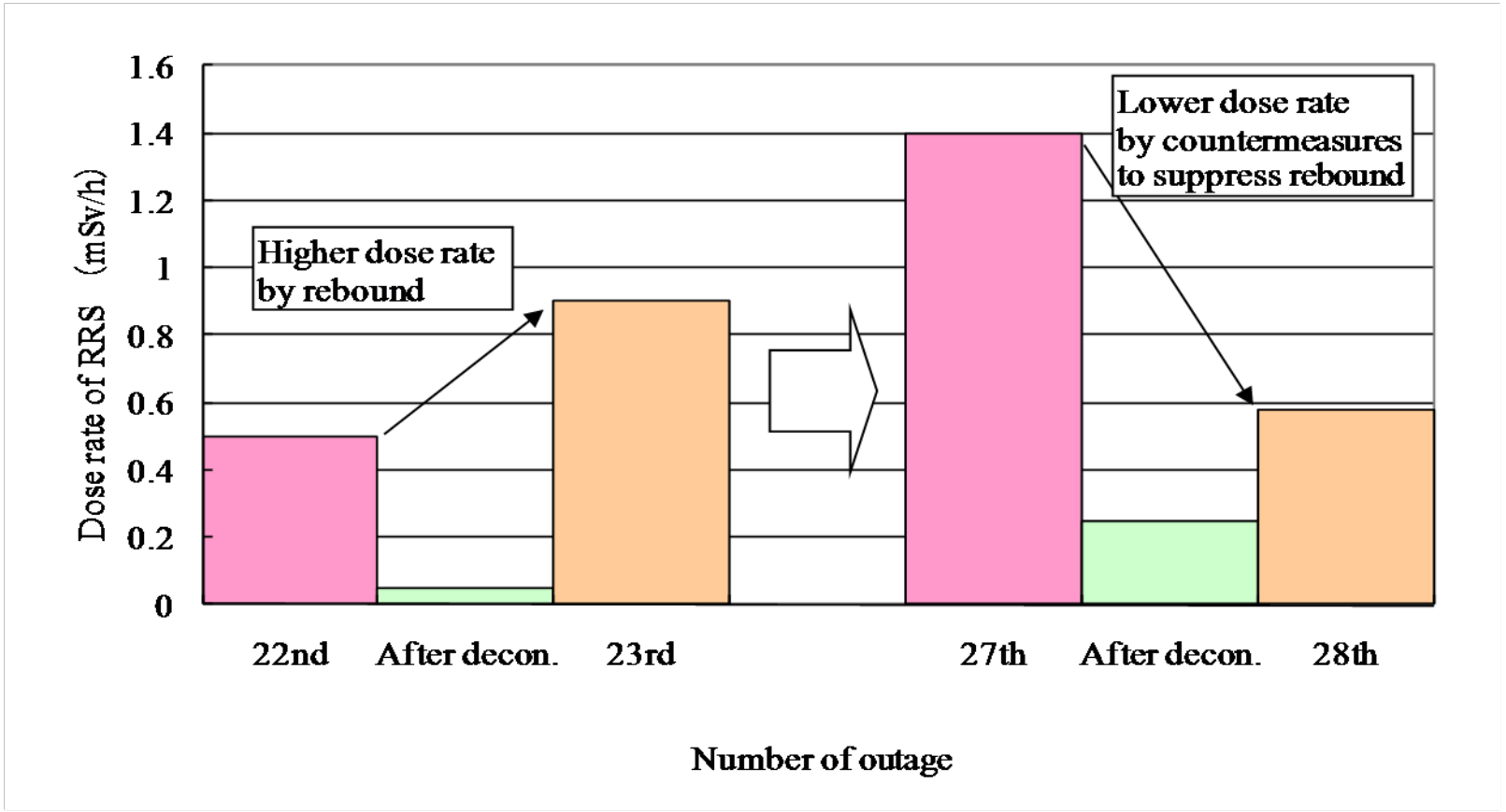


Figure 6(2) Dose rate change of RRS piping after the 27th outage

5(2).Results of countermeasures(2) total radiation exposure

- **Total radiation exposure could be suppressed to about 55% of the planned value.**
- **Term of the outage could be cut for 45 days compared to the original plan**

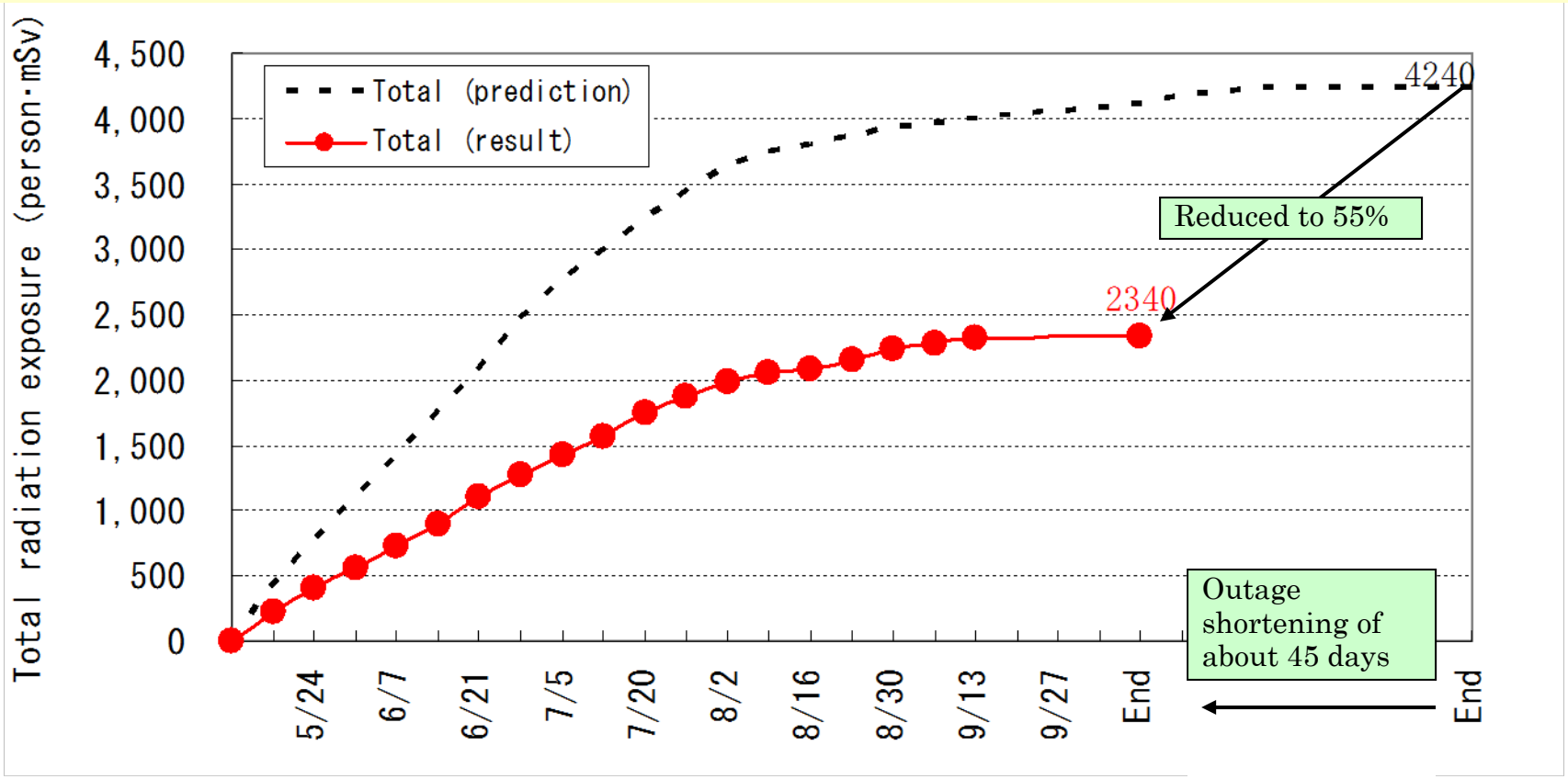


Figure 7 Trend of total radiation exposure during the 28th outage

6.Future activities(1) On-line monitor

- **Experimental equipments to gather basic data such as energy distribution of gamma ray and atmospheric dose rate in the PCV.**

Figure 8 Appearance of experimental equipments

6.Future activities(2) Zinc injection

- **Zinc injection is a permanent countermeasure to reduce dose rate to meet the company need to continue hydrogen injection.**

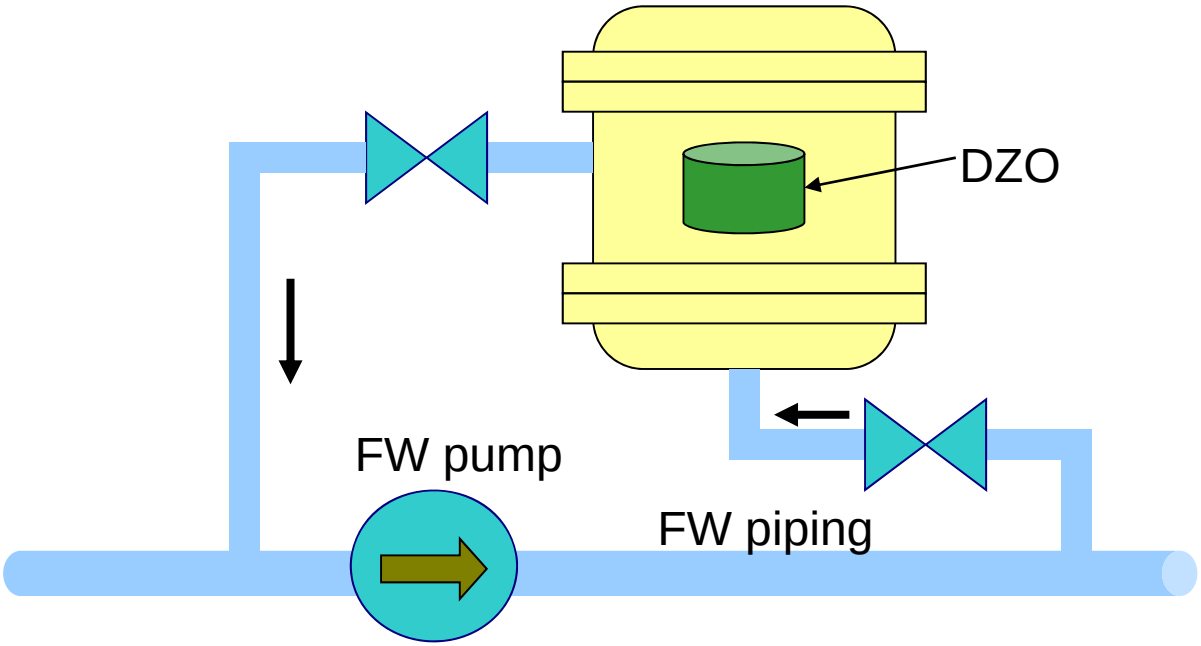


Figure 9 Image of zinc injection system

7.Summary

- As dose rate of RRS piping and radiation exposure became larger after the hydrogen injection and chemical decontamination, activity of the dose rate reduction committee was reinforced.
- As a short term countermeasures, Hi-F Coat and NWC pre-oxidation operation were applied after chemical decontamination.
- Rebound dose rate of RRS piping was much suppressed and it was about 0.5 mSv/h after one cycle operation.
- Due to the low dose rate, radiation exposure of 28th outage was suppressed to about half of the planned value and the term of outage could be cut for 45 days.
- For future activities, on-line monitor and Zinc injection are studied.

Thank-you for your attention