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Inspire the Next

Application of Hi-F Coat for Recontamination Reduction at Shimane Unit 1

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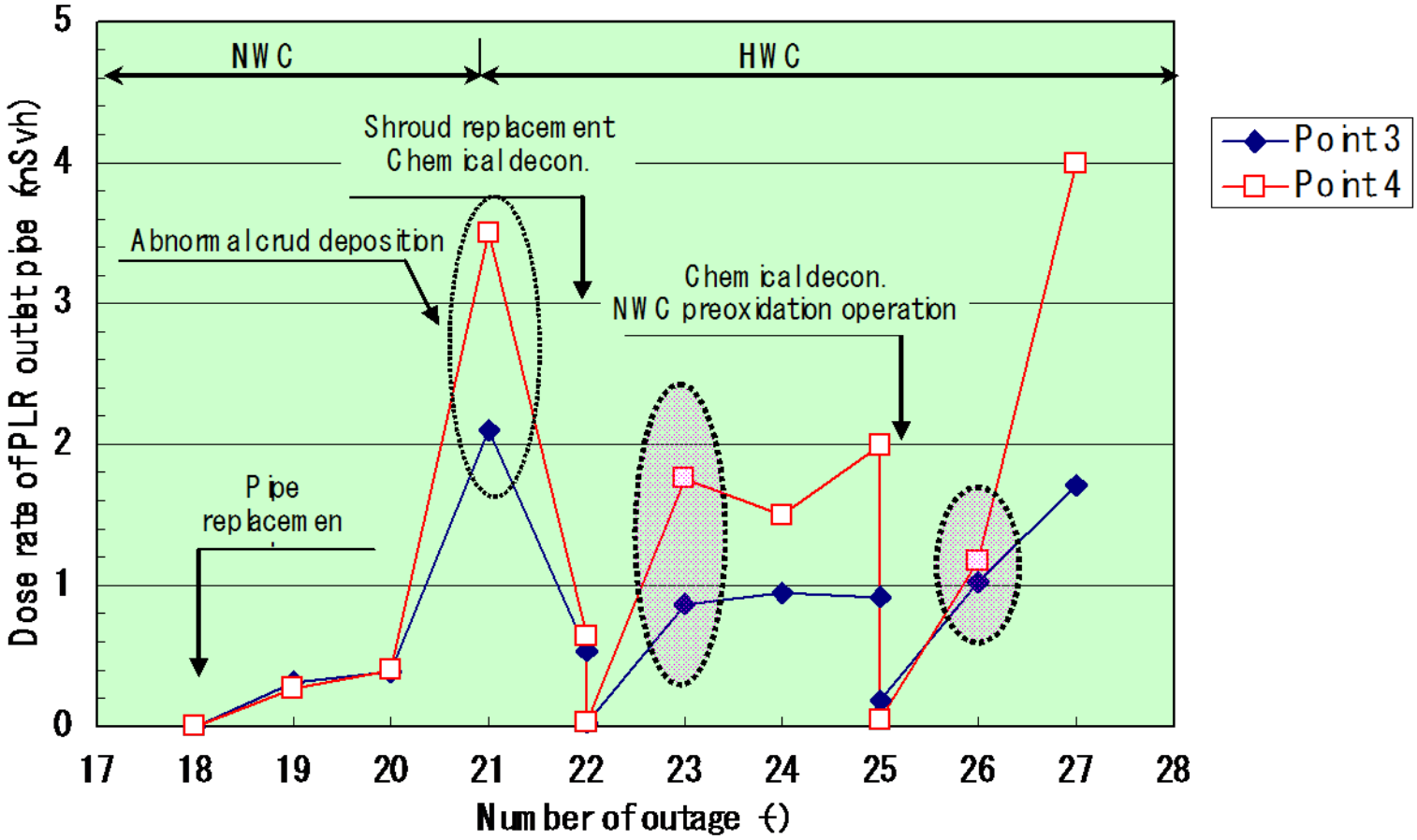
Background



- Dose rate reduction effects don't last long after operation.
- Recontamination reduction is needed to keep low dose rate.

What is Hi-F Coat

		Film of Hi-F Coat	Oxide film in plants
Chemical form	Outer	Fe_3O_4	Fe_3O_4、 Fe_2O_3、 Ni (Co)Fe_2O_4
	Inner	–	$CoCr_2O_4$、 Cr_2O_3
Size of particle		＜0.2 μm	1～10 μm
Thickness of film		＜ 0.5 μm	3～10 μm
Temperature		90℃	280℃

Principal of recontamination reduction

Formation of fine outer magnetite film before power operation

⇒Reduction of inner oxide film formation to pick up Co

Hi-F Coat : Hitachi Ferrite Coating

Section photograph of film

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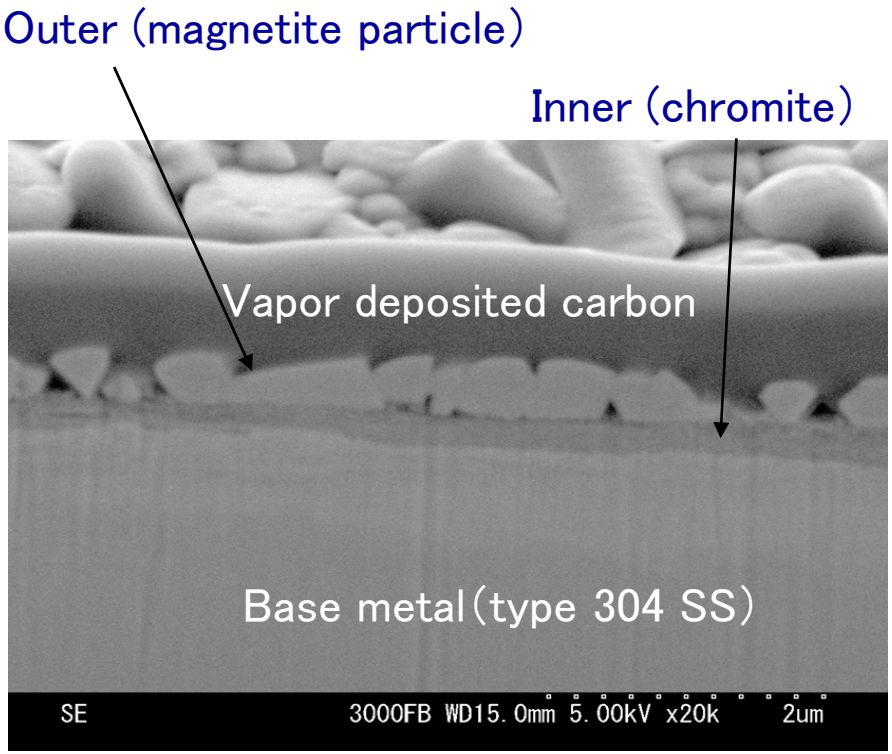
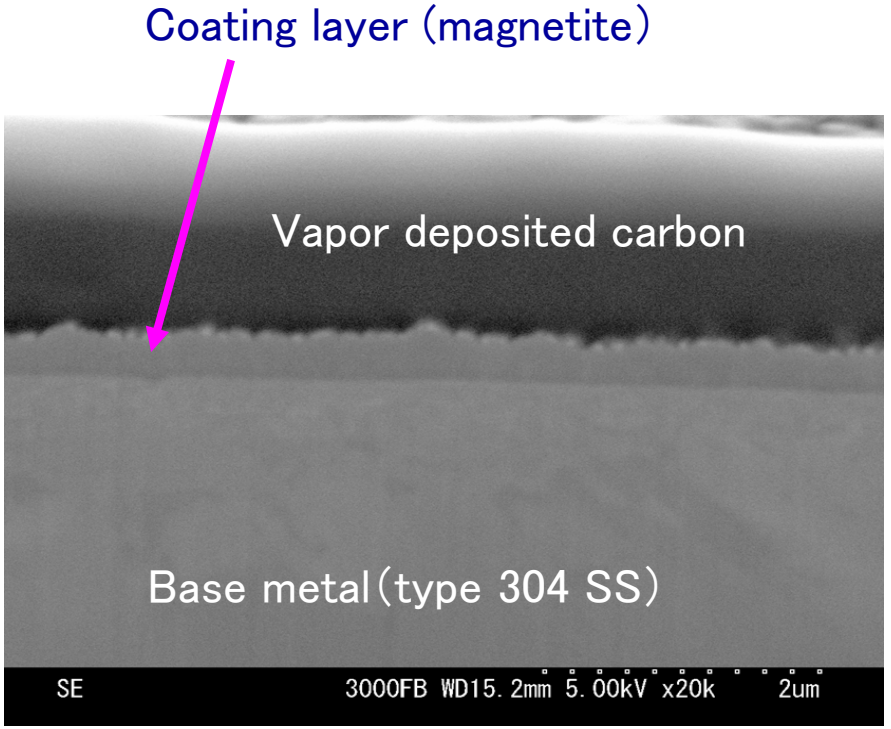
Formation of fine magnetite film (thickness : ～0.3 μm)



Film formed under NWC 200h
(DO: 300 ppb)



Film of Hi-F Caot

Reduction effect of activity deposition (laboratory data)

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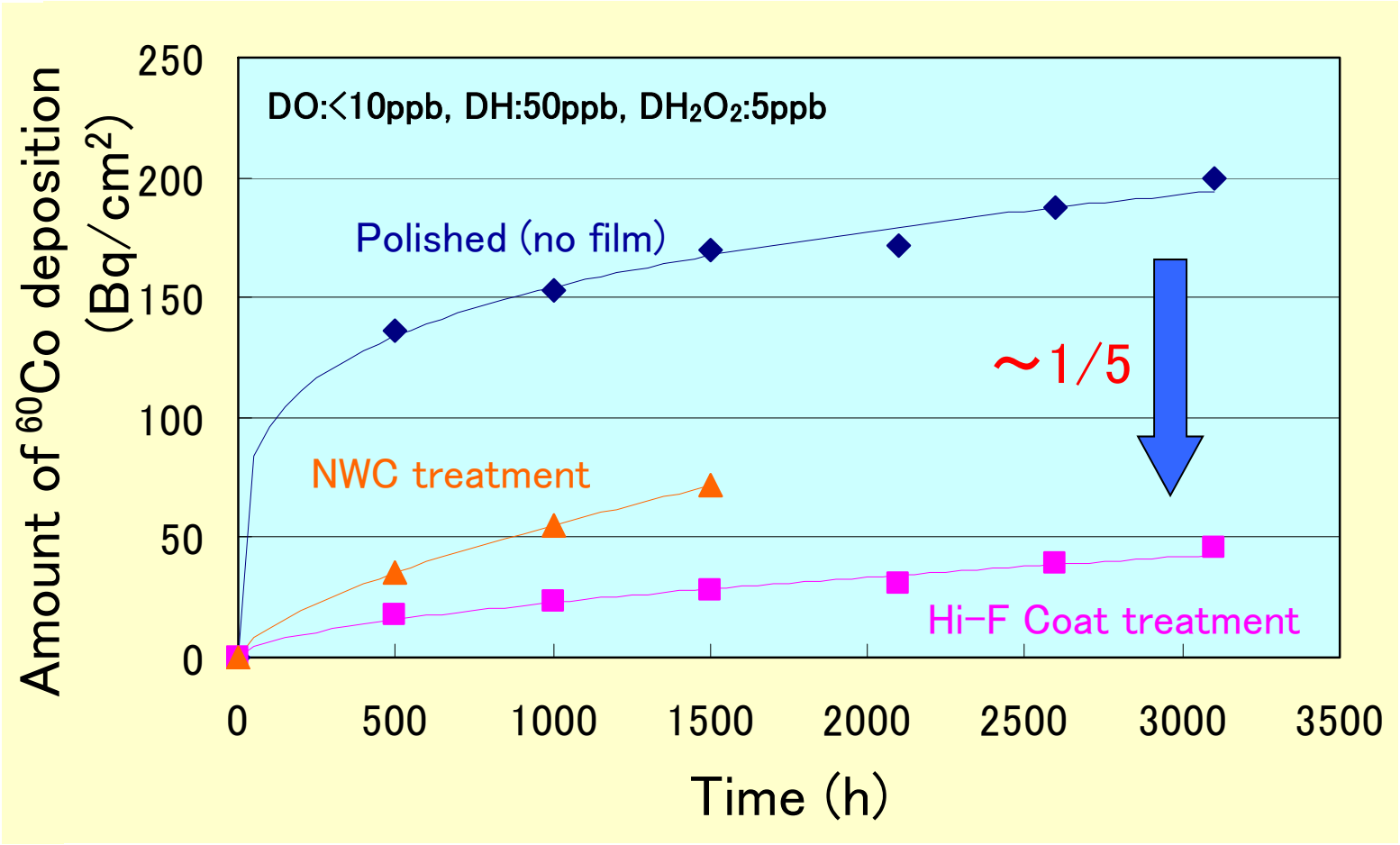
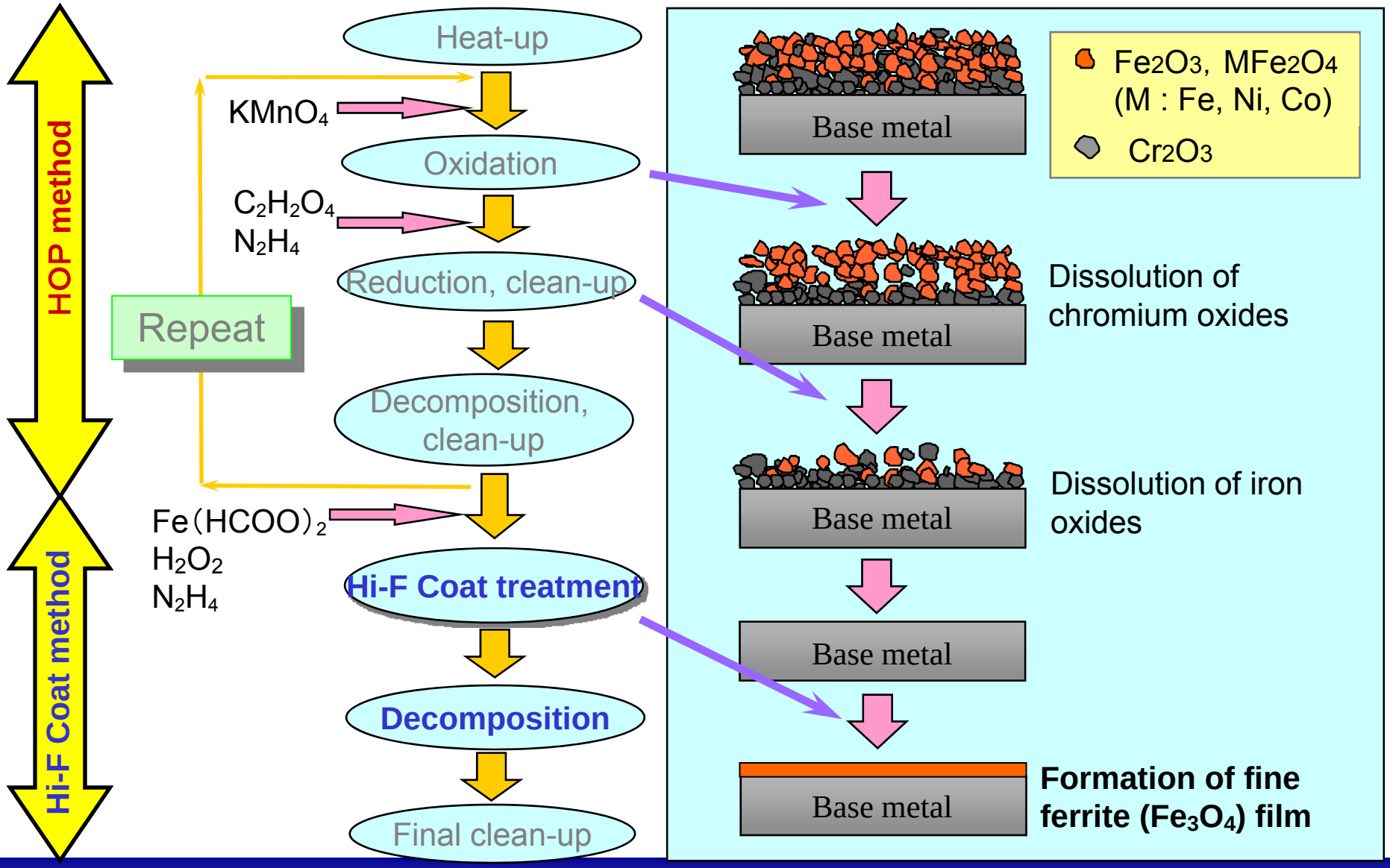
- Remarkable reduction of ^{60}Co deposition under HWC
- Continuous effect after 6 times of heat and cool (Stable)



Outline of treatment procedure



Outline of Hi-F Coat treatment equipments

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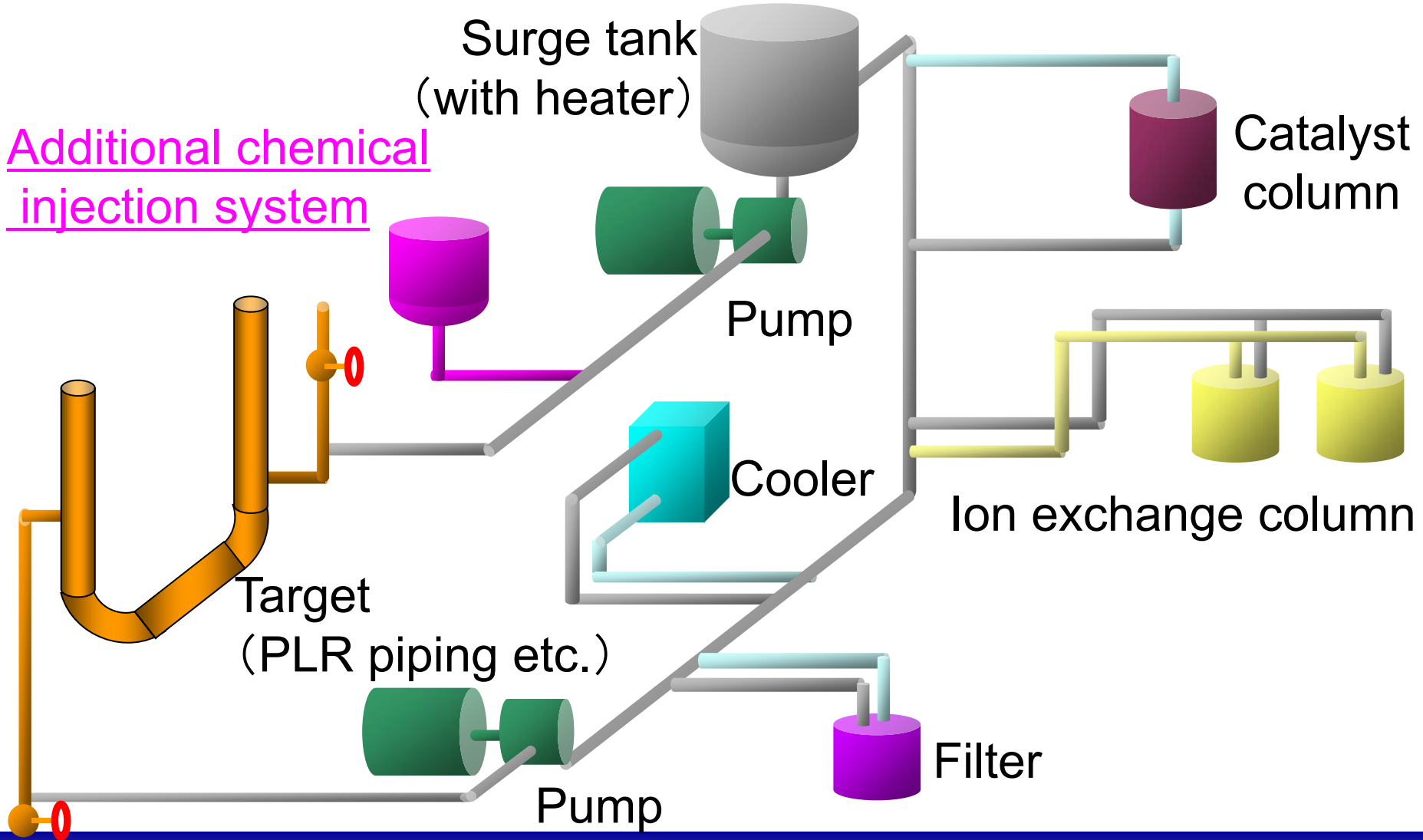
Only a little equipments are needed to decontamination equipments.



Outline of Hi-F Coat treatment chemicals

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Only iron formate is added to HOP method chemicals.

	Chemical	Conc. (ppm)	Remarks
HOP decon. process	$KMnO_4$	200～300	For oxidation
	$(COOH)_2$	2000	For reduction
	N_2H_4	～600	For pH control
	H_2O_2	—	For decomposition of chemicals
Hi-F Coat treatment process	$Fe(HCOO)_2$	Fe：～ 250 Formic ion：～ 500	Raw material for film formation Formic acid is used for LOMI* process.
	H_2O_2	—	For ion value control
	N_2H_4	200～500	For pH control

*：LOMI is one of chemical decontamination method.

Target of HOP decontamination & Hi-F Coat

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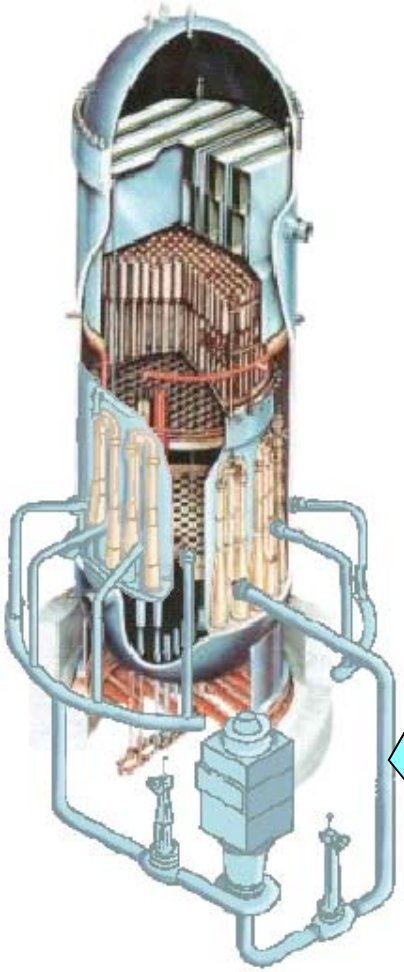
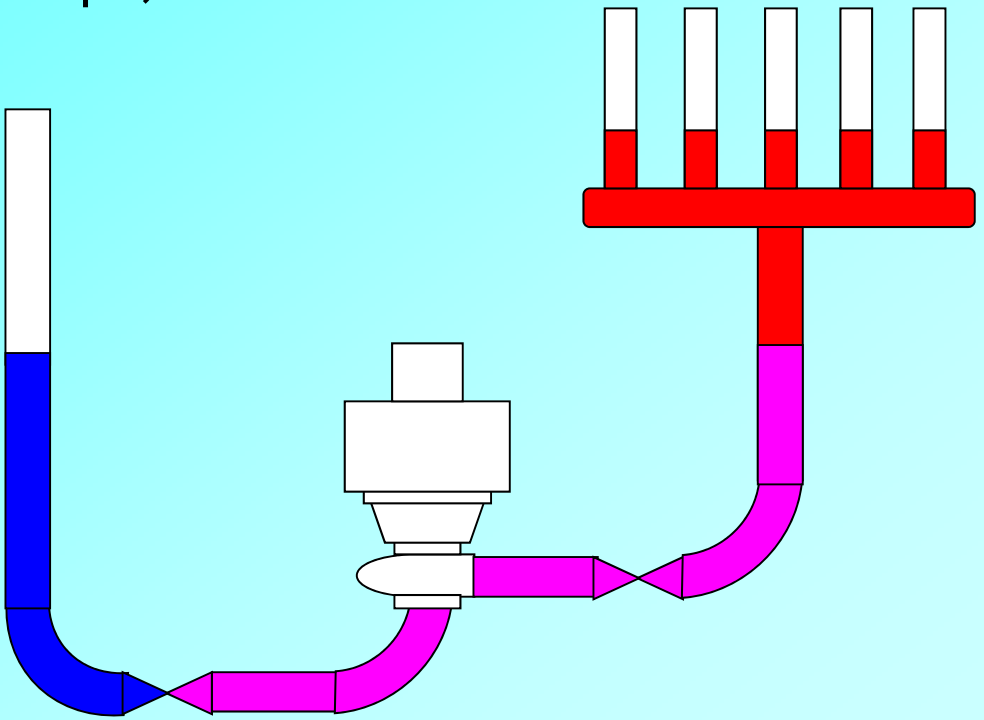


PLR piping
- PLR pump inlet & outlet
- Ring header
- Riser piping

(A & B loops)

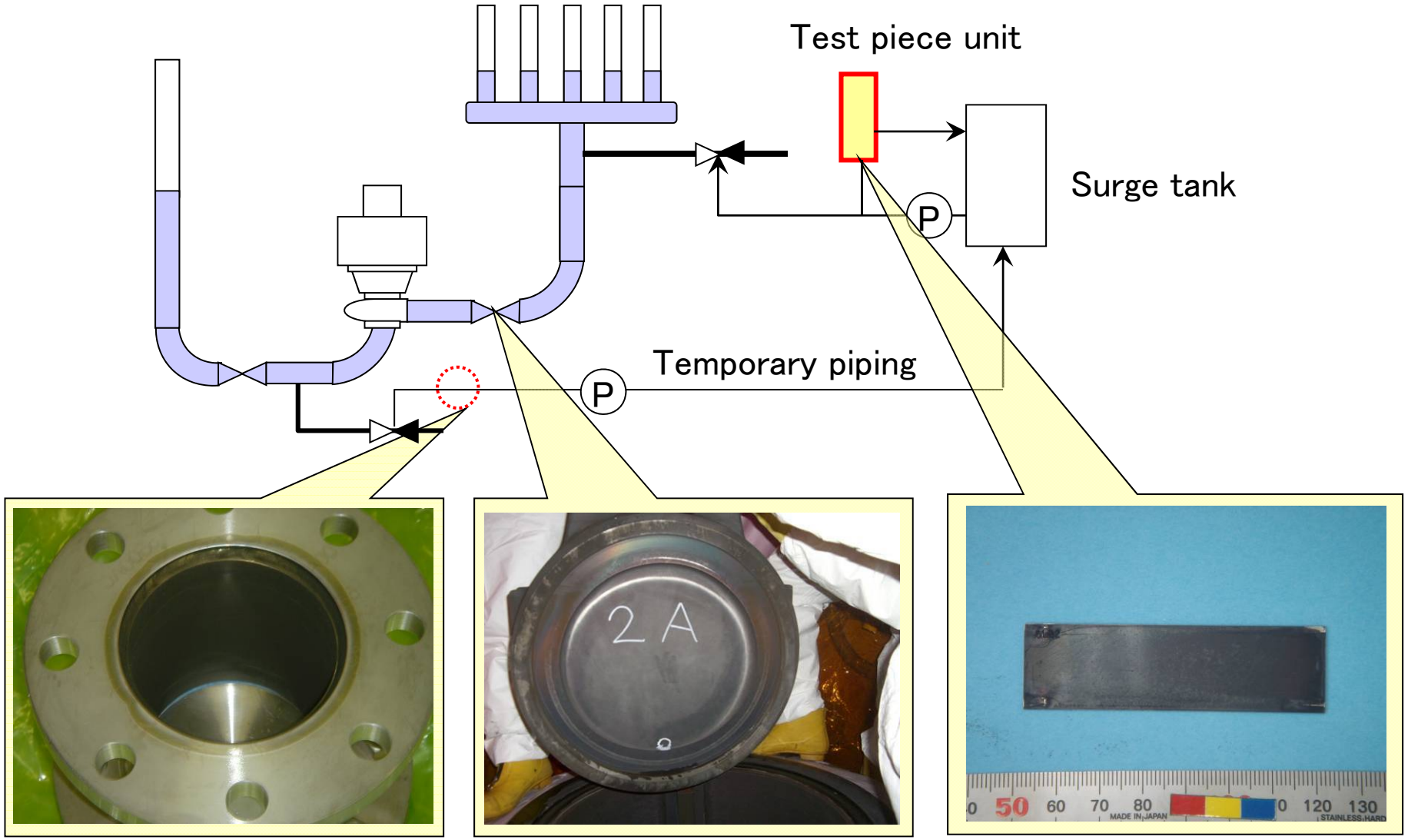
	HOP	Hi-F Coat
	1st time	1st time
	1st &2nd time	2nd time
	2nd time	2nd time



Hi-F Coat treatment conditions

Parameter	Planned value	Measured value
Fe conc.	250±50 ppm	263～296 ppm
N_2H_4 conc.	200～600 ppm	160～560 ppm

Hi-F Coat treatment results



Hi-F Coat treatment results

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More than target value of 0.1 μm (60 μg/cm^2) was achieved.

Sample item	Application	Sample No.	Deposited amount (μg/cm^2)
Test piece	1st time	1	230
		2	270
	2nd time	3	302
		4	192
	3rd time	5	125
		6	132
	4th time	7	402
		8	498
Temporary piping	2nd time	A	150
	4th time	B	359

Surface observation (SEM)

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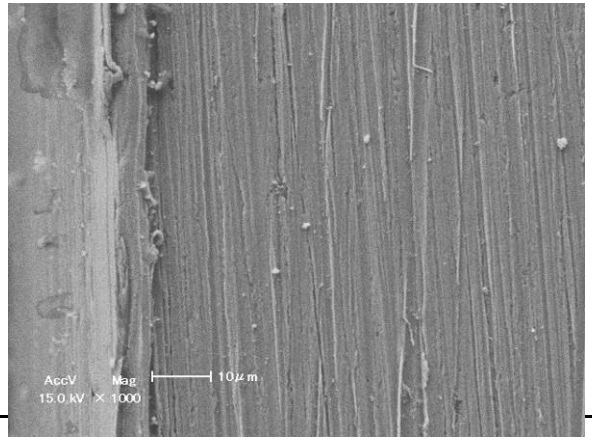
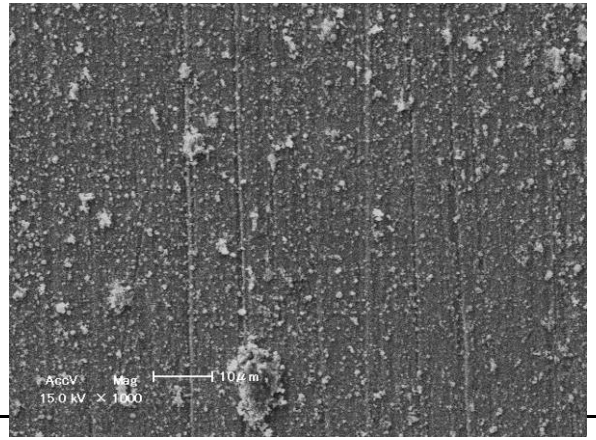
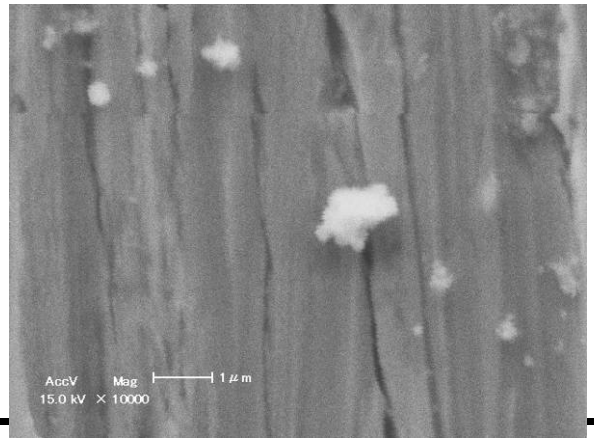
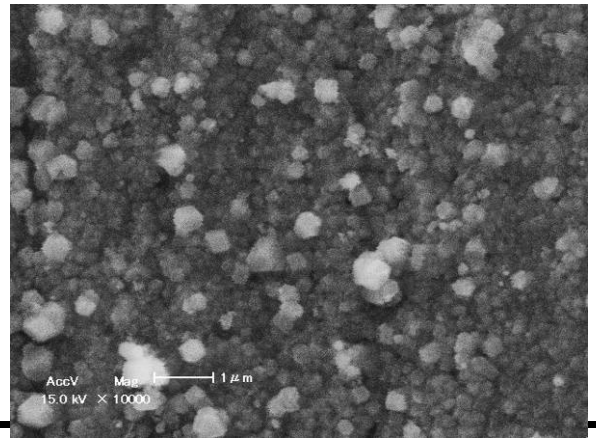
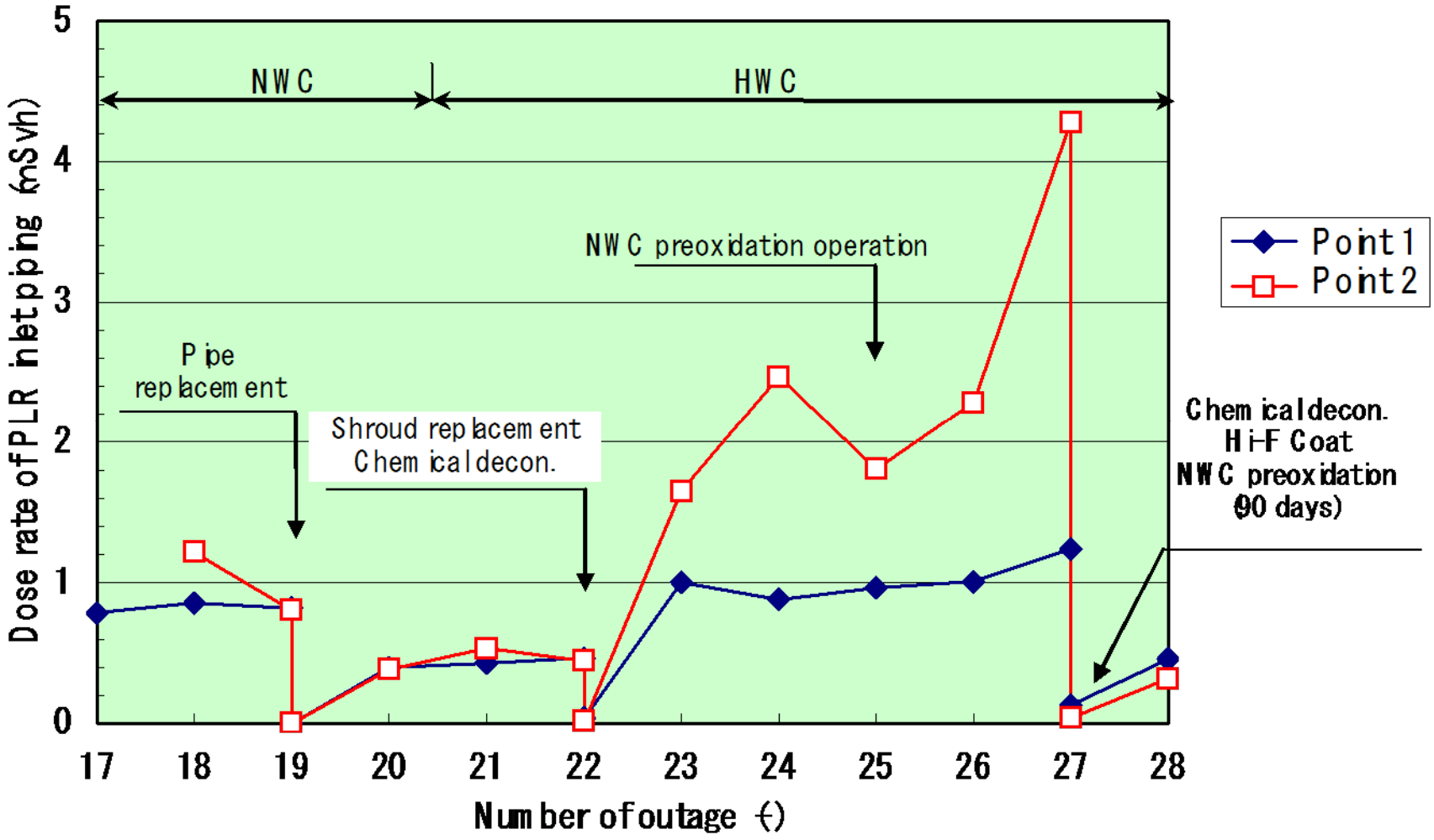
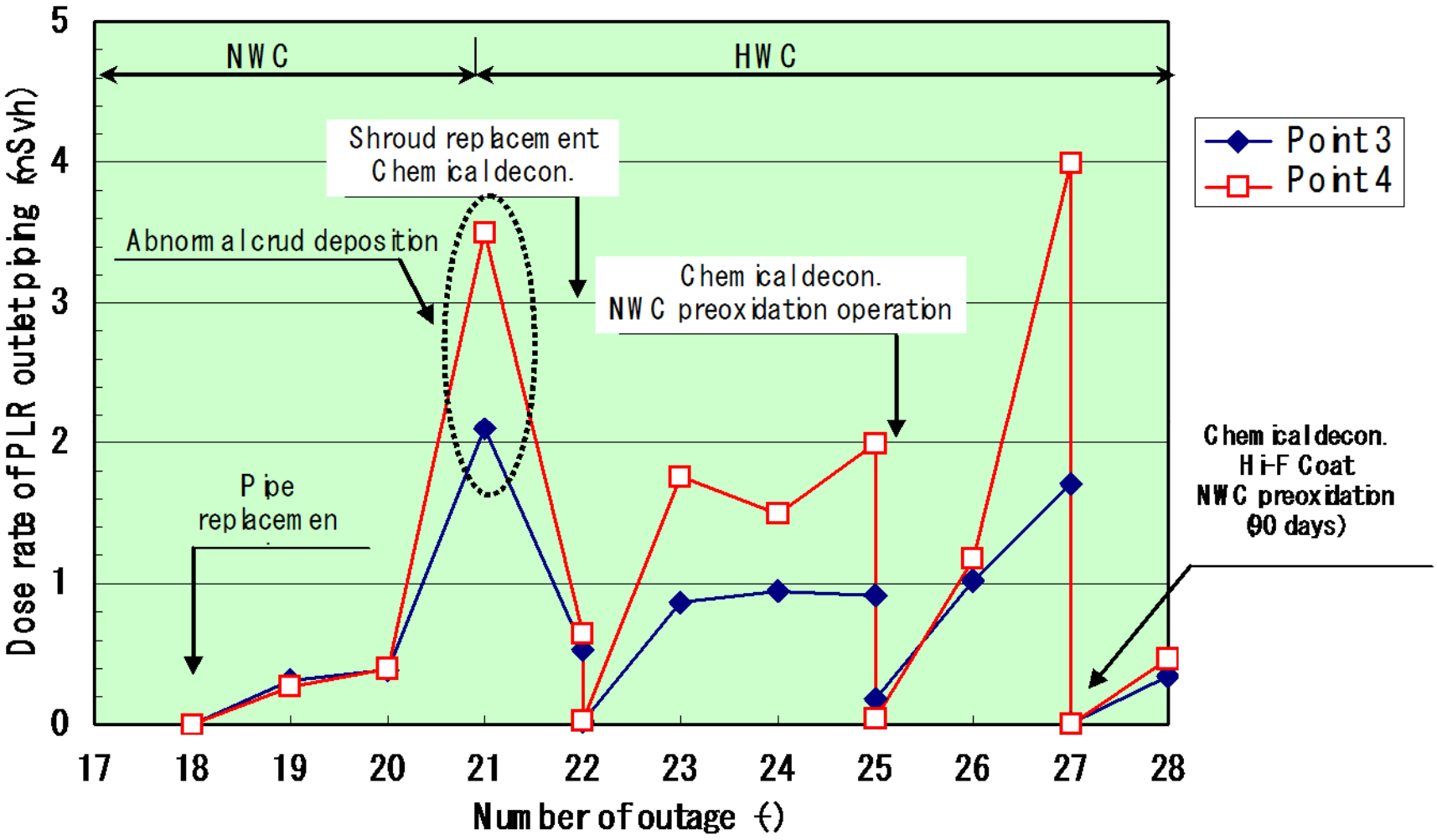
	Before Hi-F Coat (After decon.)	After Hi-F Coat
×1000		
×10000		

Dose rate of PLR piping (1/2)



Dose rate of PLR piping (2/2)



Effect of dose rate reduction (1/4)

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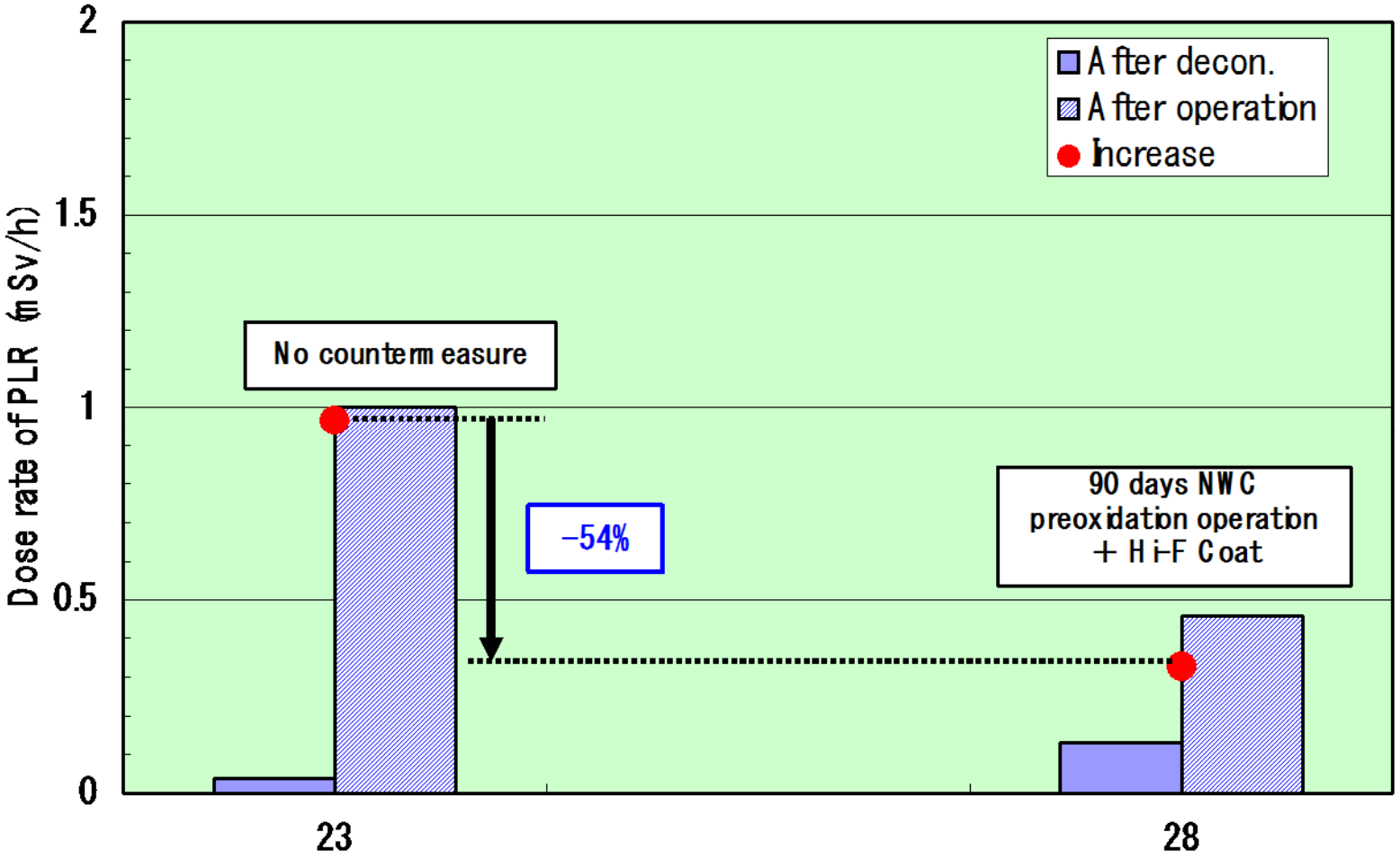
Point 1: inlet piping



Effect of dose rate reduction (2/4)

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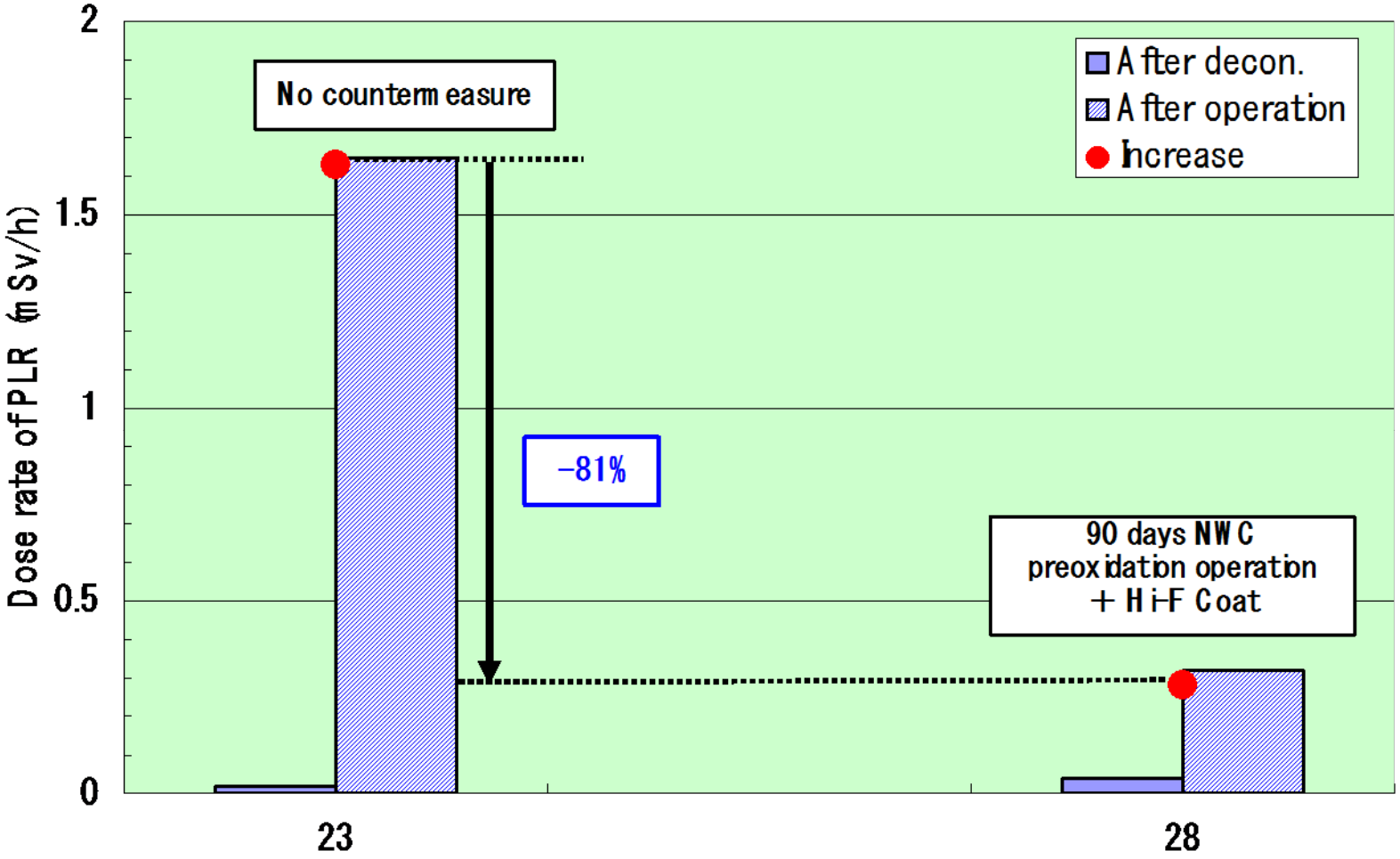
Point 2: inlet piping



Effect of dose rate reduction (3/4)

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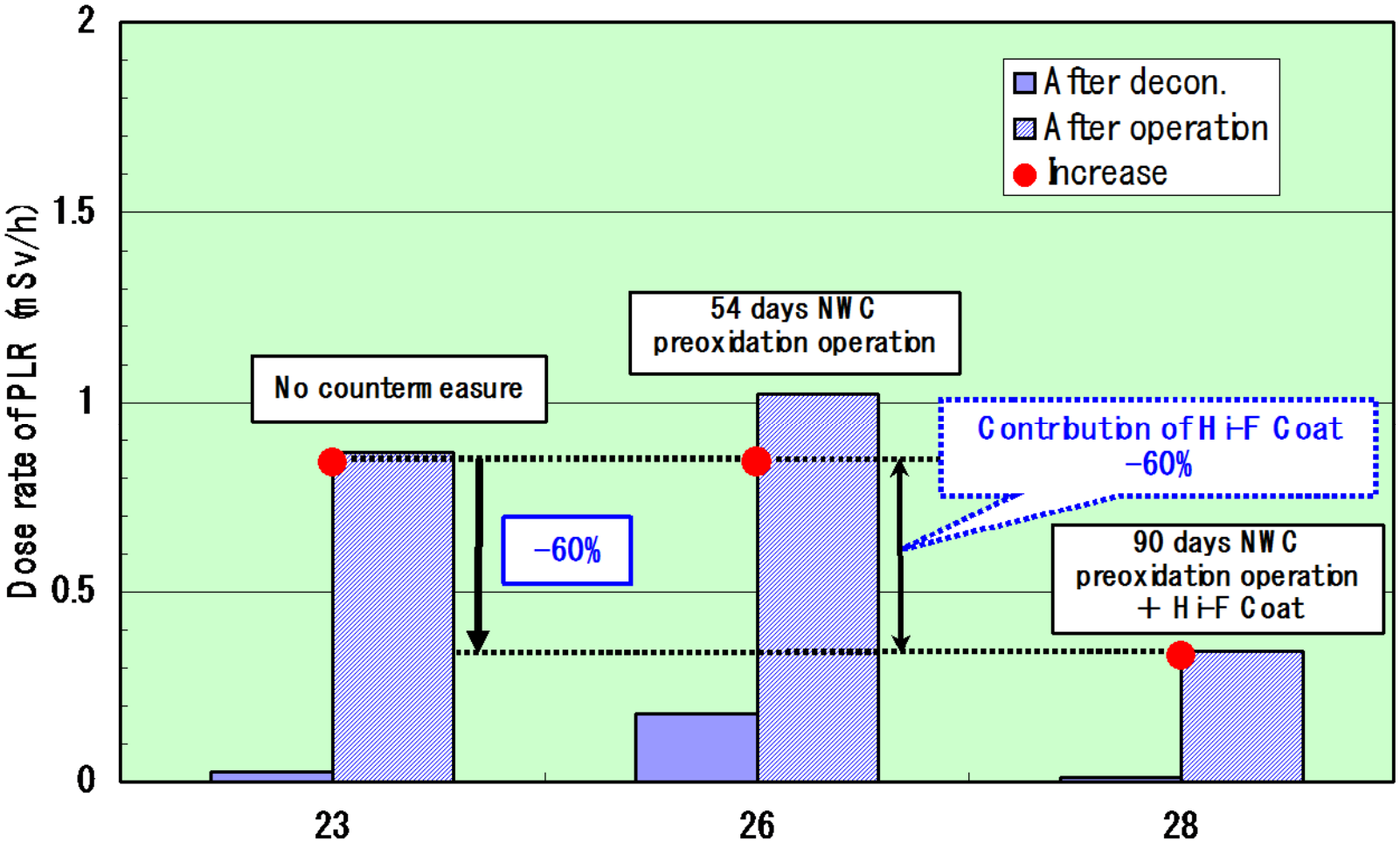
Point 3: outlet piping



Effect of dose rate reduction (4/4)

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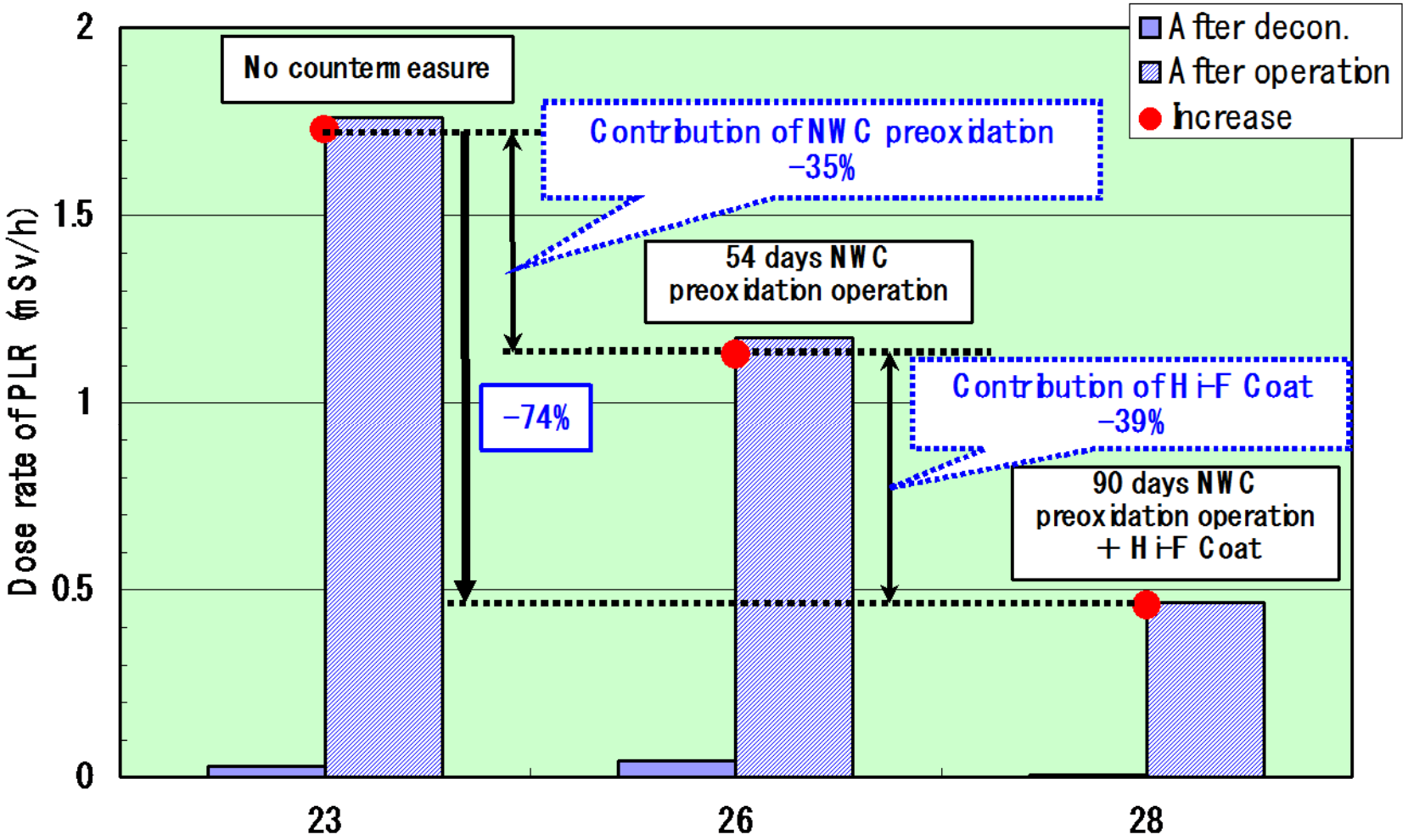
Point 4: outlet piping



Effect on chemical decontamination

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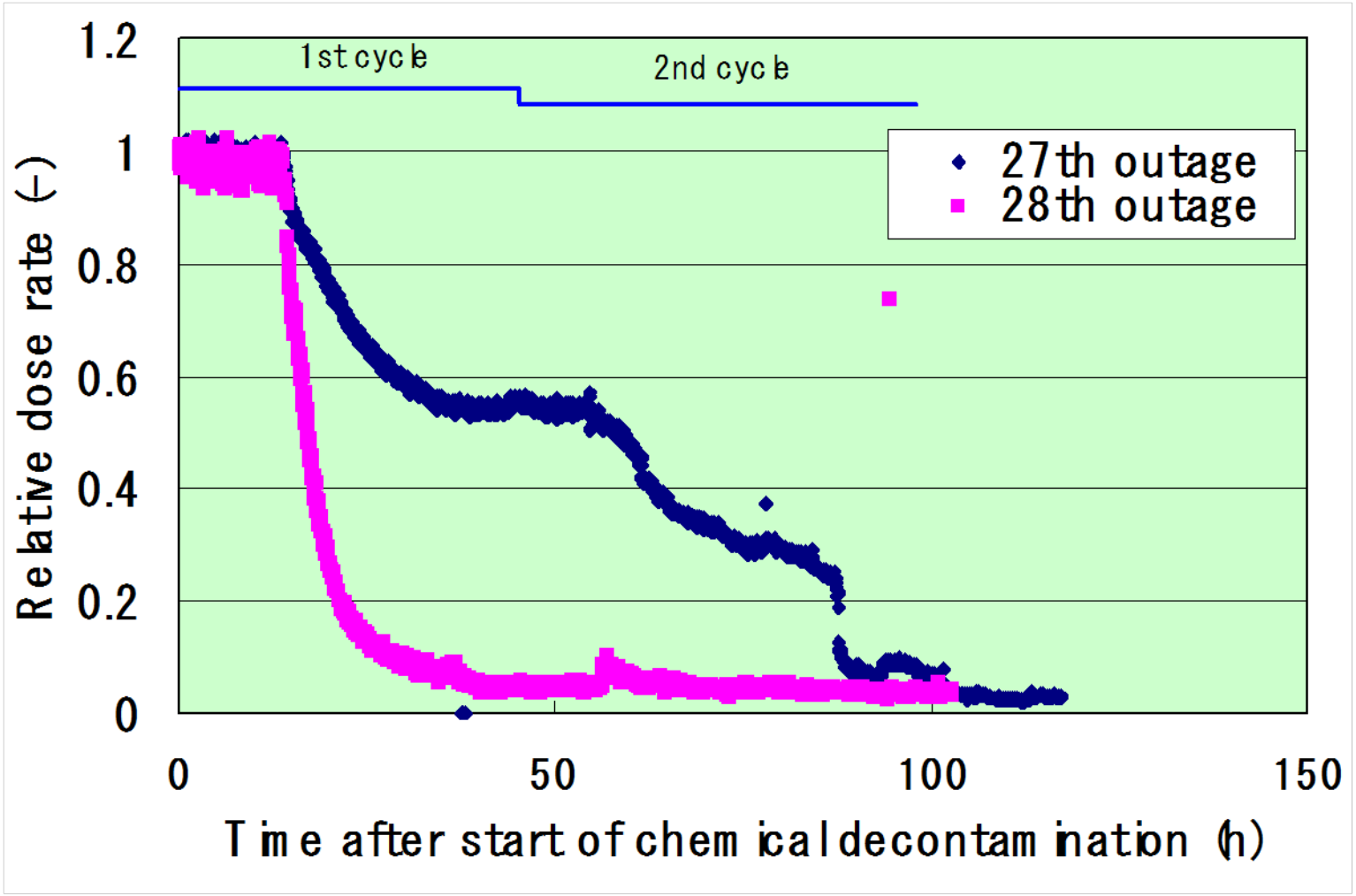
Hi-F Coat film was easy to be removed by chemical decontamination.



Effect of Zn injection on Hi-F Coat

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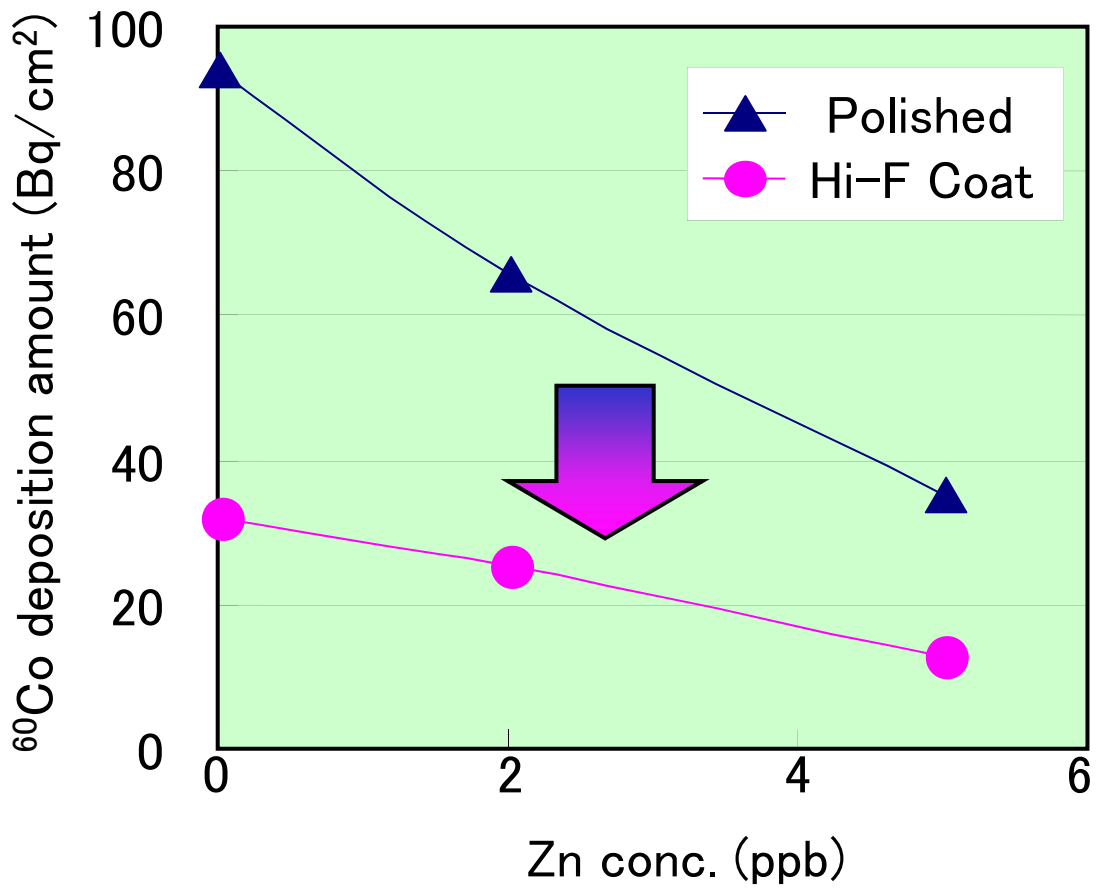
Farther Co deposition reduction can be expected with Zn injection.



Time : 500h
Temp. : 280℃
ECP : −0.5V

Hitachi laboratory data

Summary

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1. Hi-F Coat was first applied to Shimane Unit 1 after chemical decontamination.
2. Hi-F Coat treatment was successfully applied to the decontaminated surface. Deposited amount of film was about 270 μg/cm^2 which was more than target value of 60 μg/cm^2.
3. Recontamination was suppressed about 1/2 to 1/3 after one operation cycle.
4. Coated film was easy to be removed by chemical decontamination.
5. Farther dose rate reduction can be expected with Zn injection.