Approach for reduction of radiation exposure at Tohoku Electric Power Co., Inc.

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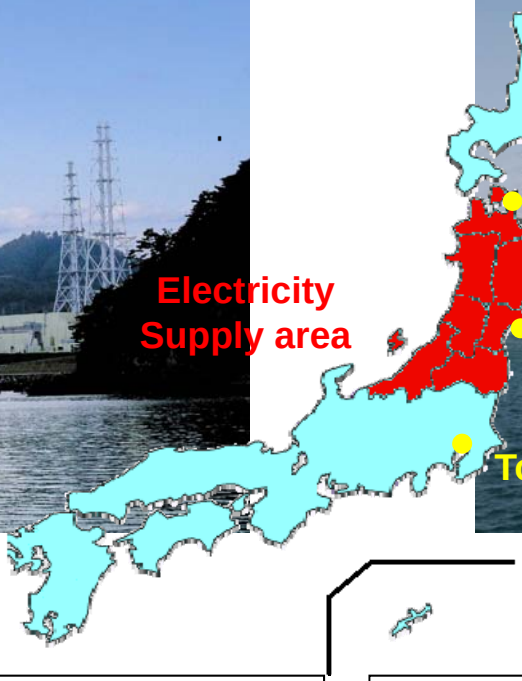


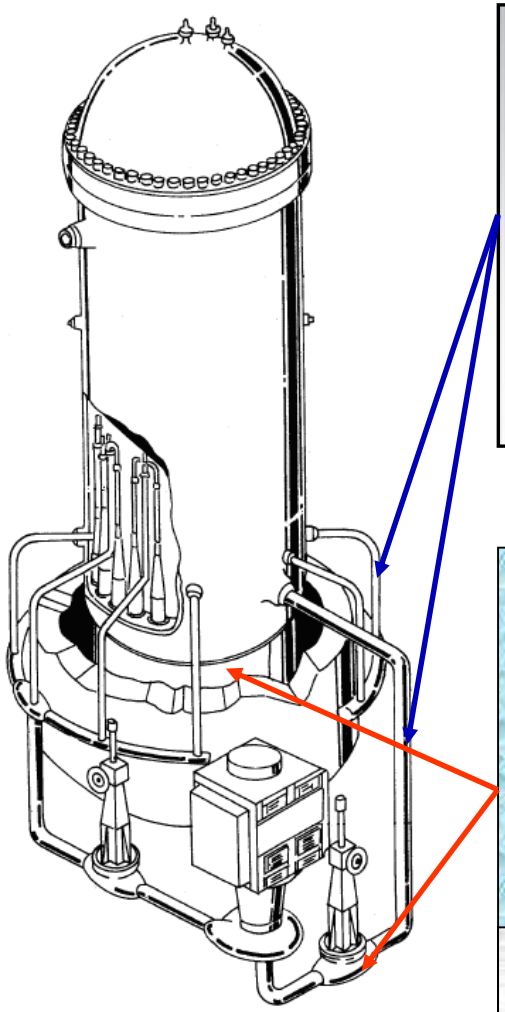
Onagawa

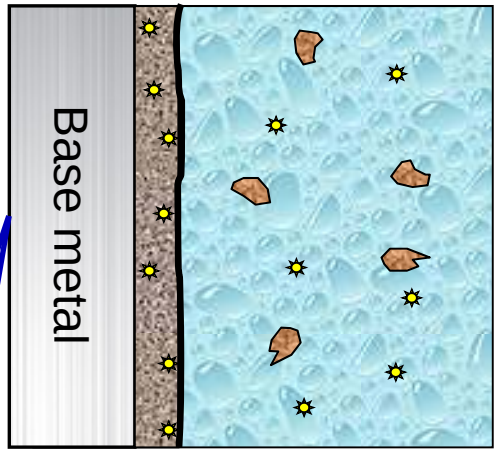
	MWe	Type	Commercial Operation
Unit-1(O-1)	524	BWR4	1984
Unit-2(O-2)	825	BWR5	1995
Unit-3(O-3)	825	BWR5	2002

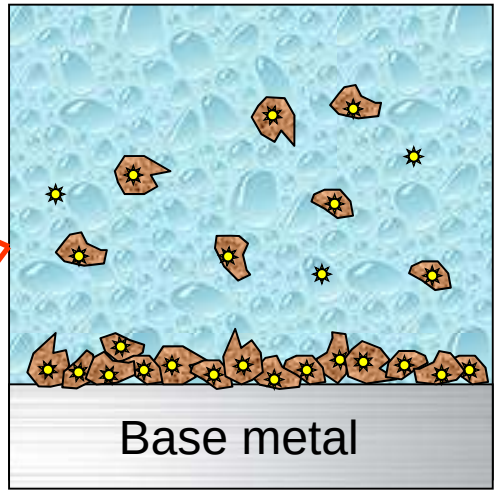
Higashidori

	MWe	Type	Commercial Operation
Unit-1(A-1)	1100	BWR5	2005

Radiation sources that control plant doses







Replacement-type sources

Radioactive ions in reactor water are incorporated in the oxidized film generated on hot portion of the reactor piping system.

・PLR/CUW piping and components

Deposition-type sources

Radioactive crud in reactor water is deposited at horizontal portions and other portions where water flow is stagnant on slow

・CRD flanges

・Filters

・Low temperature pipe sections, such as those in the RHR system

・Horizontal portions of PLR/CUW piping

・Nozzle sleeves

Measures to reduce crud （Clean plant action No.1）

① Improvement of work environment
② Protection
③ Maintenance of inner surface cleanliness

Prevention of carried-in dust by installing air guns and jet sprays at doorways

Thorough storage management and maintenance of cleanliness on inner/outer surface of system piping and equipment

Measures to reduce crud （Clean plant action No.2）

During system test

- Thorough storage management
- Purity control of test water

During start-up test

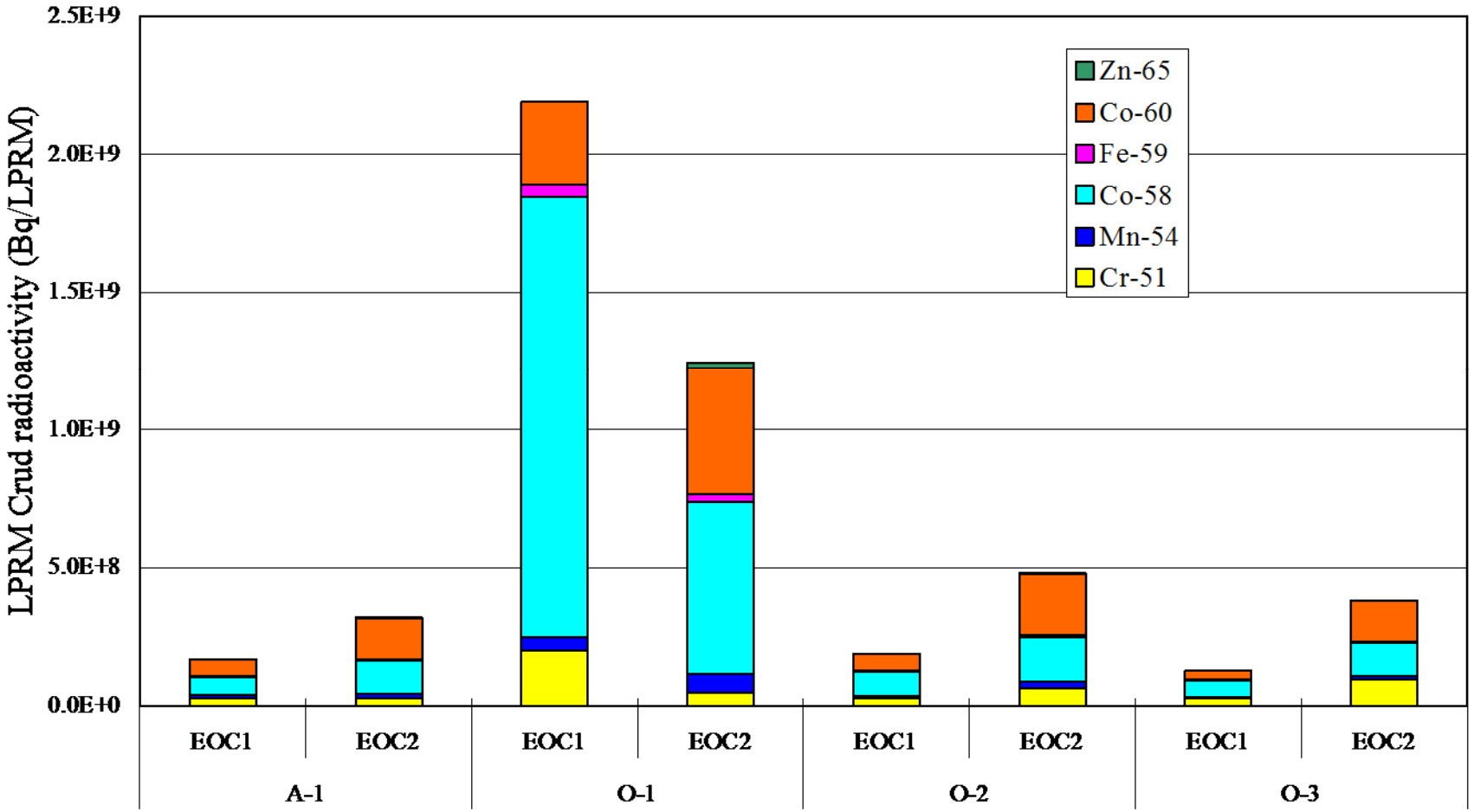
- Primary system cleanup operation
- Condensate/feedwater purification operation
- Condensate/feedwater swing operation
- Cleanup of hot well
- Cleanup of residual heat removal system
- Control of water treatment system

First cycle

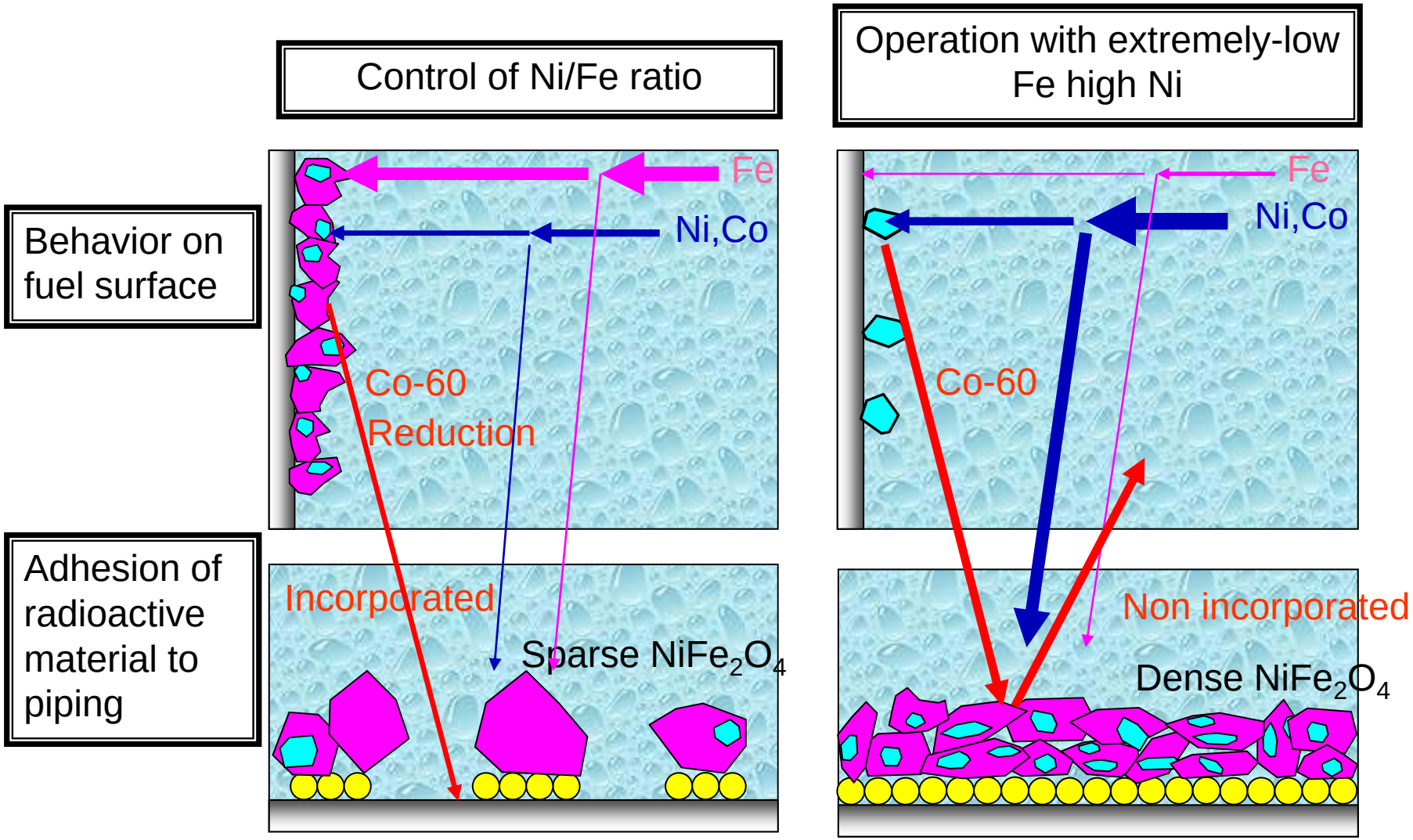
- Suppression of reactor water activity concentration

Reduction of carried-in crud

Measures to reduce crud（LPRM Crud radioactivity)



Water chemistry control（Operation with extremely-low Fe high Ni）

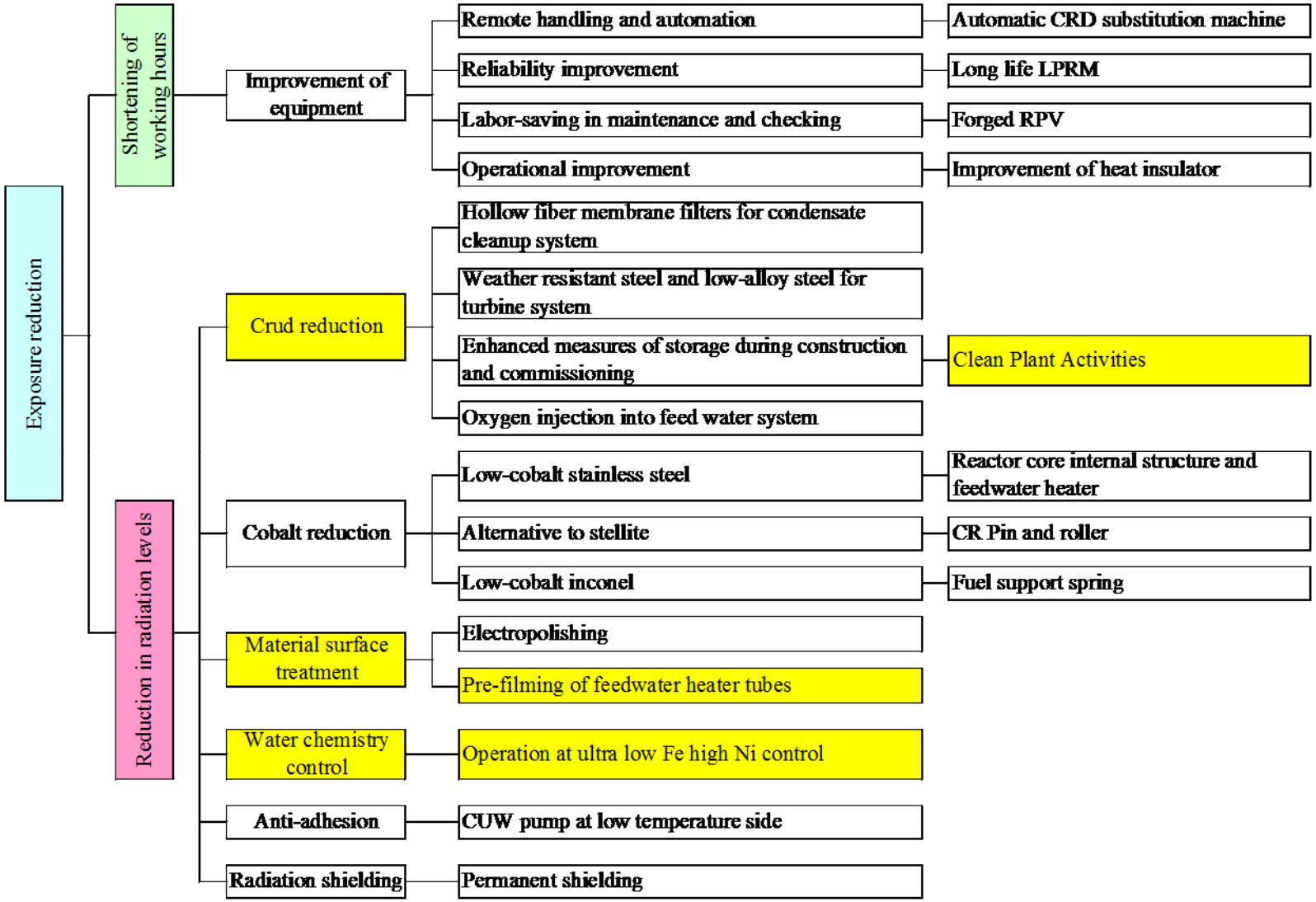


Exposure reduction measures at Tohoku Electric Power Company

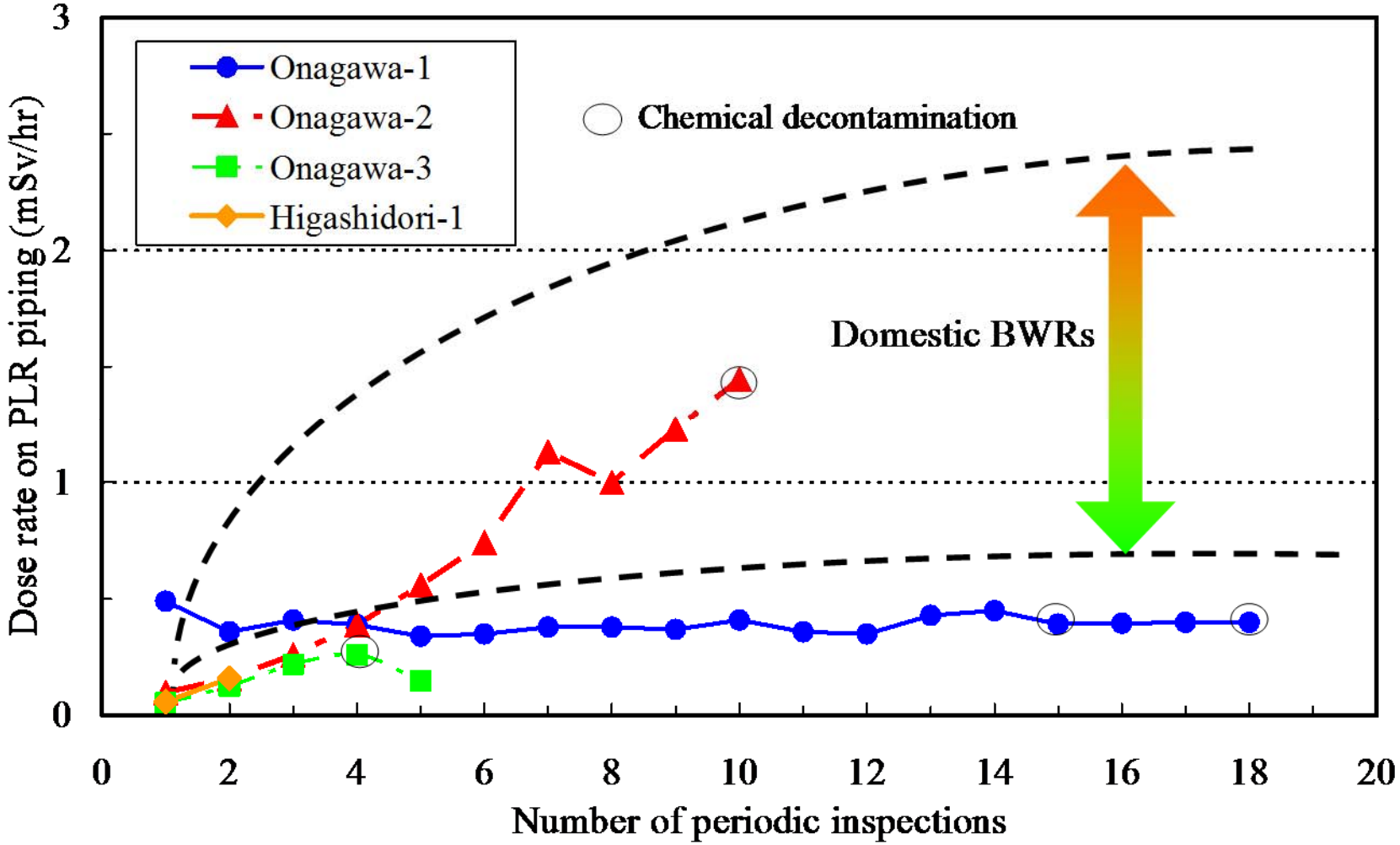
Item	Contents	Effect for Co-60	Higasidori Unit 1	Onagawa Unit 1	Onagawa Unit 2	Onagawa Unit 3
Reactor water cleanup system (CUW)		Reduction	2 %	2.8 %	3 %	3 %
Adoption of low-Co materials	Reactor core internal structure	Low Concentration	●	–	●	●
	Feedwater heater		●	●	●	●
	CR Pin and Roller		●	●	●	●
	Fuel support spring		●	●	●	●
Material surface treatment	Electropolishing of primary loop piping	Suppresses the deposition	●	–	●	●
	Pre-filming of feedwater heater tubes	Low Conc.	●	–	–	–
Water chemistry control	Fe/Ni control	Low Conc.	–	●	–	–
	Ultra Low Fe High Ni control	Supp. Dep.	●	–	●	●
Dose rate on PLR piping at first periodic inspection (mSv/h)			0.06	0.49	0.10	0.06
Total Exposure dose during the first periodic inspection （man-Sv）			0.14	0.70	0.15	0.19

“Clean Plant Activities” have been carried out by utility and contractors since Onagawa unit 1 construction.

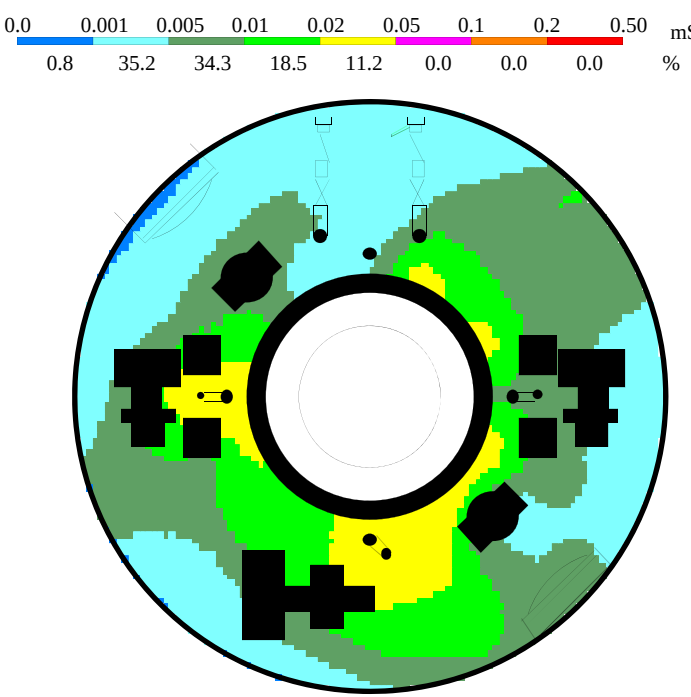
Exposure reduction measures at Higashidori



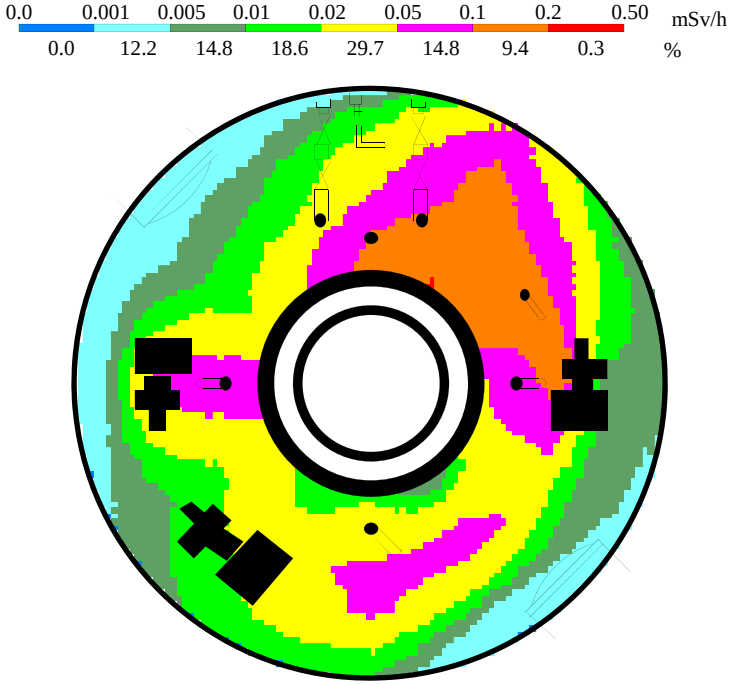
Dose rate on PLR piping



Air dose rate in reactor containment vessel



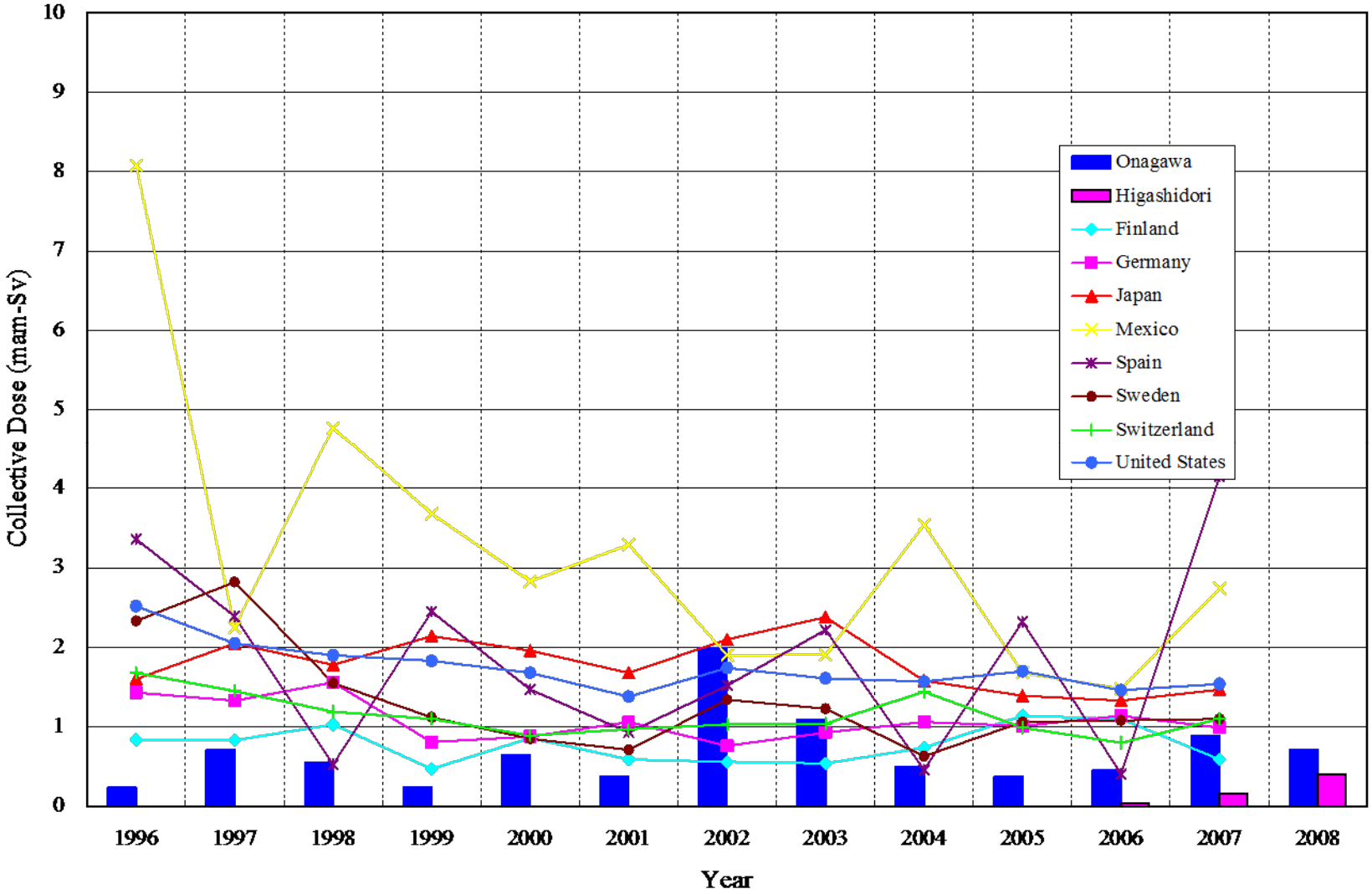
Higashidori Unit 1 First measurement



Onagawa Unit 3 First measurement

Four days after reactor shutdown On the floor of recirculation pump motor

Collective dose per reactor in BWR



Rolling average collective dose per reactor in BWR