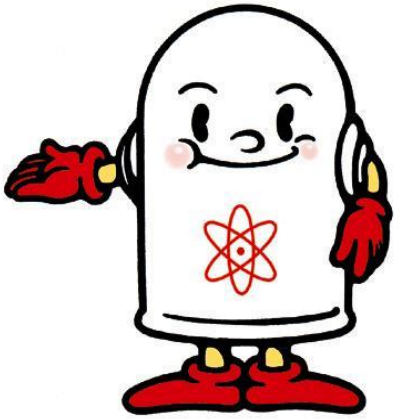
ALARA Activities and Radiation Control Practices at Tomari Nuclear Power Station

Hokkaido Electric Power Co., Inc.



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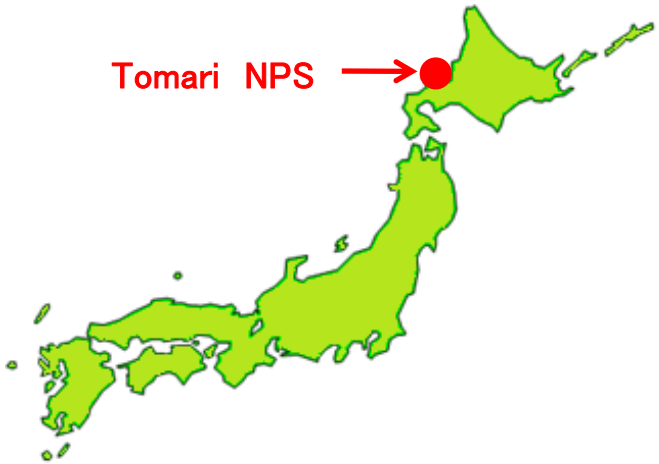
1. Overview of Tomari Nuclear Power Station

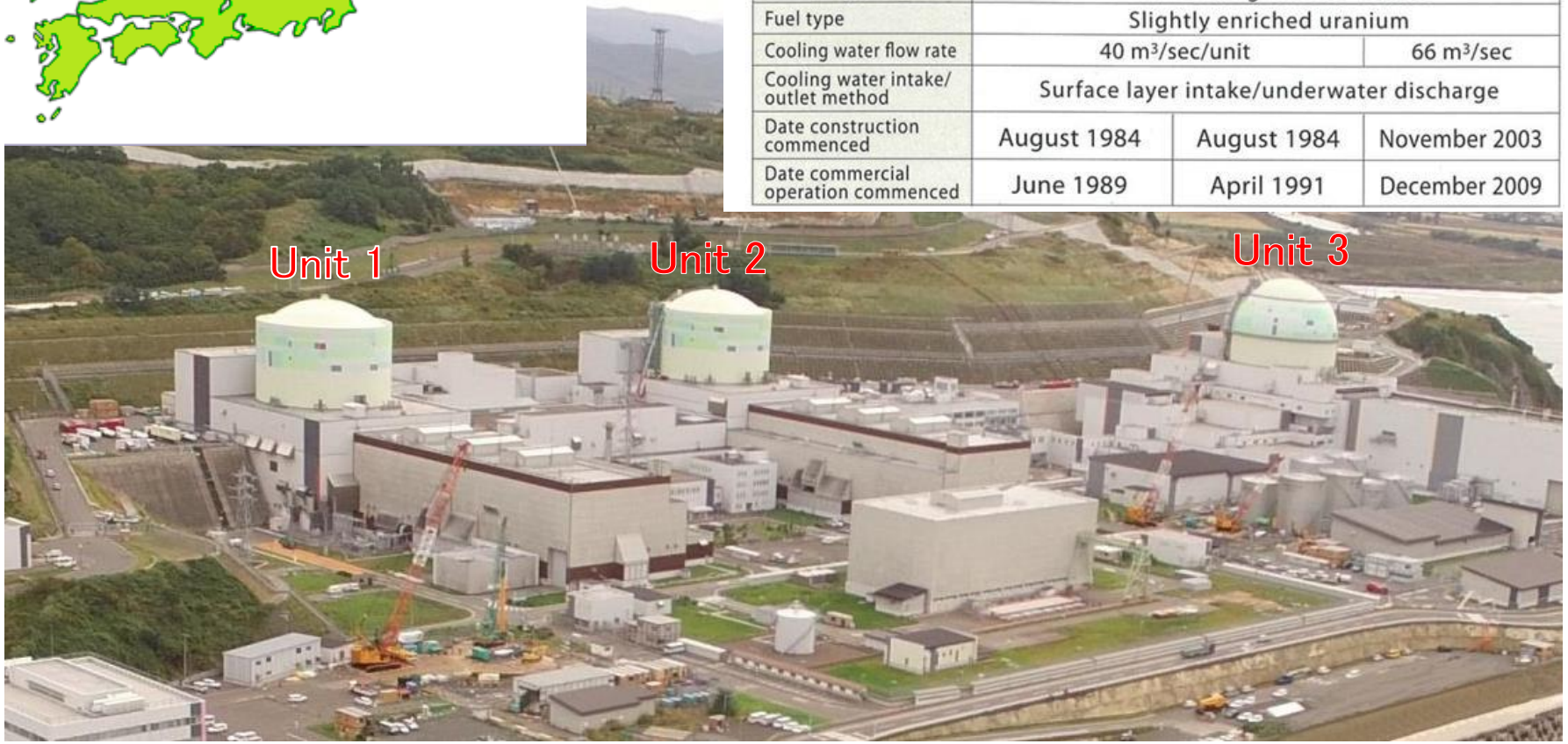


Summary of Tomari Nuclear Power Station

Tomari Nuclear Power Station

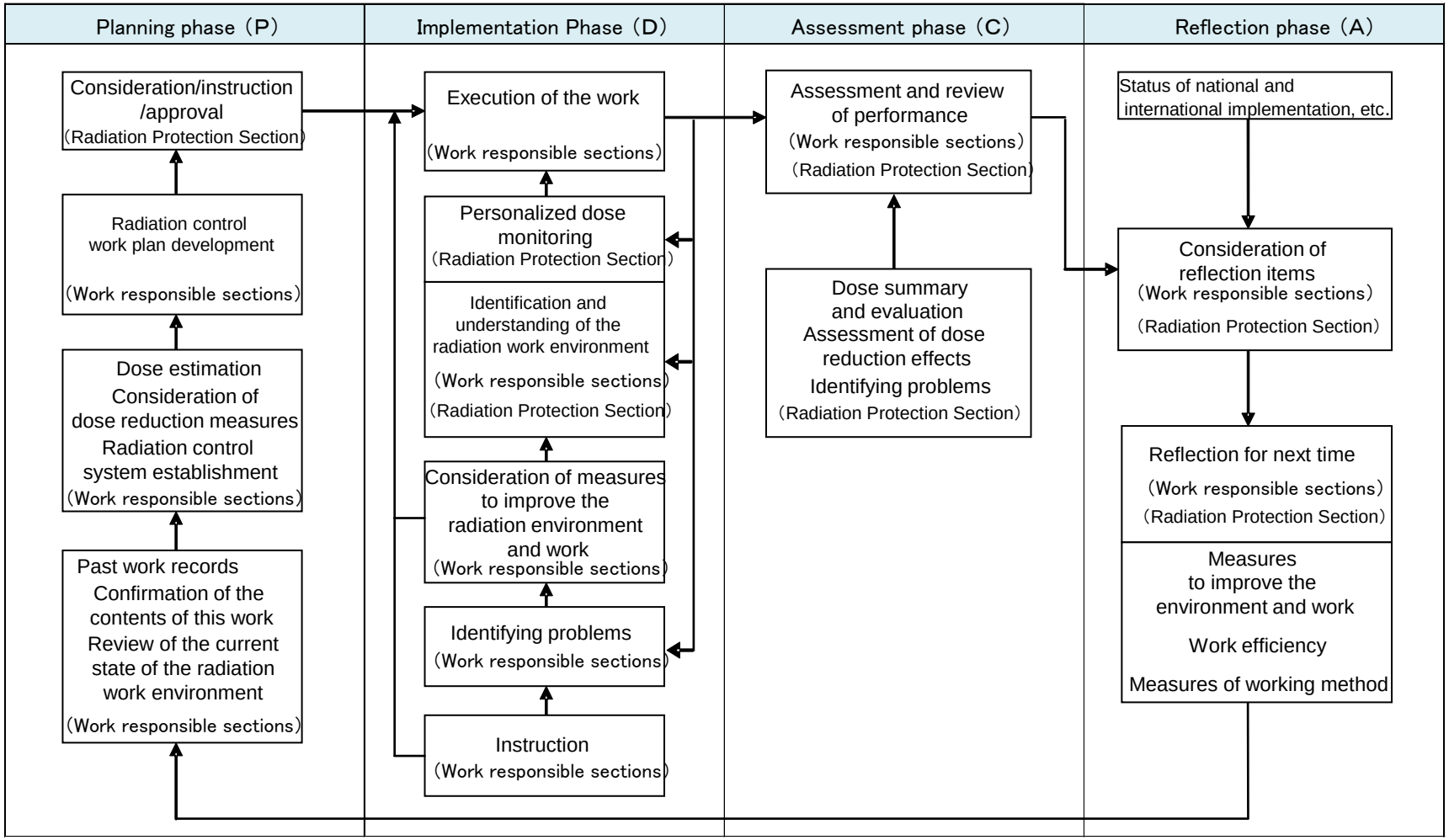
Name	
Location	Ooaza Horikappu Mura, Tomari Mura, Furuu Gun, Hokkaido, Japan
Site area	Approx. 1,350,000 m²

	Unit 1	Unit 2	Unit 3
Rated electric output	579MW	579MW	912MW
Reactor type	Pressurized light water reactor		
Fuel type	Slightly enriched uranium		
Cooling water flow rate	40 m³/sec/unit		66 m³/sec
Cooling water intake/ outlet method	Surface layer intake/underwater discharge		
Date construction commenced	August 1984	August 1984	November 2003
Date commercial operation commenced	June 1989	April 1991	December 2009



2. Management Flow for Dose Reduction Practices at Tomari NPS

When working in Radiological Controlled Areas (RCA), work responsible sections and the Radiation Protection Section utilize the Plan-Do-Check-Act (PDCA) cycle to share information and improve work practices.



Within the plant, ALARA-related meetings are held at the following four meetings

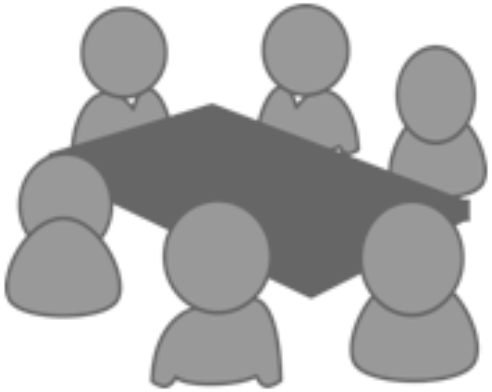
○ ALARA-Related Meetings

①Station ALARA Meetings

②Radiation Safety Management Meetings

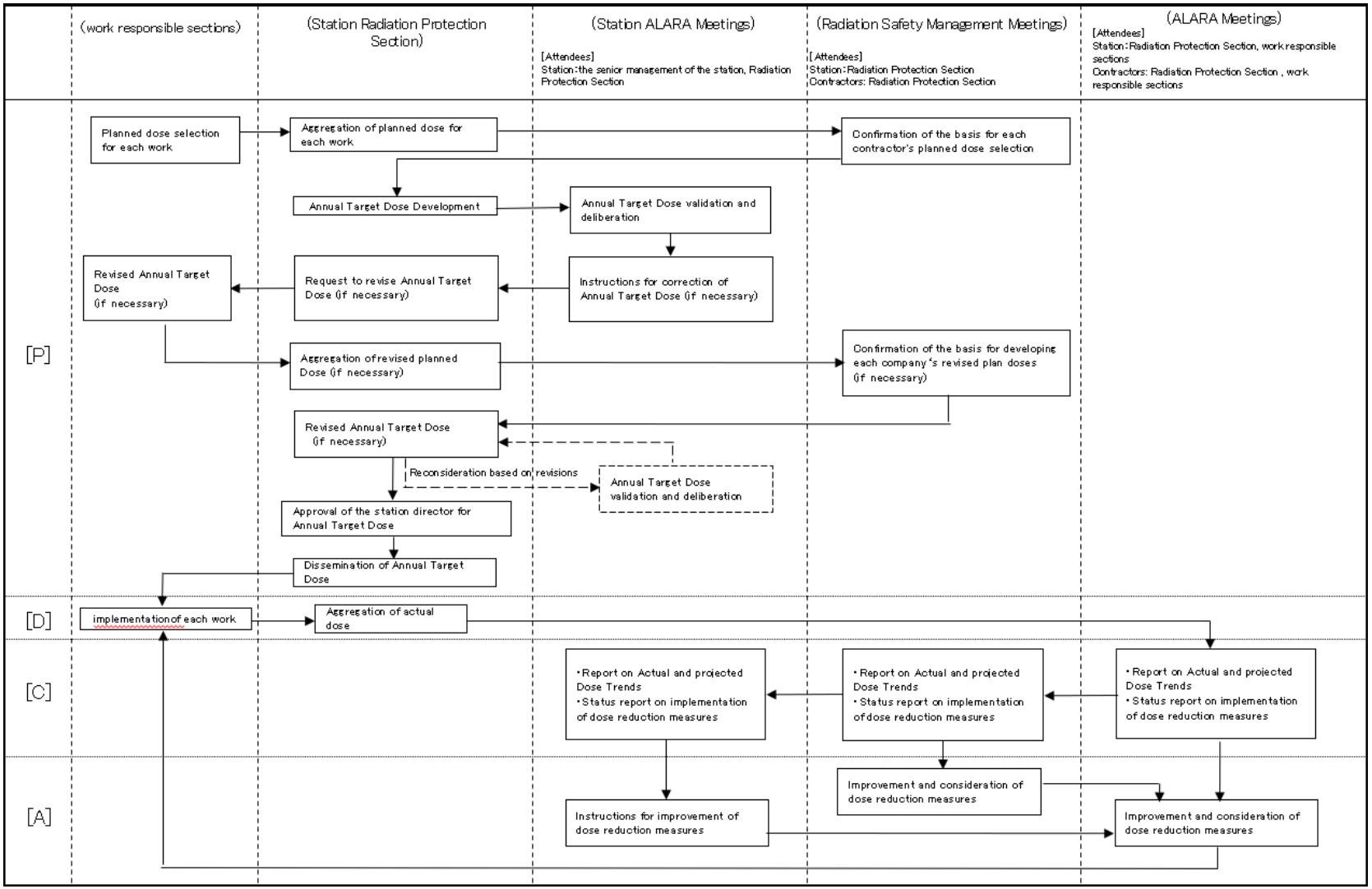
③ ALARA Meetings

④Safety and Health Council Meetings



3. Meetings Held at Tomari NPS（2）

The PDCA cycle is utelized in meetings within Tomari NPS as follows



3. Meetings Held at Tomari NPS (3)

① Station ALARA Meetings

Meetings participated by the senior management of Tomari NPS to deliberate on the exposure status of workers, confirmation of dose reduction measures, and the validation of the planned collective dose to achieve ALARA principles.

○ Station ALARA Meetings Details

(Frequency: Once in each of the first and fourth quarters, and as needed)

- Annual target dose validation and deliberation
- Revised annual target dose validation and deliberation
- Confirmation of trends in actual doses and forecasted doses in the future
- Confirmation of the effectiveness of dose reduction measures for the projects with higher planned dose
- Proposals for facility improvements as needed.
- Proposal of dose reduction measures based on domestic and international industry experience

3. Meetings Held at Tomari NPS (4)

② Radiation Safety Management Meetings

Meetings participated by the radiation control section of the station and contractors for confirmation of the dose reduction measures, etc., for the purpose of ALARA.

This meeting are held on a regular basis, as well as whenever there are important radiation control matters that need to be shared.

○ Radiation Safety Management Meetings Details

(Frequency: monthly, before/during/after outage maintenance, and as needed)

- Notification of restricted areas during the outage maintenance
- Review the "Dose Trend Summary Table of the Outage" for each contractor
- Confirmation of the status of implementation of dose reduction measures, etc
- Notification of changes in radiation control practices
- Collection of requests, etc. from contractors

3. Meetings held at Tomari NPS（5）

③ ALARA Meetings

Meetings participated by work responsible sections and the radiation control section of the station and the contractors to confirm the dose reduction measures for the projects with high planned dose to meet the ALARA principles.

○ ALARA Meetings Details

(Frequency: weekly)

- Confirmation of dose trends during the work period
- Explanation of expected dose trends
- Explanation of increase/decrease factors related to the planned dose
- Confirmation of the status of implementation of dose reduction measures

3. Meetings Held at Tomari NPS (6)

④ Safety and Health Council Meetings

Meetings participated with senior management and contractors to confirm the status of occupational safety and radiation control

○ Safety and Health Council Meetings Details (Frequency: monthly)

- Confirmation of dose trends during the outage maintenance
- Confirmation of actual dose status for each work
- Confirmation of the reasons for exceeding the planned dose for the

4. Rdiation Control Practices Which Have Been Implemented at Tomari NPS (1)

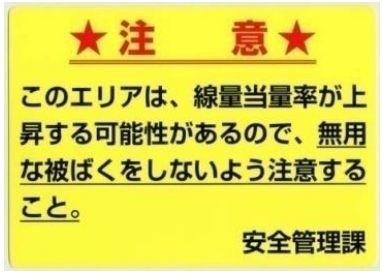
Physical warning is provided to radiation workers by posting "Dose Equivalent Rate Indicators" and "High Dose Piping Warning Indicators" in work areas and common areas.

< Dose Equivalent Rate Indicators >

○Indication to share the dose equivalent rate at the work place, etc

< High Dose Equivalent Warning Indicators >

○Indication to worn the areas with high dose equivalent rates exceeding 1 mSv/h

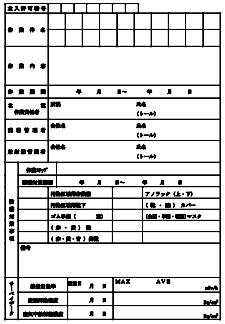


< Dose Equivalent Warning Indicators >

○ Indication to notify the areas where the dose equivalent rate may increase or change as a result of the work.

< Standby Area Indicators >

○ Indication for the standby area



< Radiation Protective Indicators >

○ Indication to instruct the radiation work environment and the radiation protective equipment

< Radiation Protection Equipment Wearing Instruction >

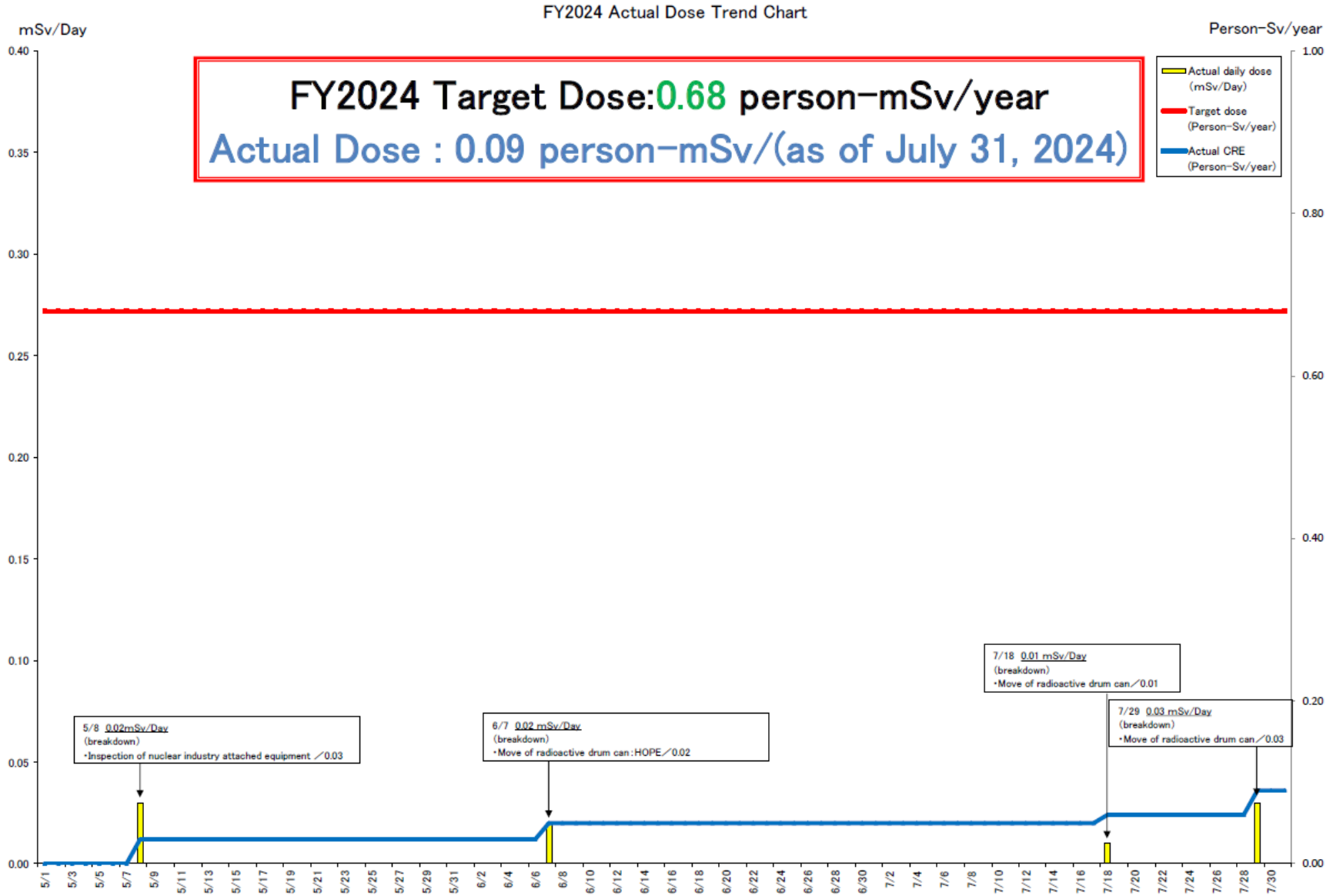
○ Indication to instruct the radiation protective equipment

○ Quarterly summary of actual dose and information share (Frequency: quarterly)
On a quarterly basis, planned and actual dose for each work project and contractor are summarized and shared.

○ Share and indication of actual dose trends (Frequency: monthly)
Monthly, a chart of actual dose trends for the last three months is shared.
This chart is posted in the locker rooms, in front of the access control counter, and in the radiation control room before entering the RCA.

○ Notification of dose equivalent rate for each building(Frequency: monthly)
In addition to the posting of dose equivalent rates at the entrance of RCA, dose equivalent rate in the reactor auxiliary building, Containment Vessel and isolated RCA (including the radioactive waste treatment building) are shared monthly.

○ Actual Dose Trend Chart (August 2024)



○ Regarding the “Tomari NPS Management, and Any Other Opinions/feedback Form”

・Tomari NPS has established a “Tomari NPS Management, and Any Other Opinions/feedback Form” to receive opinions from both internal and external workers on the management of Tomari NPS, including matters related to radiation control.

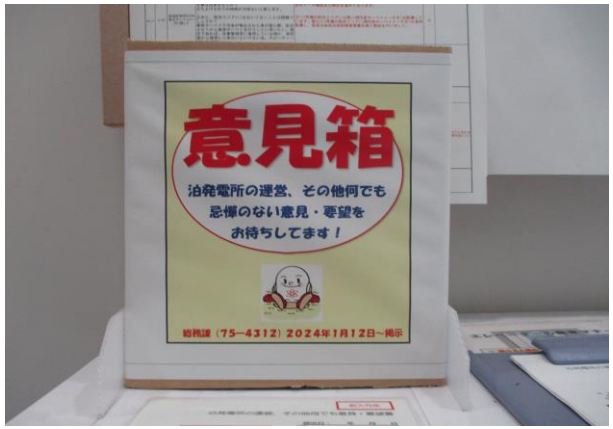
・Workers can write opinions on a form and put it in the collection box.

・We have received many opinions, some of which relate to radiation control.

・We are working to improve our management based on the opinions we have received.

The opinions board

The collection box



Opinions received to the date and our response to them

Summary of Opinions	Response Details
To prevent heat stroke during summer, I would like to have a water station installed in the RCA.	We promptly installed a water station.
The smell of the RCA work clothes bothers me and I would like something to be done about it.※1	We deployed disposable work clothes for those who suffered from the smell.
I would like the GM survey meter for self-survey before leaving the RCA to be turned on all the time.※2	At Unit 3, which has a large number of in/out workers and is expected to have a larger number in the future, a trial implementation was made to turn on the GM survey meter.

※1 Causes of Work Clothing Smell:
The smell remained due to room drying instead of washing and steam drying for cost and other reasons.

※2 Purpose of the Self-Survey :
・To prevent the spread of contamination through early detection of contamination
・To prevent exit monitors from triggering alarms when the RCA is exited.

○ Heat Stroke Prevention in the RCA

・In recent years, due in part to rising summer temperatures, attention has focused on measures to prevent heat stroke as a measure to improve the workplace.

・There is a growing need for products to prevent heat stroke not only in outdoor workplaces, but also in the RCA .

・The Radiation Control Section is contacted by work responsible sections if there are any heat-protective items they would like to use in the RCA, and the Section responds as to whether or not they can be used.

・The results of the responses are listed and shared both internal and external workers.

・As a general rule, if the heat-protective items were not exposed to RCA atmosphere by covered by their work clothes and do not removed in the RCA, they can be taken out by passing the exit monitor.
In addition, if the item is worn in the RCA over the work clothes for RCA, it must be surveyed before and after use.

List of Responses

Heat-Protective Items*	Allowed:○ Prohibited: ×	Reason etc.
Air Conditioned Suit	○※	※May be used in RCA where there is no risk of contamination. Cannot be used in RCA where there is a risk of contamination as it may result in the spread of contamination.
Head Cooler	○	Allowed
Neck Cooler	○	Allowed
Aqua Water Vest (Evaporation Heat Removal)	○	Allowed
PCM Power Cool Vest	○	Allowed
cooling towel	×	Cannot be used in RCA because it may be used to wipe sweat, etc. and there is a risk of body contamination.

＊ Includes all products of the same type.

5. Conclusion

・Continue to implement the management flow for ALARA at the Tomari NPS to reduce dose.

・In the future, there is a possibility of an increase in major maintenance work due to the aging of the plant and the restart of operation of Unit 3, thus we will implement appropriate dose reduction measures for each of these to reduce dose.

・ We will continue to communicate and post necessary information so that every radiological worker to be aware of the need for dose reduction.

ともに輝く明日のために。
Light up your future.
ほくでん

Reference

【Reference】1. Evolution in Dose Reduction Measures（ Unit 1. ）

Tomari NPP is a late comer to the nuclear power industry in Japan, and proactively take into account the dose reduction measures from industry experience. This slide shows the evolution of typical dose reduction measures implemented at the Tomari NPP Unit 1.

Evolution in Dose Reduction Measures（ Unit 1. ）

Item \ Number of periodic inspections	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Automation of work	▽Using reactor vessel stud tensioner															
	▽Using reactor vessel stud bolt rotating device															
	▽Using reactor vessel stud bolt holes brushing device															
	▽Adopting eddy-current inspection robot for steam generator heat-transfer pipes															
	▽Adopting pipe automatic UT device															
								▽Adopting check valve seat automatic facing device								
Rationalization of work	▽Using improved thermocouple connector															
	▽Using reactor vessel sealing plate															
	▽Using primary coolant pump cartridge seal															
	▽Using DF probe for volumetric inspection work of steam generator heat-transfer pipes															
	▽Using steam generator manhole lid handling device															
	▽Installing a fan to prevent the suppression of dust while reactor vessel upper lid is open															
										▽Adopting steam generator new type nozzle lids							
Reducing dose equivalent rate in work environment	▽Integration of control rod driving device cooling duct															
	▽Optimization of water quality control during shutdown															
	▽Adopting low-cobalt materials for reactor vessel, etc.															
	▽Shielding reactor vessel upper lid temporary placing space with lead screens and lead mats															
	▽Lead shielding of pipes on passageways in reactor containment vessel															
	▽Permanent shielding of main coolant pipes															
		▽Lead shielding of reactor vessel upper lids														
									▽Adopting primary coolant pump internal decontamination							
										Using lead shielding tools for the maintenance of steam generator primary manhole, etc. ▽						
												Installing shielding lid on the primary coolant pump casing ▽				
													Optimization of pH control of primary coolant during operation ▽			
														Injecting Zn into primary coolant system while plant is in operation ▽		

【Reference】2. Zinc Injection into Primary Coolant During Operation

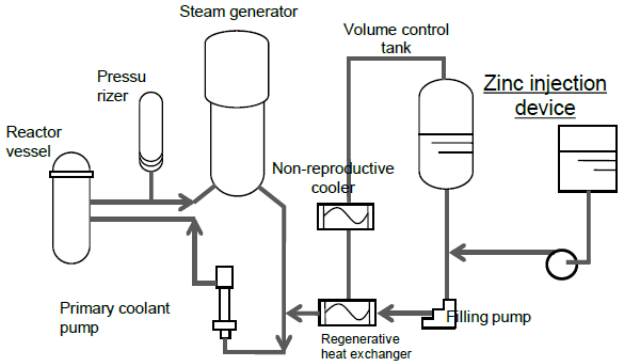
・During operation, zinc is injected into the primary coolant system. The zinc replaces cobalt absorbed in the oxide film and prevents cobalt from being absorbed on the surface of the tubes. With this method, the dose equivalent rate of the primary coolant system is reduced, and radiation exposure is reduced accordingly.

・<u>In Unit 3 of the Tomari NPP, we were the first in the world to introduce zinc injection into the primary coolant system since the hot functional test to reduce radiation dose.</u>

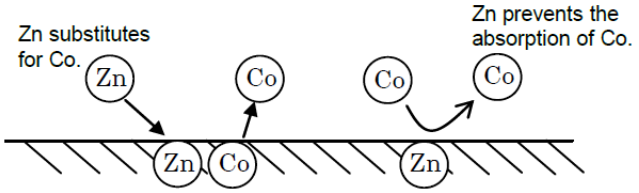
Effect of zinc injection to reduce dose equivalent rate (Unit: mSv/h)

	Unit 1				Unit 2					Unit 3	
	Before injection	After injection		Reduction effect (1-((2)/(1)))	Before injection	After injection			Reduction effect (1-((4)/(3)))	After injection	
	15th (1)	16th	17th (2)		13th (3)	14th	15th	16th (4)		1st	2nd
S/G water chamber (HOT)	24.00	19.00	13.00	Reduced by approx. 46%	22.00	13.00	13.00	14.00	Reduced by approx. 36%	15.00	7.00
S/G water chamber (COLD)	39.00	22.00	22.00	Reduced by approx. 44%	35.00	18.00	16.00	18.00	Reduced by approx. 48%	15.00	5.00
R/V upper lid	12.00	17.00	16.00	Increased by approx. 33%	18.00	16.00	6.00	12.00	Reduced by approx. 33%	14.00	10.00
Primary coolant pipe HOT	0.017	0.035	0.021	Increased by approx. 24%	0.046	0.031	0.020	0.014	Reduced by approx. 70%	0.020	0.012
Primary coolant pipe COLD	0.124	0.106	0.045	Reduced by approx. 63%	0.181	0.142	0.079	0.088	Reduced by approx. 51%	0.025	0.013
Primary coolant pipe CROSS	0.025	0.029	0.017	Reduced by approx. 32%	0.044	0.032	0.017	0.020	Reduced by approx. 55%	0.012	0.006

(Outline of the zinc injection system)



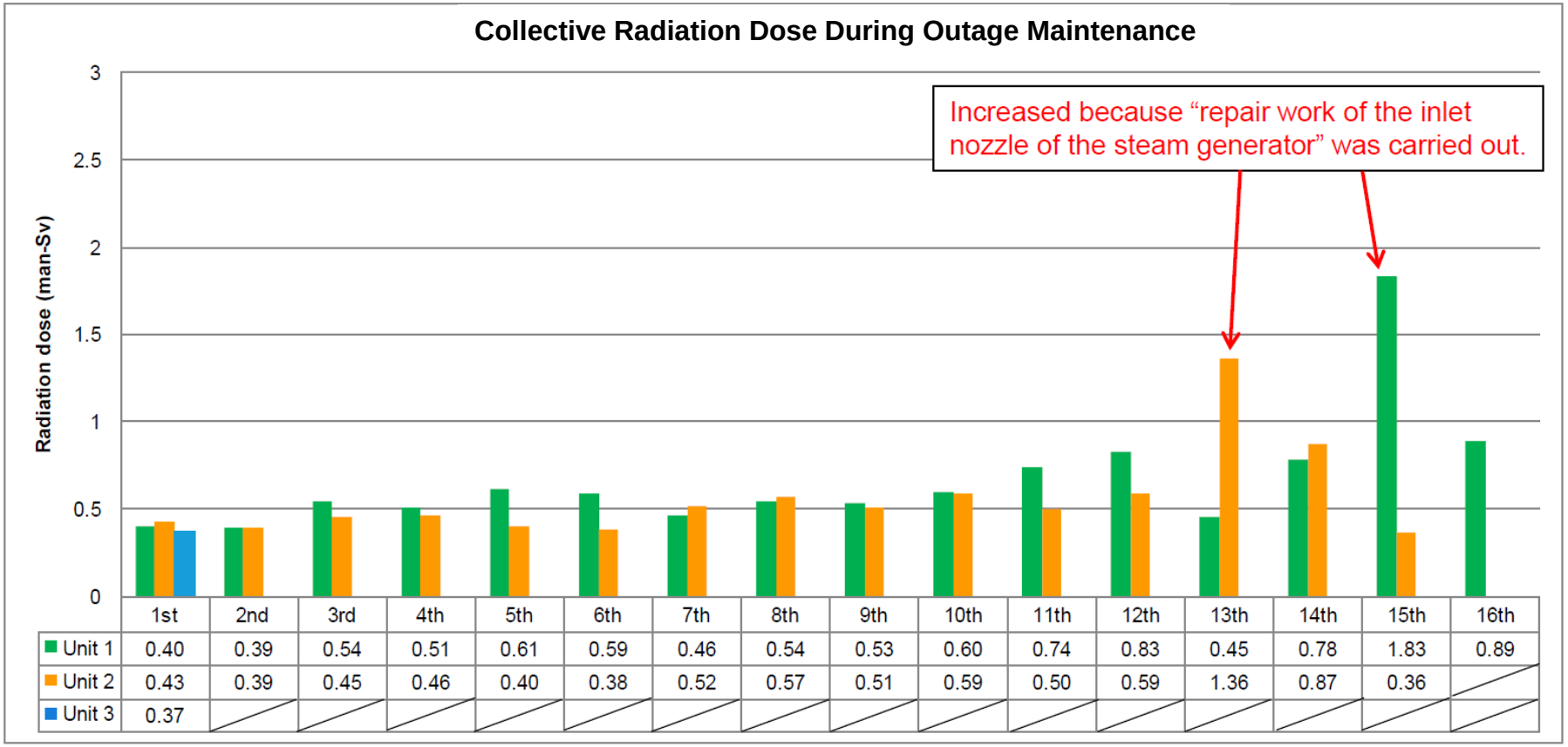
(Mechanism to reduce radiation exposure)



【 Reference 】3. Collective Radiation Dose During Outage Maintenance

Since the first outage maintenance, collective radiation dose at Tomari NPS has been mitigated at the level of 0.5 person-Sv/ Outage.

This is regarded as a result of the dose reduction measures proactively taken into account from industry experience since the design phase by utilizing an advantage of being a late comer in Japanese nuclear industry.



	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th
Unit 1	0.40	0.39	0.54	0.51	0.61	0.59	0.46	0.54	0.53	0.60	0.74	0.83	0.45	0.78	1.83	0.89
Unit 2	0.43	0.39	0.45	0.46	0.40	0.38	0.52	0.57	0.51	0.59	0.50	0.59	1.36	0.87	0.36	
Unit 3	0.37															

【Reference】4. Dose Reduction Measures through Temporary Radiation Shielding（1）

○Installation of temporary radiation shielding in Radiological Controlled Areas (RCA).
At Tomari NPP, the Radiation Protection Section installs temporary radiation shielding as dose reduction measures in common areas other than work areas where radiation dose levels are high.

Temporary radiation shielding with an impulse (e.g.)

Temporary radiation shielding with tungsten mats(e.g.)

Tungsten mats were installed at a total of 15 locations (116 pieces of shielding material), such as main pipes, to reduce dose equivalent rates in common areas at the time of the 3-2 outage maintenance.
As a result, the radiation dose reduction effect of tungsten mats was 3.84 person-mSv/ Outage, according to the collective radiation dose in common areas. During the next outage maintenance, tungsten mats will be installed in more locations to further reduce dose.

Effect of Shielding Installed at Time of 3-2 Outage Maintenance (Major Common Areas)

Installation location		Dose equivalent rate before shielding (mSv/h)	Dose equivalent rate after shielding (mSv/h)	Reduction rate in dose equivalent rate at the time of 3-2 periodic inspection (%)
C/V17.8m	A-C Loop Room 1F passageway RHR pipe	0.027	0.020	25.9
C/V17.8m	A Loop Room 1F RHR pipe	0.025	0.020	20.0
C/V24.2m	A Loop Room 3F SI pipe	0.096	0.080	16.7
C/V24.2m	C Loop Room3F SI pipe	0.102	0.070	31.4
C/V26.6m	A Loop Room 4F SI pipe	0.078	0.050	35.9
C/V26.6m	B Loop Room 4F SI pipe	0.060	0.040	33.3
C/V26.6m	C Loop Room4F SI pipe	0.075	0.050	33.3

END