Activities to reduce radiation exposure during outages of Ikata Power Station Unit 3

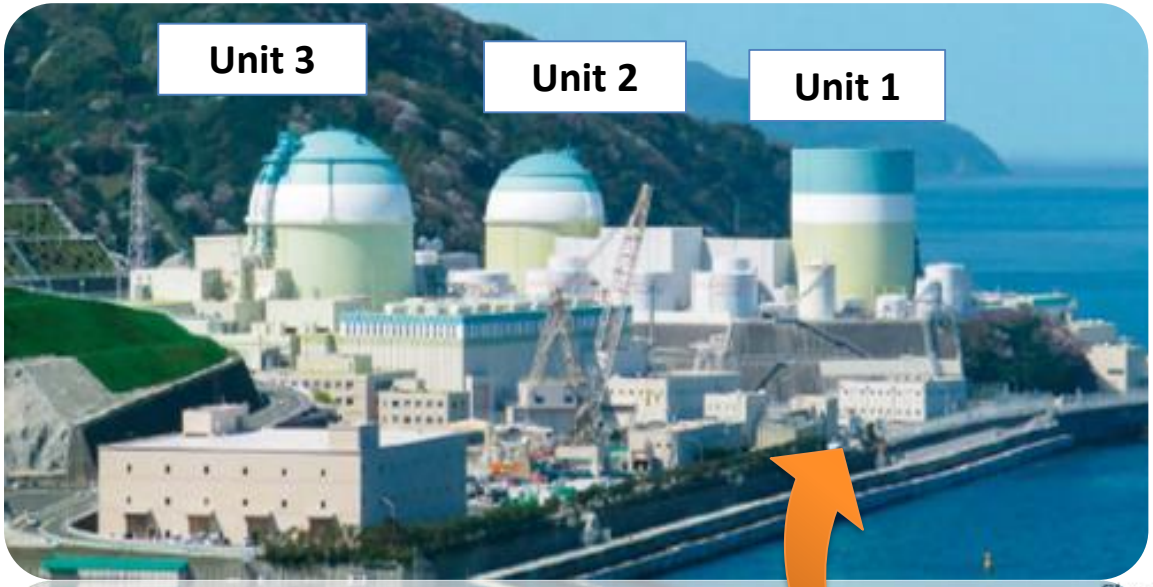
October,2024

Shikoku Electric Power Co., Inc

2024 ISOE International Symposium
Kyoto, 1-3 October 2024

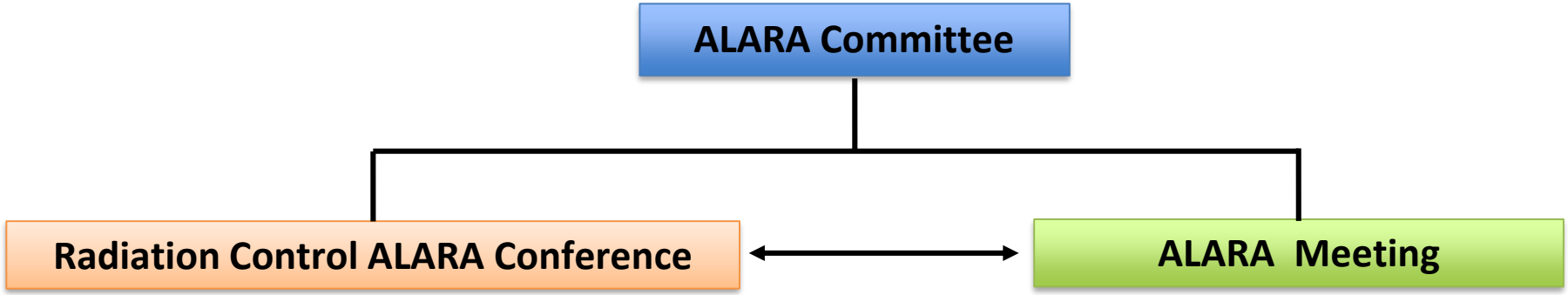
1. Outline of the Ikata Power Station

Ikata Power Station（PWR）



	Unit 1	Unit 2	Unit 3
Rated electrical output	(566 MW)	(566 MW)	890 MW
Startup	September 30, 1977	March 19, 1982	December 15, 1994
Termination	May 10, 2016	May 23, 2018	—

2. System of ALARA activities



【ALARA Committee】

- **Deliberation and report on previous year's actual dose, fiscal year's dose objective, dose trend, ALARA Activity results.**
- Members（only Shikoku Electric Power）
  Ikata PS Director, Deputy Director, Technical Department Managers and Section Chiefs

Plan
Do
Check
Action

【Radiation Control ALARA Conference】

- **Confirm dose objective, actual dose, appropriateness of reduction measures of exposure and waste .**
- Members
  - Radiation and Chemical Control Section (Shikoku Electric Power)
  - Radiation Control Supervisor (contractor companies)

Plan
Do
Check
Action

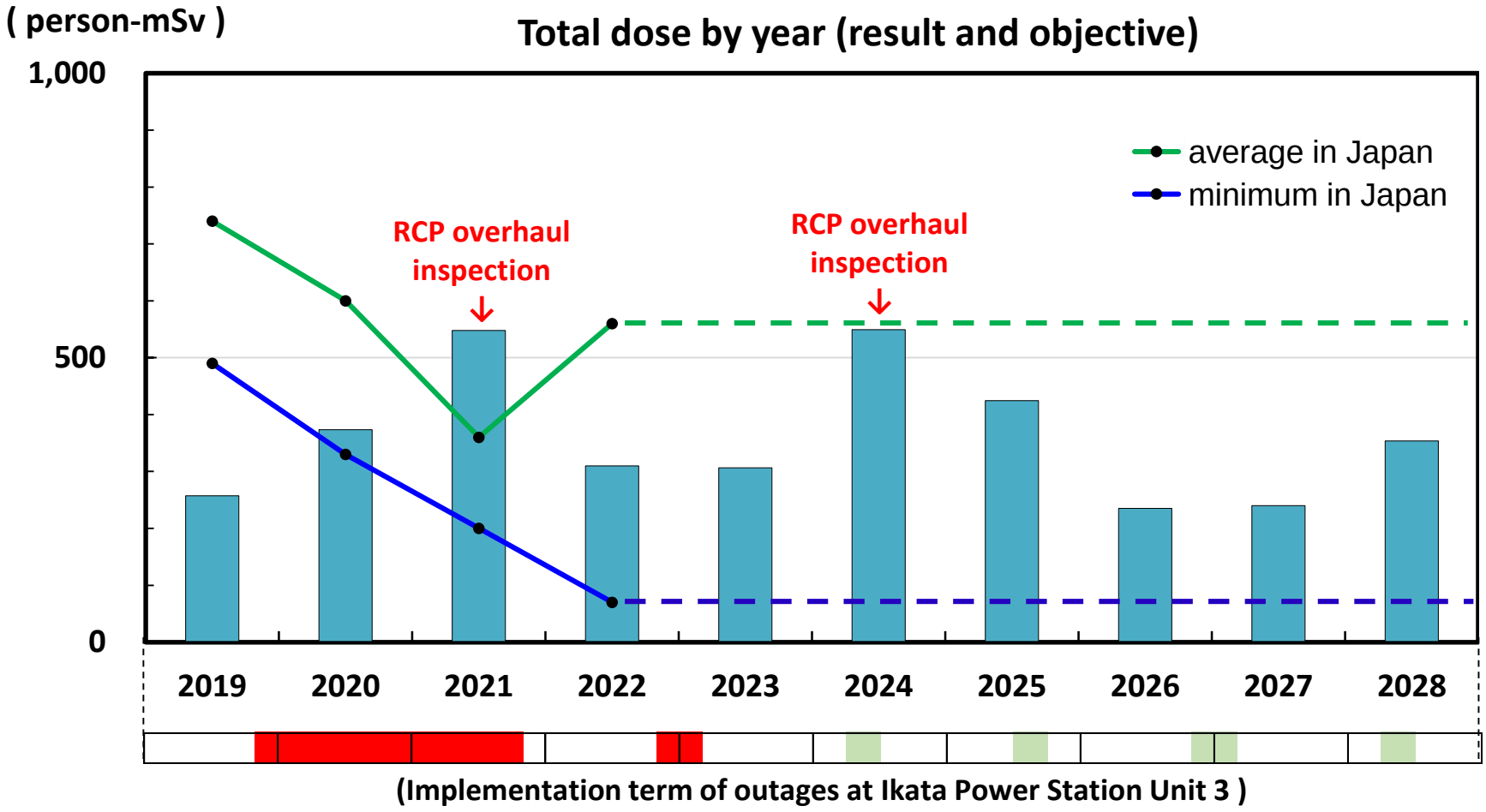
【ALARA Meeting】

- **Consider measures to decrease radiation exposure and waste for construction. (Projected dose: 5 person-mSv over, waste generation: 50 bags over)**
- Members
  - Radiation and Chemical Control section (Shikoku Electric Power)
  - Radiation Control Supervisor and Work Manager (contractor companies)

Plan
Do
Check
Action

follow the PDCA cycle through two conferences and a committee

3. Dose trend of Ikata Power Station



As for the mid- to long-term dose objective (～2028), it is expected to be below the average of restarted plants in Japan, but the objective may change depending on the construction details of outages and the full-scale start of decommissioning of Unit 1 and 2.

Need to continue ALARA activities certainly through Radiation Control ALARA Conference and ALARA Meeting, etc.

4-1. ALARA Activity Results

ALARA Activity objective in FY2024 (main assignment)

Items	Contents	Objectives
▶ RCP overhaul inspection ・Method of reducing exposure during overhaul inspection after internal decontamination （Improvement of ambient dose equivalent rate）	▶Previous result (3-15 Outage) Target: 103 person-mSv Result: 157 person-mSv （About 50% over） 【Cause】 The dose equivalent rate after internal decontamination was much higher than expected. →There was a big difference between estimated value and actual value of yardstick for decontamination and projected dose equivalent rate, lead to excesstive exposure.	▶Change the yardstick for decontamination Average: 5mSv/h or less ↓ Maximum: 5mSv/h or less
▶Radiation Visualization	▶Utilization of portable gamma ray visualization camera →Reduce unnecessary exposure	▶Display dose distribution maps (photos) on site ・Display the dose distribution of high dose equivalent rate areas on site to accurately inform workers about hot spots of dose equivalent rates, and it will read to reduce unnecessary exposure.

4-2. ALARA Activity Results (RCP overhaul inspection)

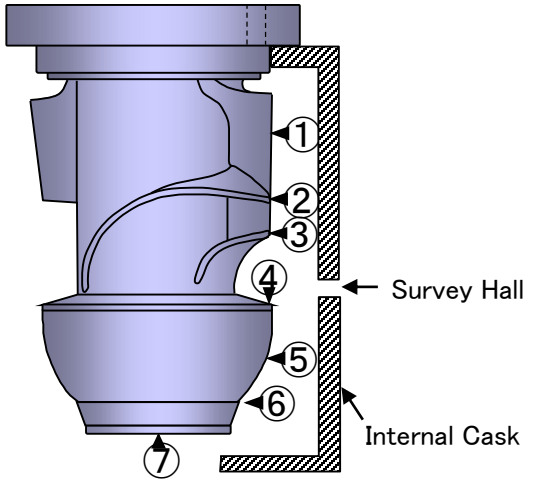
Exposure reduction measures for each work step

Work steps (RCP Internal-related)	3-15 outage Actual dose (person-mSv)	Exposure reduction measures, etc.	3-17 outage Projected dose (person-mSv)
①Hoist ・Loosen bolts～ Carrying in/out to/from a cask	**13.27**	**Enhance temporary shieldings**	**8.71** **(-4.56)**
②Decontamination ・Decontamination of the internals and impellers, Treatment waste liquid	**12.65**	**Enhance temporary shieldings** (lead wool mat ⇒ lead plate)	**5.99** **(-6.66)**
③Overhaul inspection ・Invert the Internal, Remove the parts, Inspection, Assembly, Store the Internal into the cask	**108.12**	**Maximum dose equivalent rate ⇒ 8.0 mSv/h** (Calculated taking into consideration the maximum dose equivalent rate and working time of previous outages.)	**94.3** **(-13.82)**
④Bring down ・Bring down RCP Internal, Install bolts ～ Clean up	**7.13**	**Difference of ambient dose equivalent**	**13.46** **(+6.33)**
⑤Management work	**15.92**	**Improve Radiation Control work efficiency**	**13.84** **(-2.08)**
Total	**157.09**		**136.30** **(-20.79)**

- 13%

4-2. ALARA Activity Results (RCP overhaul inspection)

【 3-17 outage result (RCP Internal Decontamination) 】



No.	3-15 outage (mSv/h) 【Unit A】		3-17 outage (mSv/h) 【Unit C】	
	Before decontamination	After decontamination	Before decontamination	After decontamination
①	[redacted]			
②				
③				
④				
⑤				
⑥				
⑦				
AVE				
DF※ (total)				
DF※ (/time)				

※decontamination factor

【 Result of RCP Internal decontamination 】

Target ：Maximum Dose Equivalent Rate 5mSv/h or less

Result ：Maximum Dose Equivalent Rate 12mSv/h（target level＋7mSv/h)

▶In the primary cooling system, zinc injection has been injected into the primary coolant since January 2019 in order to suppress the adhesion of Co-60 and other substances to the piping within the system. However, continued zinc injection over a long period of time has increased the thickness of the zinc film formed on the metal surface, which may have reduced the decontamination effect on the Co-60 contained in the film.

⇒It is necessary to consider new measures to reduce radiation exposure, such as increasing the number of decontamination operations by the next time.

4-3. ALARA Activity Results (Radiation Visualization Camera)

Introducing a radiation distribution visualization camera(2023～)

▶Performance

It is possible to identify location and visualize of radiation source.
(This camera can detected gamma rays.)

▶By overlaying the radiation distribution on the optical image, the location of the radiation can be determined.
(Real time measurement is possible)

▶By measuring the distance from the object using the built-in range finder, the approximate dose rate of the source can be estimated.

▼Camera Body

▼Measurement results (Hoist RCP Internal)

◀Measurement results（「multicolor display」）

left side：Normal Image
right side：Measurement screen

※The displayed color changes depending on the intensity of the dose distribution.

high ⟵ intensity ⟶ low

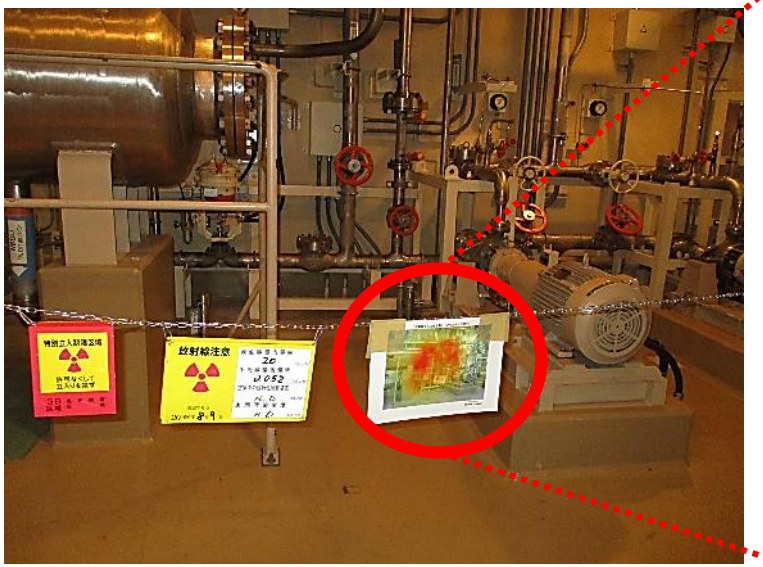
red ＞ yellow ＞ green

※Relative Intensity Display

4-3. ALARA Activity Results (Radiation Visualization Camera)

【 Utilization results 】 Dose distribution maps posted at high dose equivalent rate areas.

▼ CVCDT※ (during outages)



※ Containment Vessel Coolant Drain Tank

▶By posting the analysis results from the radiation visualization camera on-site, locations within the area with high dose equivalent rates can be visually recognized.

→Effective in reducing frequency of approaching high dose rate areas!

4-4. ALARA Activity Results (Others)

▽ Site Management (Exposure reduction measures)

- **Lead shielding**

- **illumination**
  (for alerting people to high dose equivalent rate locations)

- **Gamma ray area monitor**
  (For air dose measurement)

- **Display at the site**
  (High dose equivalent rate locations)

- **Occupational exposure monitoring equipment**

Thank you for your attention ！