Measure to Reduce Radiation Exposure during the RV Core Internals Replacement at Ikata Nuclear Power Sation Unit-1

November, 2005

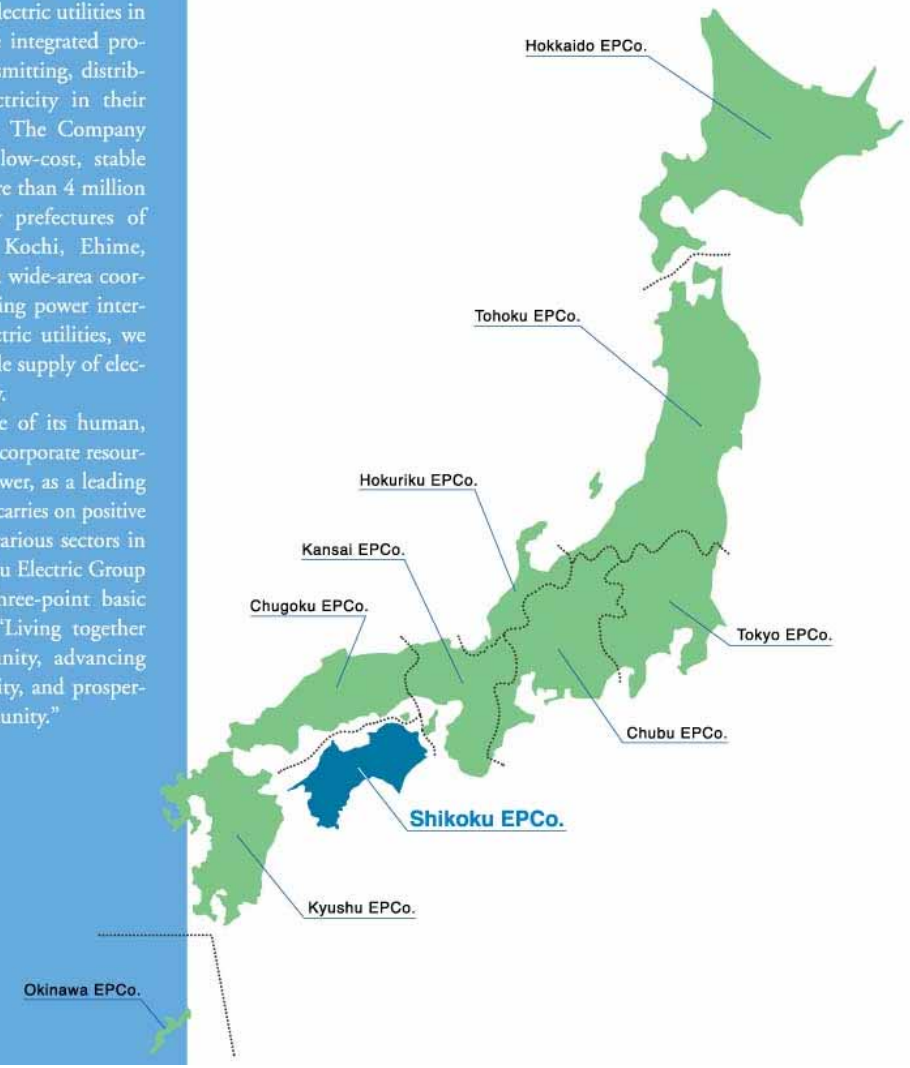
Shikoku Electric Power Co.,Inc.

Electric Utilities in Japan

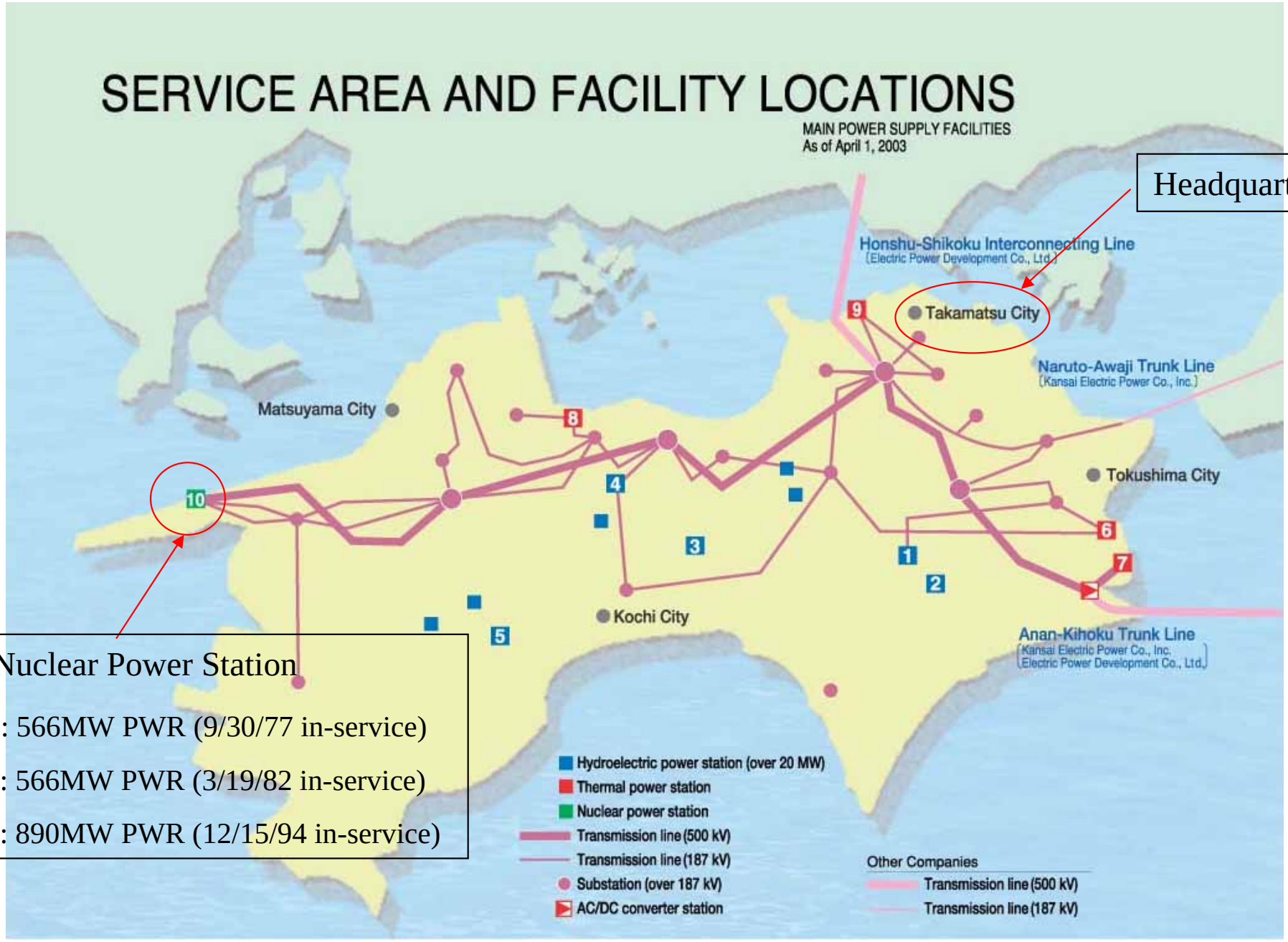
THE COMPANY

Shikoku Electric Power Company, Incorporated, was established on May 1, 1951, and in 2001 celebrated 50 years of continuous service. Shikoku Electric Power is one of the 10 electric utilities in Japan that carry on the integrated process of generating, transmitting, distributing, and selling electricity in their respective service areas. The Company provides high-quality, low-cost, stable electricity service to more than 4 million customers in the four prefectures of Shikoku—Tokushima, Kochi, Ehime, and Kagawa. Through a wide-area coordination system, including power interchanges with other electric utilities, we also contribute to a stable supply of electricity across the country.

Making effective use of its human, technological, and other corporate resources, Shikoku Electric Power, as a leading enterprise in the locality, carries on positive business operations in various sectors in cooperation with Shikoku Electric Group companies under its three-point basic corporate philosophy: "Living together with the local community, advancing with the local community, and prospering with the local community."



Shikoku Electric Power Co., Inc.



Headquarters

Ikata Nuclear Power Station

Unit-1: 566MW PWR (9/30/77 in-service)

Unit-2: 566MW PWR (3/19/82 in-service)

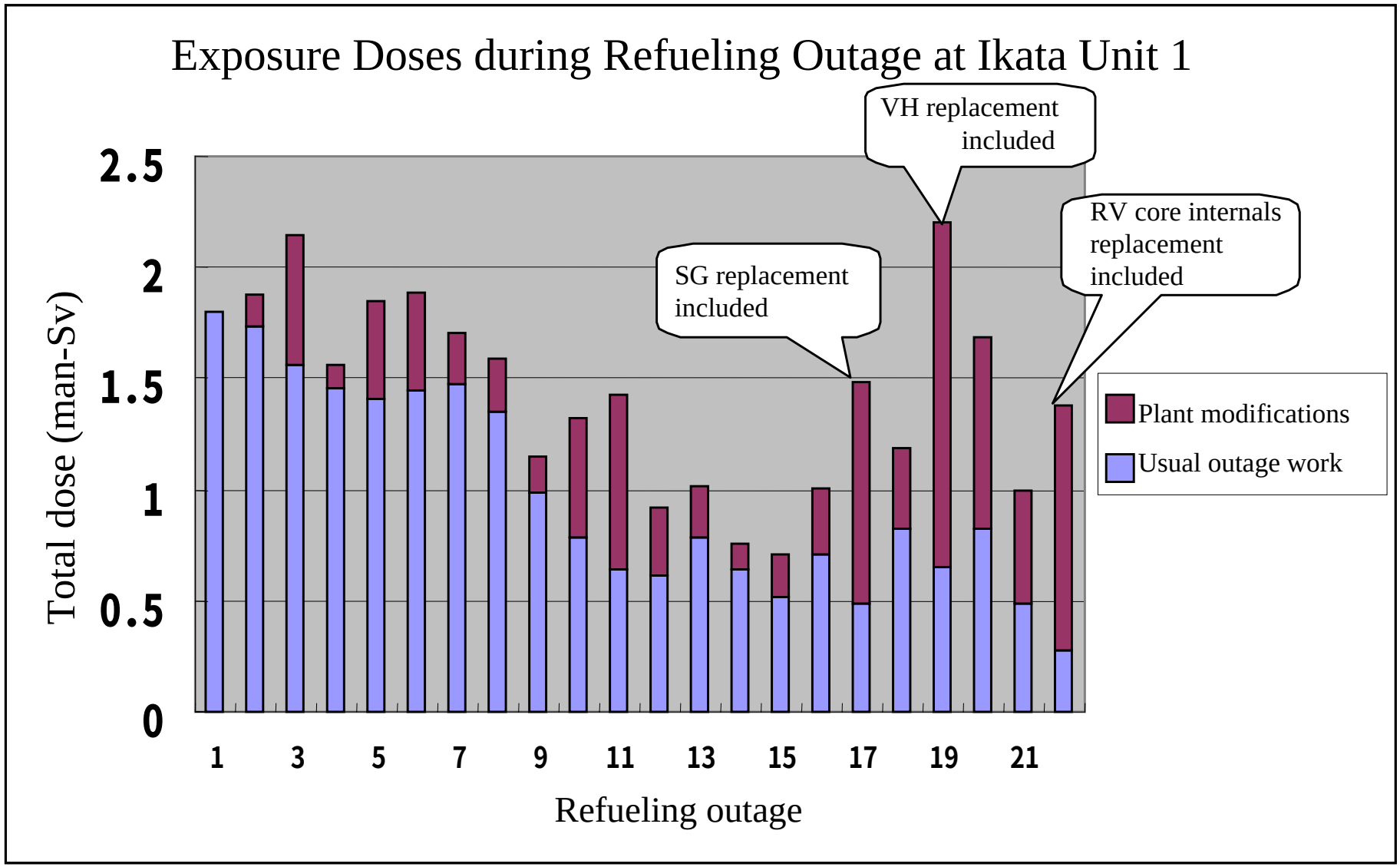
Unit-3: 890MW PWR (12/15/94 in-service)

Ikata Power Station

Overview of Ikata Power Station

As of Aug. 31 2004

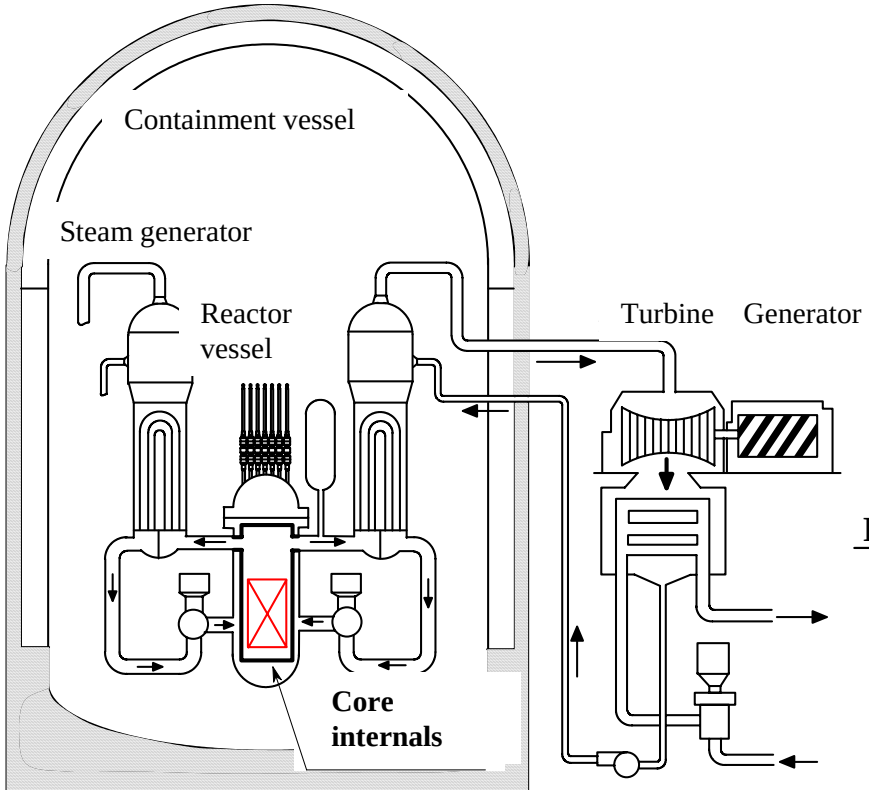
	Output (MW)	Commercial operation started in	Operating hours (10^4 hrs)	Major modifications
Unit 1 (PWR)	566	Sep. 1977	20.0	1998 Steam generator replacement 2000 Reactor vessel head replacement *2004 Core internals replacement*
Unit 2 (PWR)	566	Mar. 1982	17.9	2002 Steam generator replacement Reactor vessel head replacement *(Planned)* *2005 Core internals replacement*
Unit 3 (PWR)	890	Dec. 1994	8.1	—

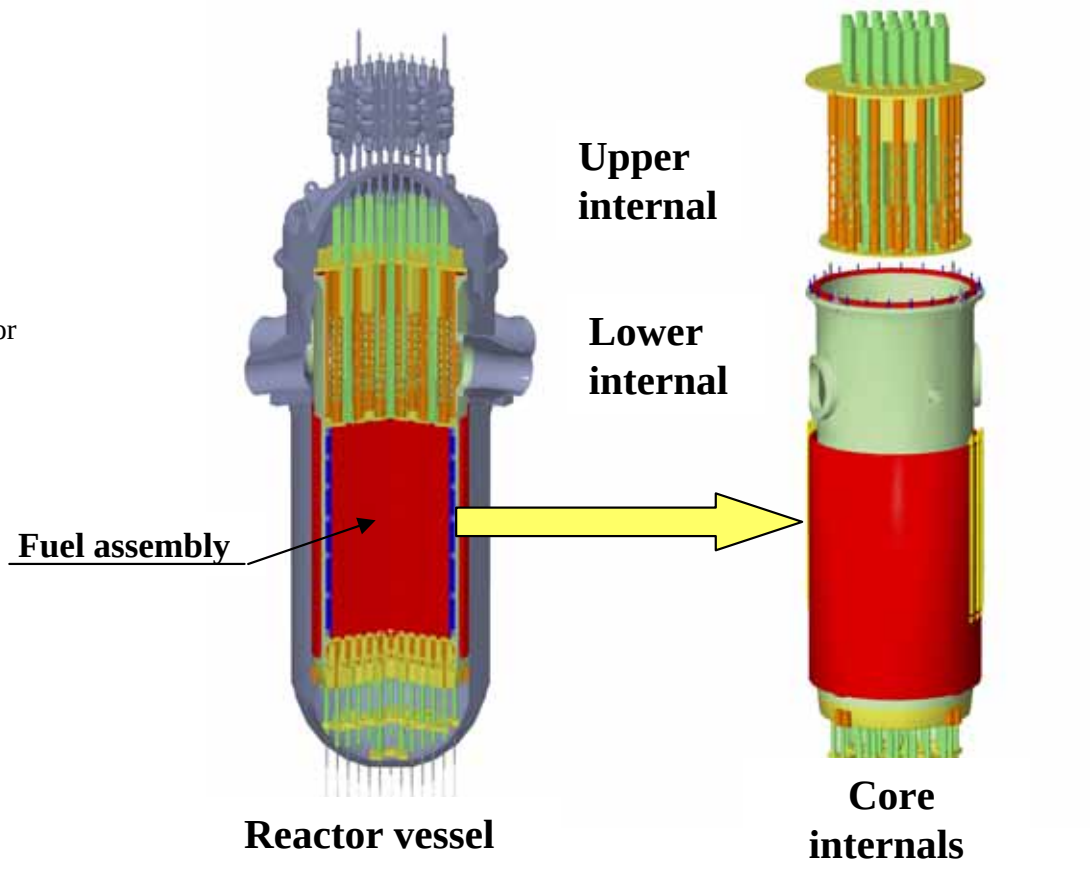

Exposure Doses during Refueling Outage at Ikata Unit 1
VH replacement included
SG replacement included
RV core internals replacement included
Plant modifications
Usual outage work
Total dose (man-Sv)
2.5
2
1.5
1
0.5
0
1
3
5
7
9
11
13
15
17
19
21
Refueling outage

Why Core Internals replacement?

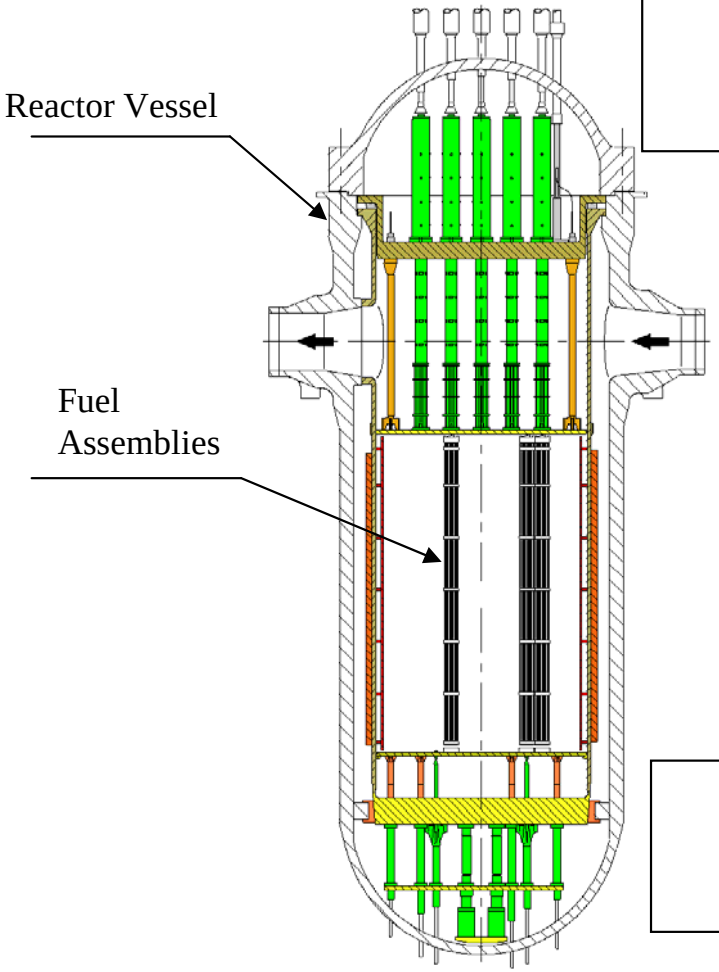
Four guide tubes will be added to accommodate four additional control rod clusters which will be necessary to operate with high burn-up fuel.

For preventive maintenance, in view of the stress corrosion cracking found on RPV baffle former bolts at several overseas plants in other countries, the replacement was decided on. Core internals of the same design as that of Unit 3, which has incorporated most advanced technology, are will be introduced.

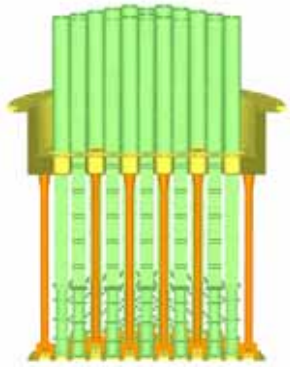




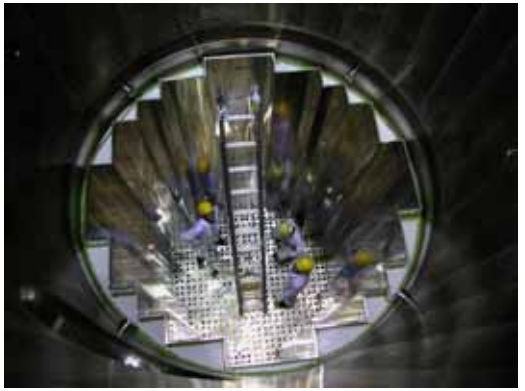
Scope of the Core Internals (CI) Replacement



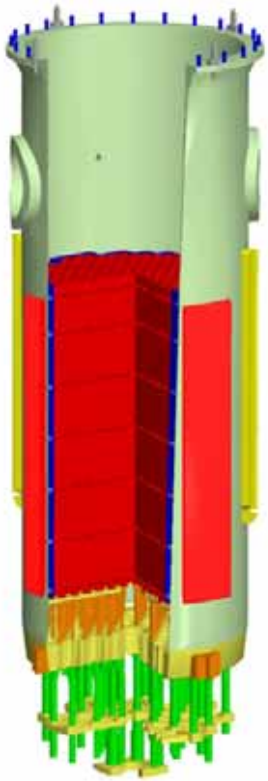
Replacement
Upper Core
Internals



(Photo A)



(Photo A)

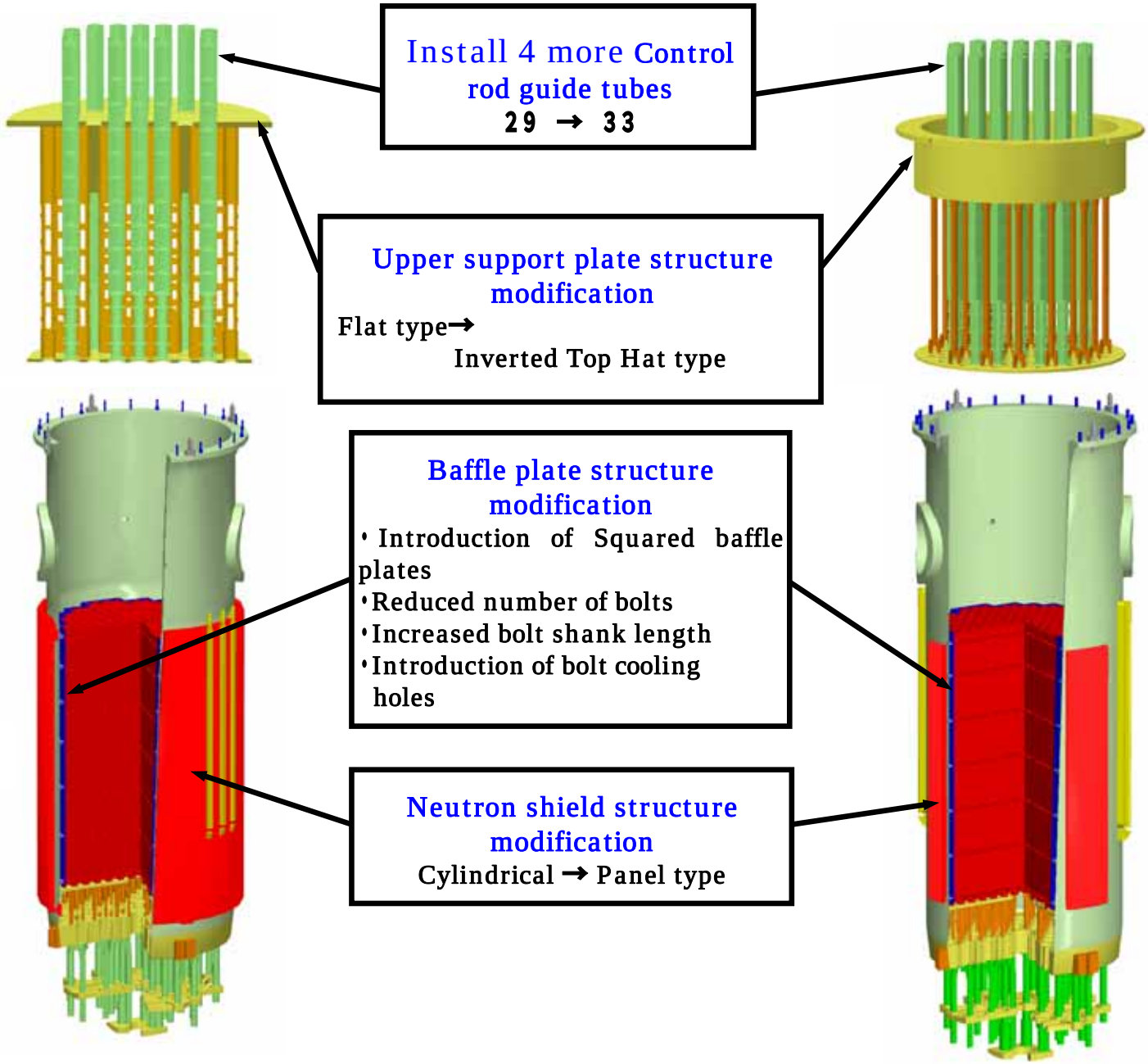


Replacement
Lower Core
Internals

(Photo B)

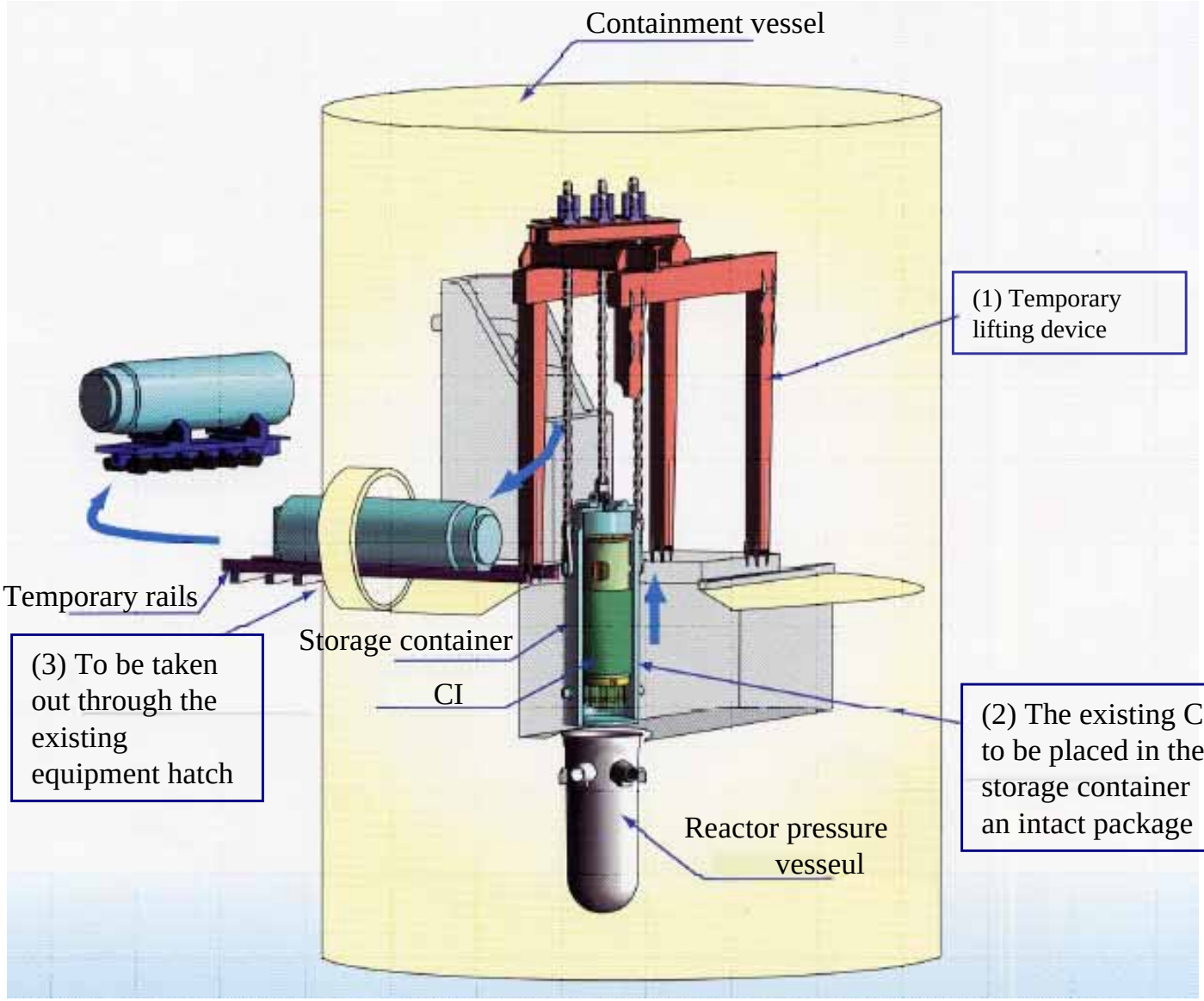
(Photo B)

Replace the upper and lower
core internals at the same time



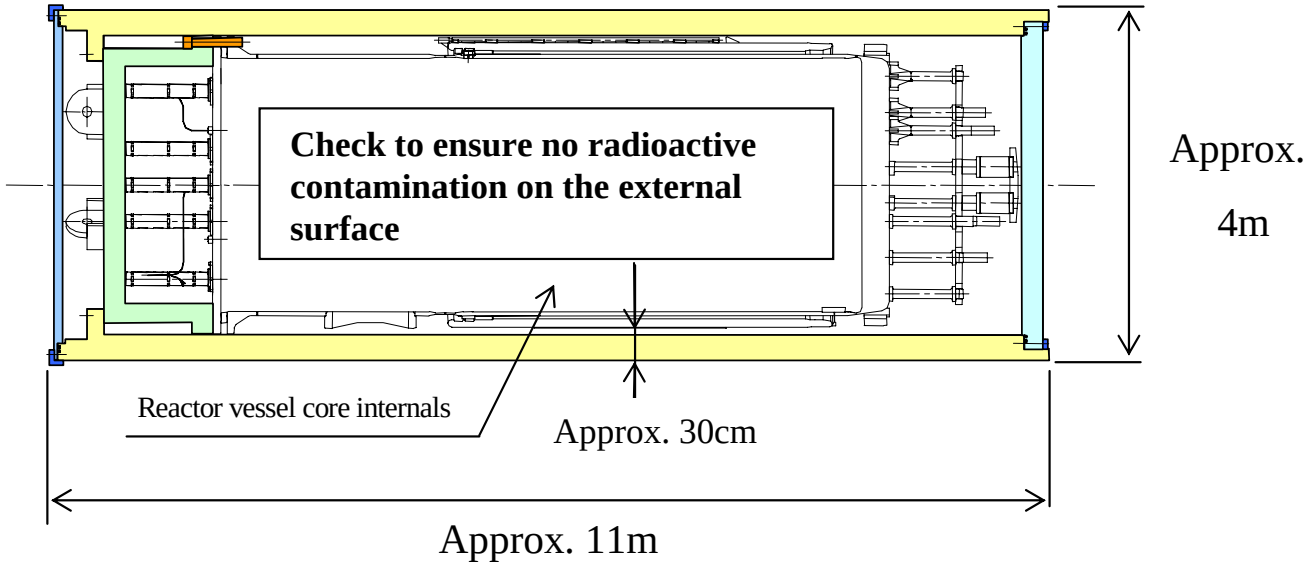
Comparison of the Structure

Conceptual Drawing for the Core Internals (CI) Replacement



Removal and Storage of Old Core Internals

Old core internals are to be loaded into a special storage container made of steel to contain radioactive substances. When moved out of the CV, the container external surface is to be checked to ensure no radioactive contamination.

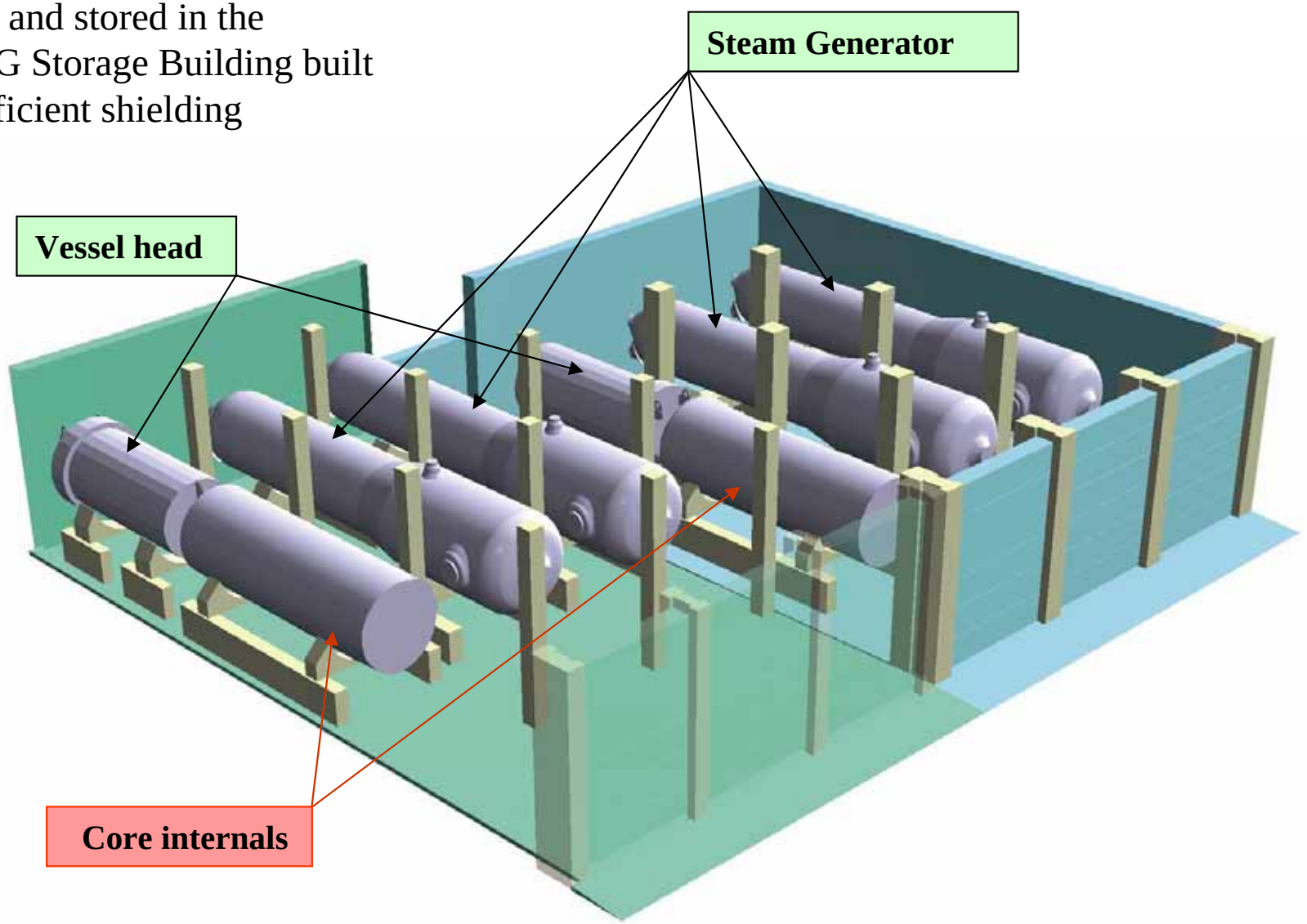


The storage container has been designed to satisfy the surface dose rate to 2mSv/h or lower to avoid significant radiation exposure of workers and the public.

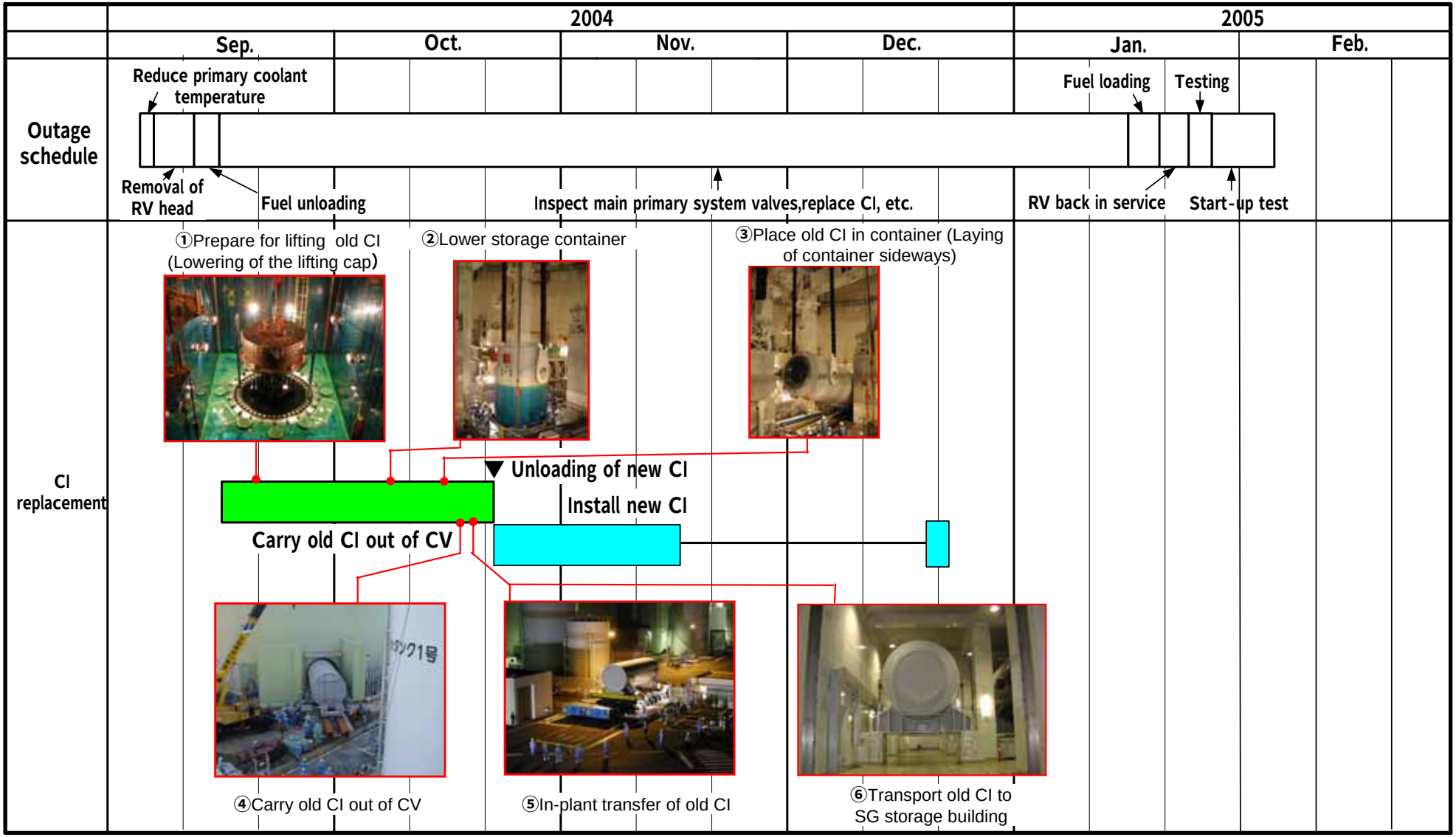
The total weight of the storage container and the core internals is approximately 450 tons.

Storage of Removed Core Internals

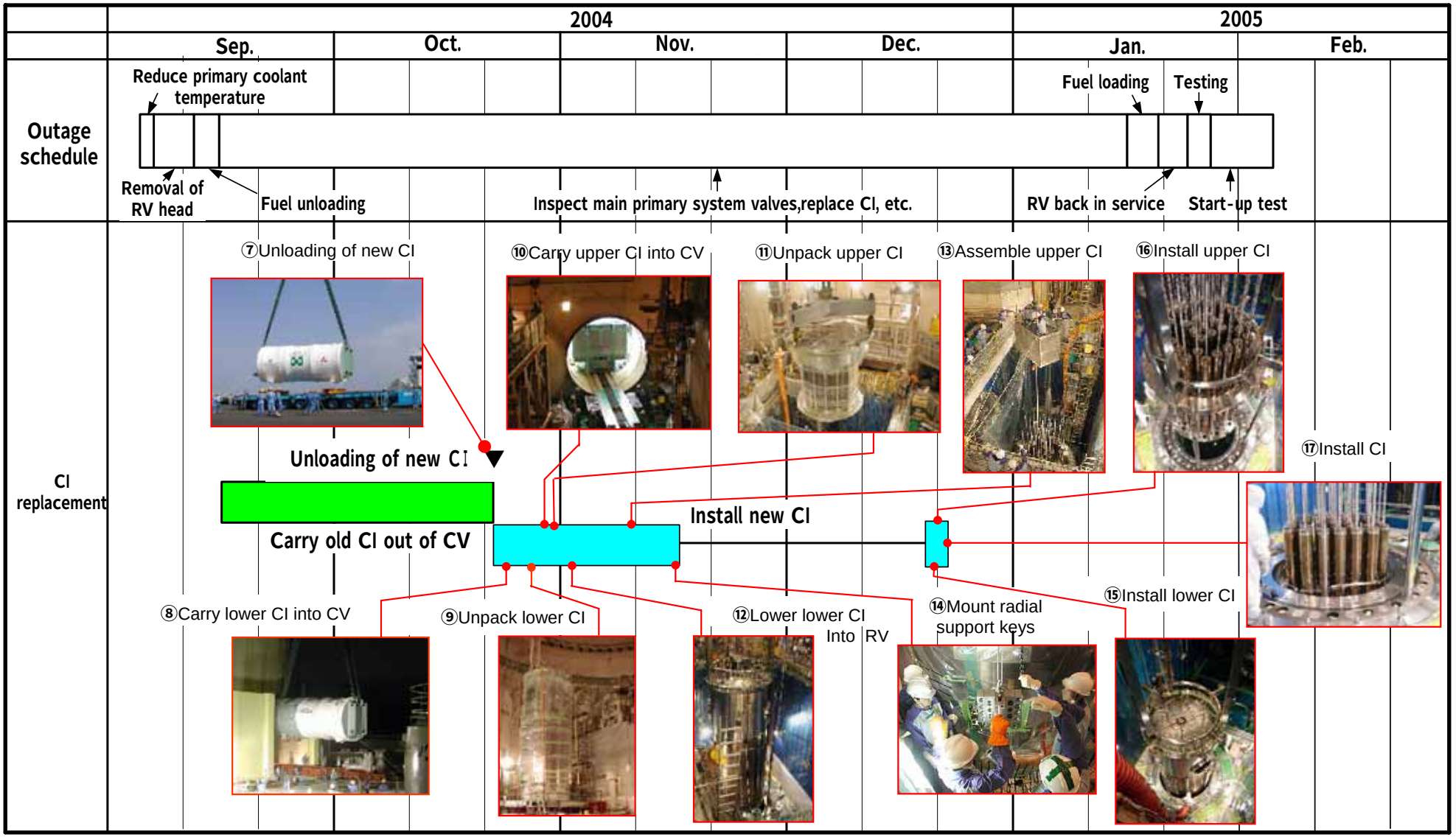
Old core internals and their attachments are to be contained in the specially designed storage containers and stored in the existing SG Storage Building built with a sufficient shielding capability.



Core Internals Replacement Schedule (1/2)



Core Internals Replacement Schedule (2/2)



Radiation Control for the Core Internals Replacement

■Construction dose record

Planned dose (man Sv)	Dose received* (Man Sv)	Number of radiological workers
1.8	0.14	422

Planned dose (per day) (man Sv)	Dose received * (per day) (Man Sv)	Jobs performed
2.50	1.63	Measurement of the new lower CI
Planned dose (man Sv)	Dose received * (man Sv)	Jobs performed
20.00	4.50	Installation of the new CI and other jobs

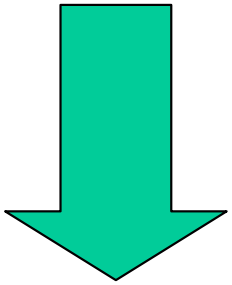
* - Measured by the alarm pocket dosimeter

■Dose records by the category of work

Work Category	Main Activities	Predicted Dose(man-Sv)	Actual dose (man-Sv)
①Preparation	• Various pre-work activities • Remove the irradiation test specimens • Remove the drive rods and other components from the upper CI • Install the lifting plate(i.e.the top of the storage container) to the existing CI • Install the temporary lifting device in the CV	0．4	0．04
②Placement of the existing CI into the storage container and its removal from the CV	• Carry into the CV and install the container for storing the existing CI • Place the existing CI into the storage container • Remove the old CI out of the CV • Disassemble and remove the temporary lifting device from the CV	0．8	0．03
③Delivery into the CV, assembly, and installation of the new CI	• Carry into the CV and assemble the new CI • Lift down the new lower internals into the RV and take dimensional measurements • Install the new CI in the RV	0．4	0．07
④Work after the installation of the new CI	• Clear the reactor cavity • Install the irradiation test specimen • Various post-work activities	0．2	0．00
Total		1．8	0．14

① The dose equivalent rate from the old CI storage container was about 1/3 of the planned rate.

② Various measures were implemented to reduce radiation exposure.



The total dose was below 1/10 of the planned dose.

2. Radiation Control for the Core Internals Replacement

Dose equivalent rate on the container surface –

planned rate : 2mSv/h → actual rate (maximum) : 0.60mSv/h

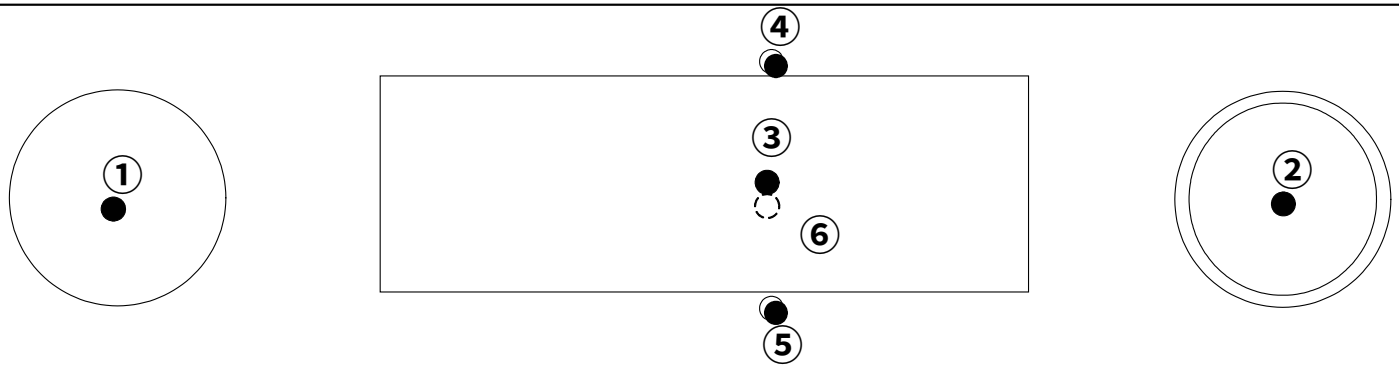
■ Dose equivalent rates and contamination recorded on the storage container for old CI

[Measurements taken before the removal of the old CI from the CV]

Period : from October 11 to October 16, 2004

Location : EL 32m of Unit 1 CV

Points of measurement for surface dose equivalent rate and surface contamination density (six points)



Points of measurement	Dose equivalent rate (mSv/h)*1	Surface contamination density (Bq/cm^2)*2
①	0.0005	Less than LDL
②	0.25	Less than LDL
③	0.50	Less than LDL
④	0.60	Less than LDL
⑤	0.45	Less than LDL
⑥	0.55	Less than LDL

*1- Measured by an ionization chamber survey meter; lower detection limit (LDL) =0.0005mSv/h

The dose equivalent rates include the effects from other equipment in the CV.

*2- Measured by the smear method ; lower detection limit = 0.048Bq/cm^2

Storage of the Old Core Internals (CI)

□To be placed in steel containers and stored in the SG storage building

■Unit 1 CI placed in storage on October 18, 2004

□Unit 2 CI to be placed in storage around October, 2005

■Dose equivalent measurements outside the SG storage building

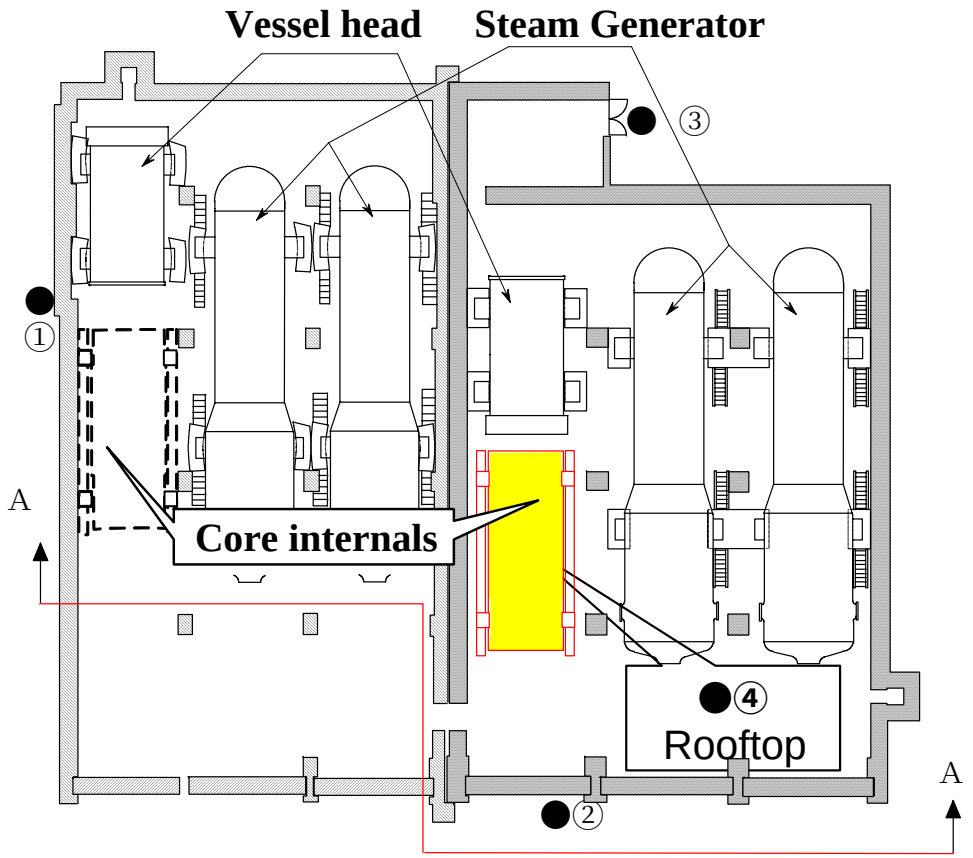
After placing the Unit 1 CI in storage (October 18, 2004)

Points of measurement	Dose equivalent rate (mSv/h)*1
①	< 0.0005
②	< 0.0005
③	< 0.0005
④ (Roof top)	< 0.0005

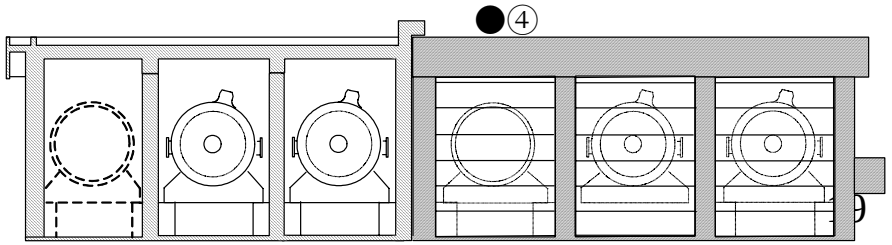
*1 - Measured by an ionization chamber survey meter; lower detection limit =0.0005mSv/h

●Points of dose equivalent rate measurement (4 points)

(Plan view)



(A-A Cross section)



3. Measures for reducing radiation exposure(1/2)

(1) Pre-studied work methods carefully

- Lifting and placing into the storage container of the upper and lower CI as an intact package
- No cutting and welding of CI.

(2) Mock-up training

- Training in the removal of support column flange bolts of the existing upper CI using the mock-up
- Training in the clearance measurement at the outlet nozzle and radial support of the new CI using the mock-up

3. Measures for reducing radiation exposure(2/2)

(3) Temporary shielding

- Install a temporary shielding for the waiting area in the reactor cavity
- Install a temporary shielding plate to cover the reactor vessel head

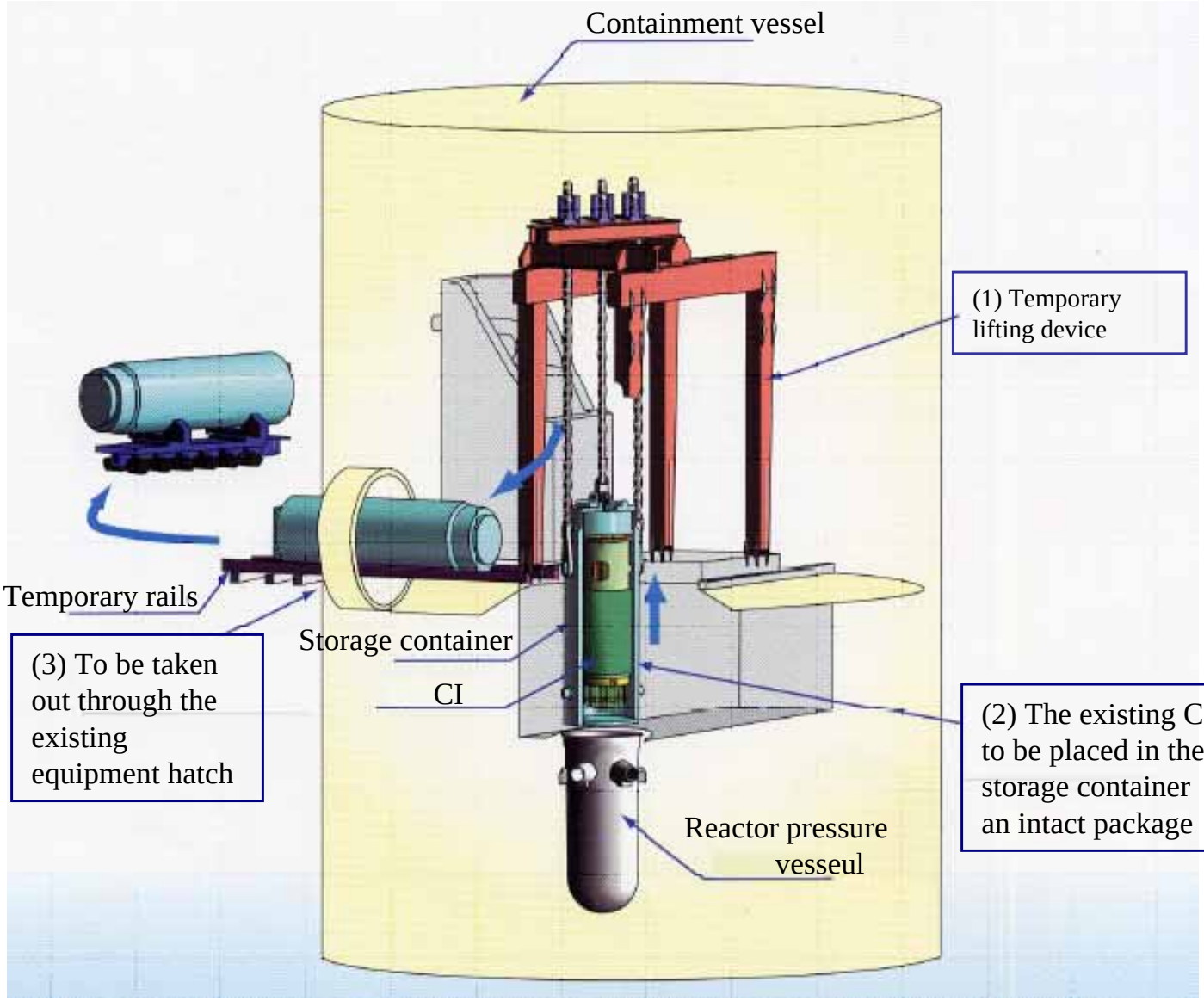
(4) Automation of the work

- Remote-control the operation to install the bottom plate to the old CI storage container

(5) Warning of workers

- Install a dose equivalent rate indicator on the reactor vessel head

(1) Pre-studied work methods carefully



(2) Mock-up training

Relevant activities of the CI replacement	Training Description	Place of Training	Date of Implementation	Number of Training Recipients
1. Separation of the T/C support columns	Train personnel in cutting the T/C conduit tube, removing the T/C support column flange bolt, and attaching a plug to the T/C support column for tip-over prevention	Ikata NPP	Aug.23 - Sep. 2, 2004	28
2.Removal of components from the existing CI	Train personnel in separating the T/C support column, marking the I/S when taking them out, and placing them back into their original positions	Mitsubishi Heavy Industries	May 10 - May 21, 2004	10
3. Assembly and installation of the new CI	Train personnel in lifting down the new CI into the RV, performing alignment, measuring the clearances at the outlet nozzle and the crevice insert, and shrink fitting the radial support key	Mitsubishi Heavy Industries	Jul.12 - Jul.23, 2004	28

T/C: thermocouple, I/S: irradiation specimens

【Hands-on training in separation of the T/C support columns】

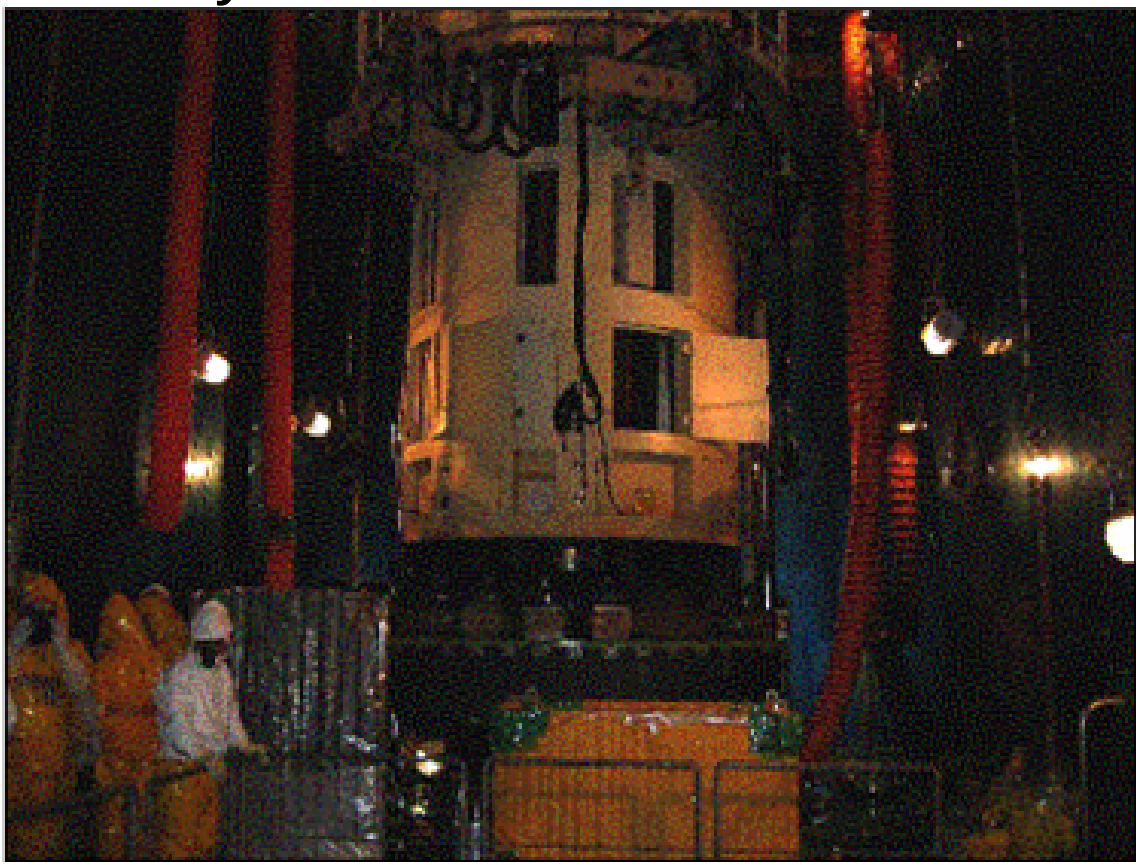
(3) Temporary shielding(1/4)

【Temporary shielding during the T/C conduit tube cutting operation】

Dose equivalent rate (before shielding)(mSv/h)	Dose equivalent rate (after shielding)(mSv/h)
17	**15**

(3) Temporary shielding(2/4)

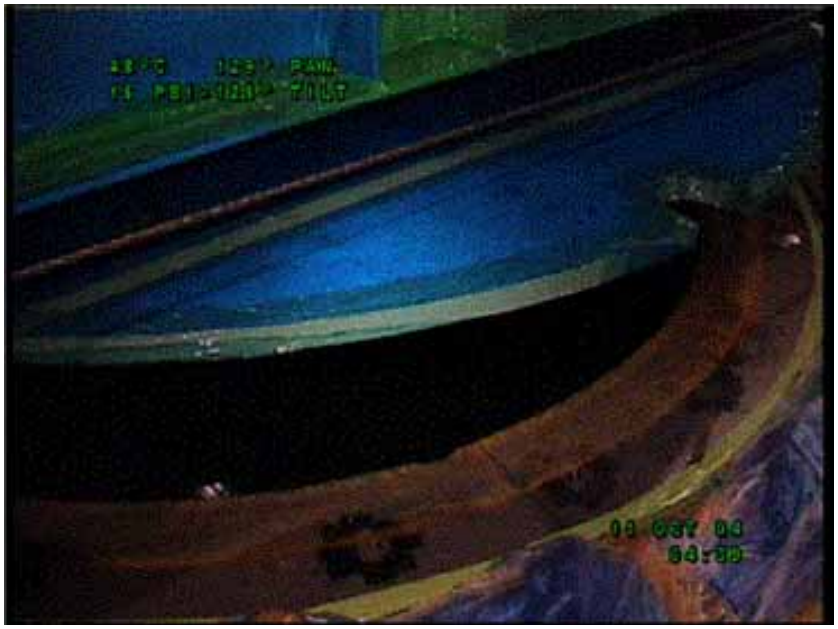
【Temporary shielding around the waiting space in the reactor cavity】



Dose equivalent rate (before shielding)(mSv/h)	Dose equivalent rate (after shielding)(mSv/h)
0.50	0.25

(3) Temporary shielding(3/4)

【Temporary shielding plate over the top of the reactor vessel】



Dose equivalent rate (before shielding)(mSv/h)	Dose equivalent rate (after shielding)(mSv/h)
3.5	0.4

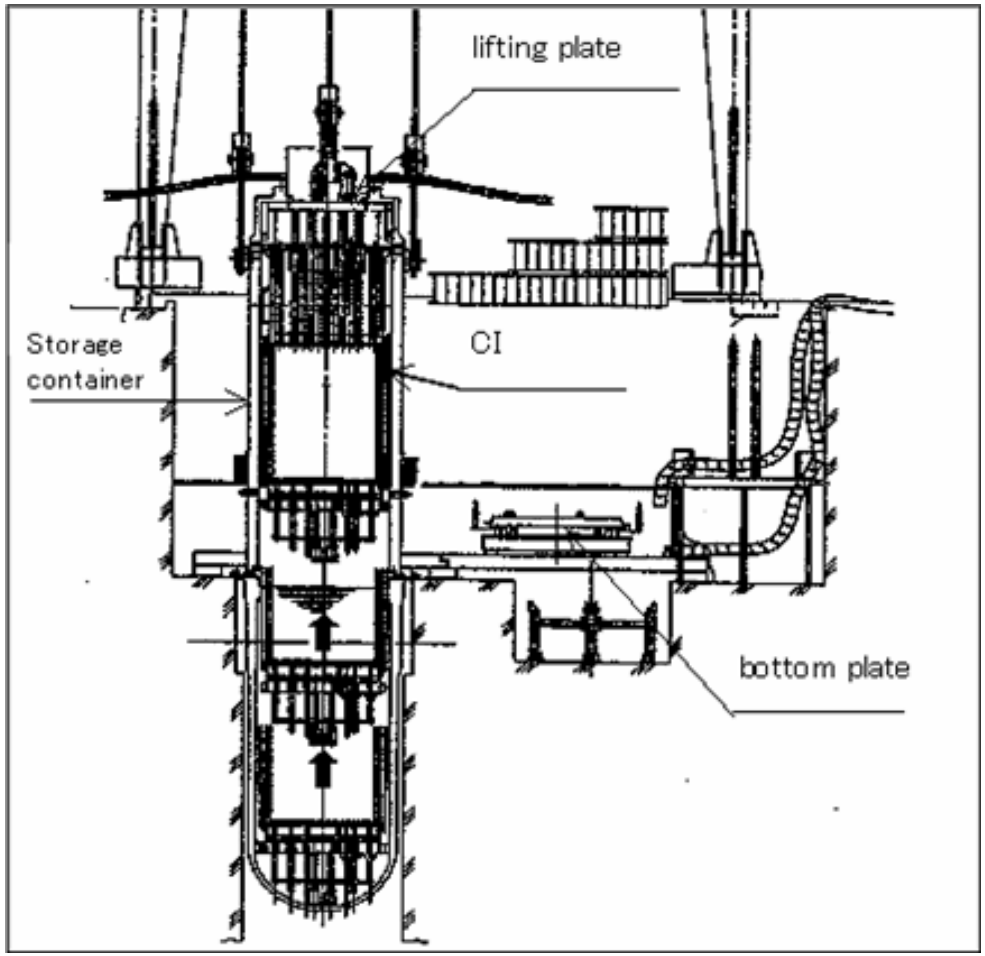
(3) Temporary shielding(4/4)

【Temporary shielding surrounding the vessel head】

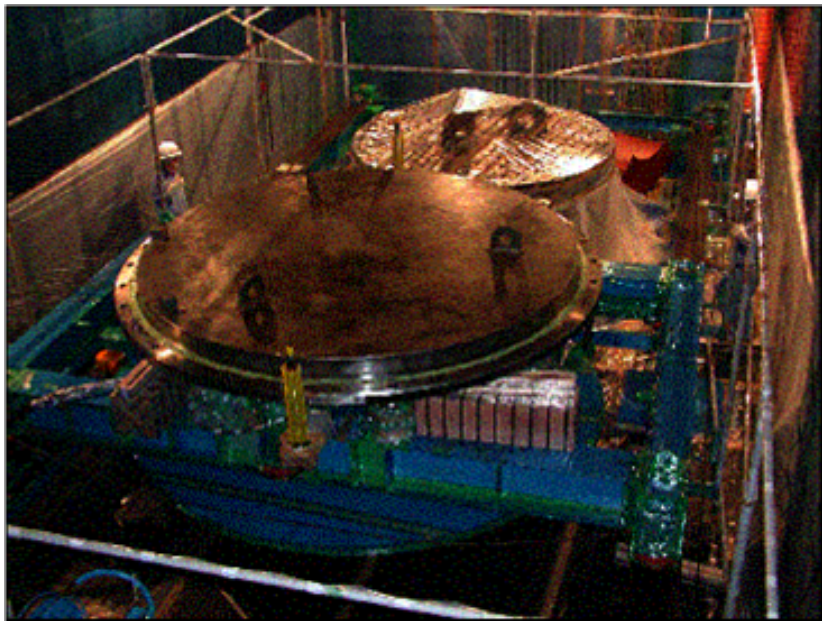
Dose equivalent rate (before shielding)(mSv/h)	Dose equivalent rate (after shielding)(mSv/h)
0.02	0.01

(4) Automation of the work

Installed the bottom plate to the CI storage container automatically by remote-control to reduce exposure.



【How the bottom plate was installed】



(5) Warning to workers

Installed dose equivalent meters around high-dose equivalent rate equipment to warn workers of radiation hazards

○CI replacement is now under way at Ikata Unit 2 incorporating the lessons learned from the job at Unit 1.

Schedule : Sep. 2005 - Jan. 2006

Total planned dose : 0.28 man.Sv

We will make best effort for dose reduction of Ikata.

"Tuswabuki" or Japanese silverleaves,
the flower of the Ikata Town