NRA
Nuclear Regulation Authority

Reducing Risk at Fukushima Dai-ichi NPS

Toyoshi Fuketa
Nuclear Regulation Authority

Workshop on Decommissioning of Nuclear Power Plants

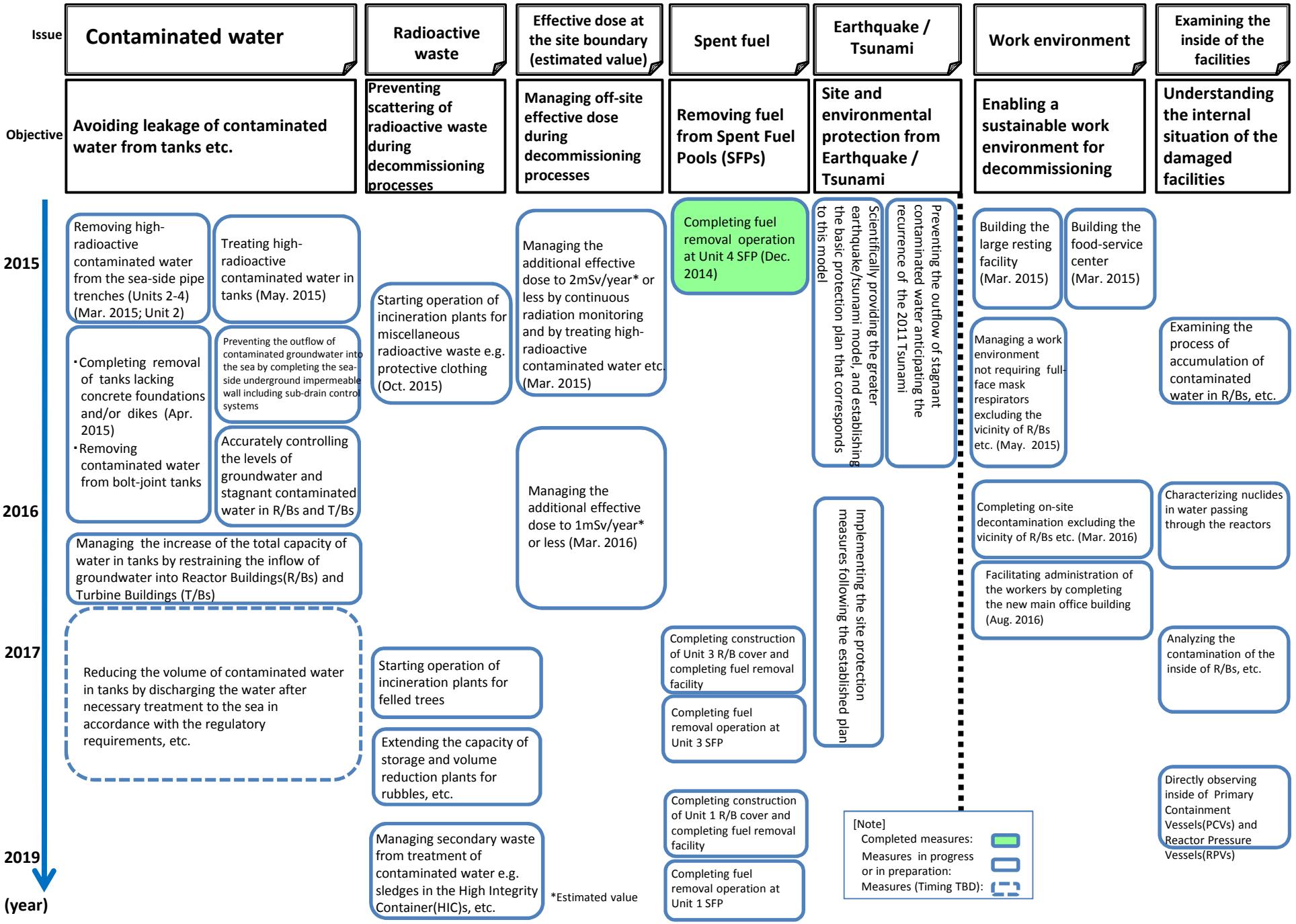
Hotel Grand Hill Ichigaya Tokyo, Japan
April 8, 2015

Introduction

- ✓ According to the amended Nuclear Regulation Act, the NRA designated the Fukushima Dai-ichi Nuclear Power Station as “Disaster-experienced Nuclear Power Plant” on November 7, 2012, which needs special measures to prevent further disaster and to ensure nuclear security.
- ✓ The NRA requested TEPCO to prepare an implementation plan regarding decommissioning processes for Units 1 thru 4, maintaining shut-down status for Units 5 and 6, monitoring plant status for Units 1 thru 6, physical protection, and others.
- ✓ In order to address risk concerns plainly, the NRA produced “Measures for Mid-term Risk Reduction” on February, 2015.

18 February, 2015

Measures for Mid-term Risk Reduction at TEPCO's Fukushima Daiichi NPS (as of February 2015)



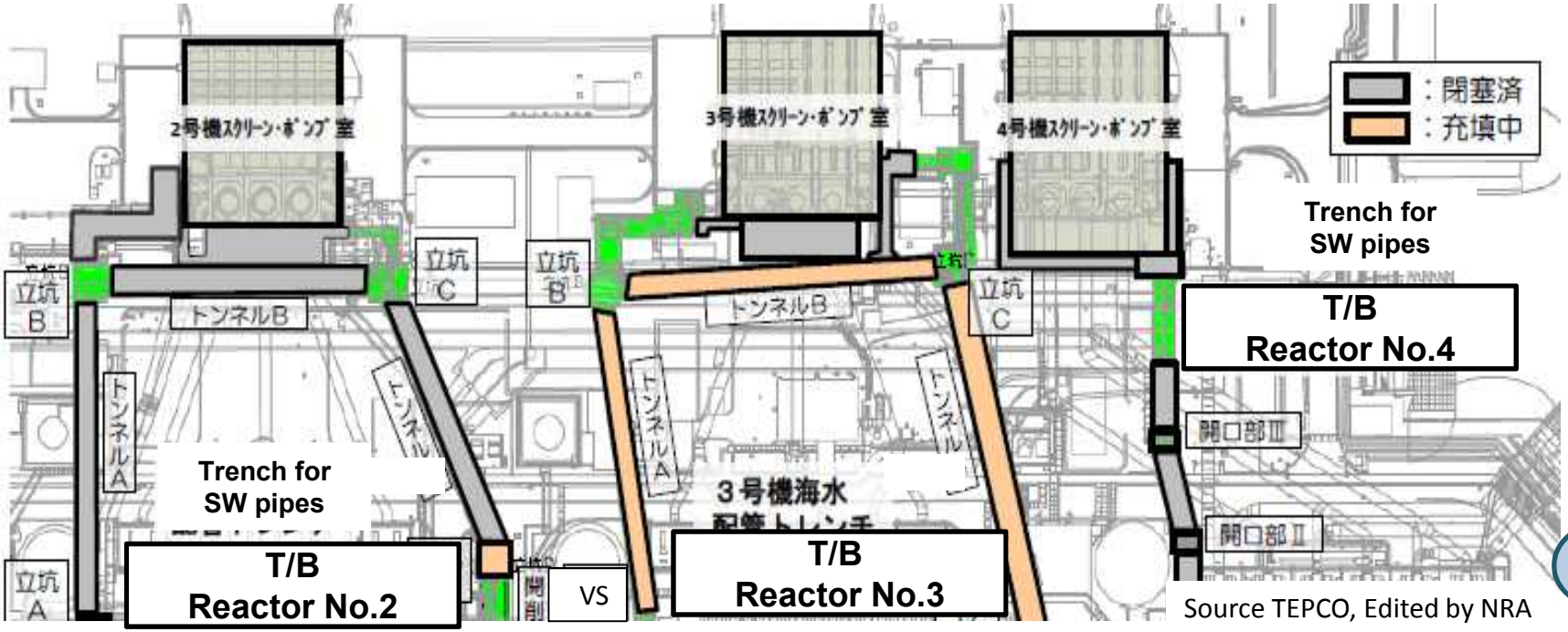
This presentation covers;

- ✓ Most significant concerns are;
  - Water removal and stabilization in underground trenches connected to the reactor turbine buildings on the seaward side,
  - Fuel removal from spent fuel pool of Units 1 thru 4,
  - Water decontamination and management of processed water, and
  - Water levels management in order to reduce inflow of ground water into reactor and turbine buildings.
- ✓ Another several issues regarding the decommissioning.

1 Underground Trenches

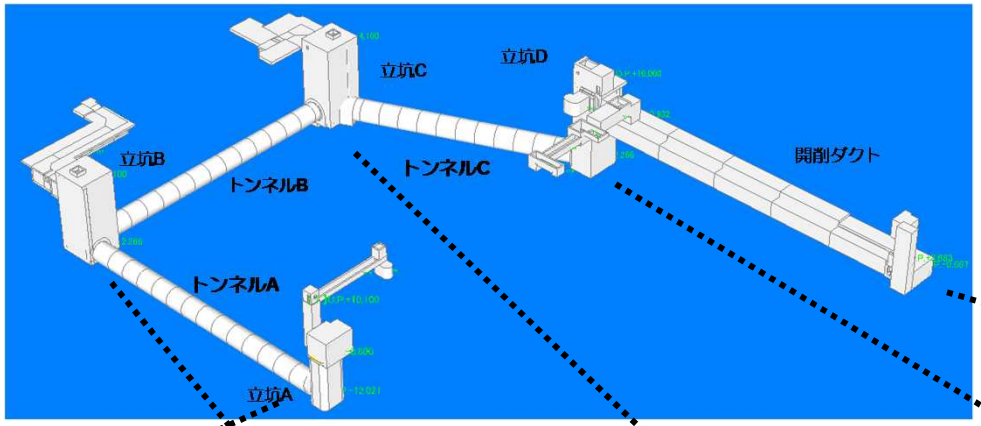
- ✓ The NRA considers that a risk of water leakage from underground trenches connected to the reactor turbine buildings on the seaward side is most significant.
- ✓ e.g., ~10^{15} Bq of Cs-137 in Unit 2 trenches

(estimated in July 2013)



Source TEPCO, Edited by NRA

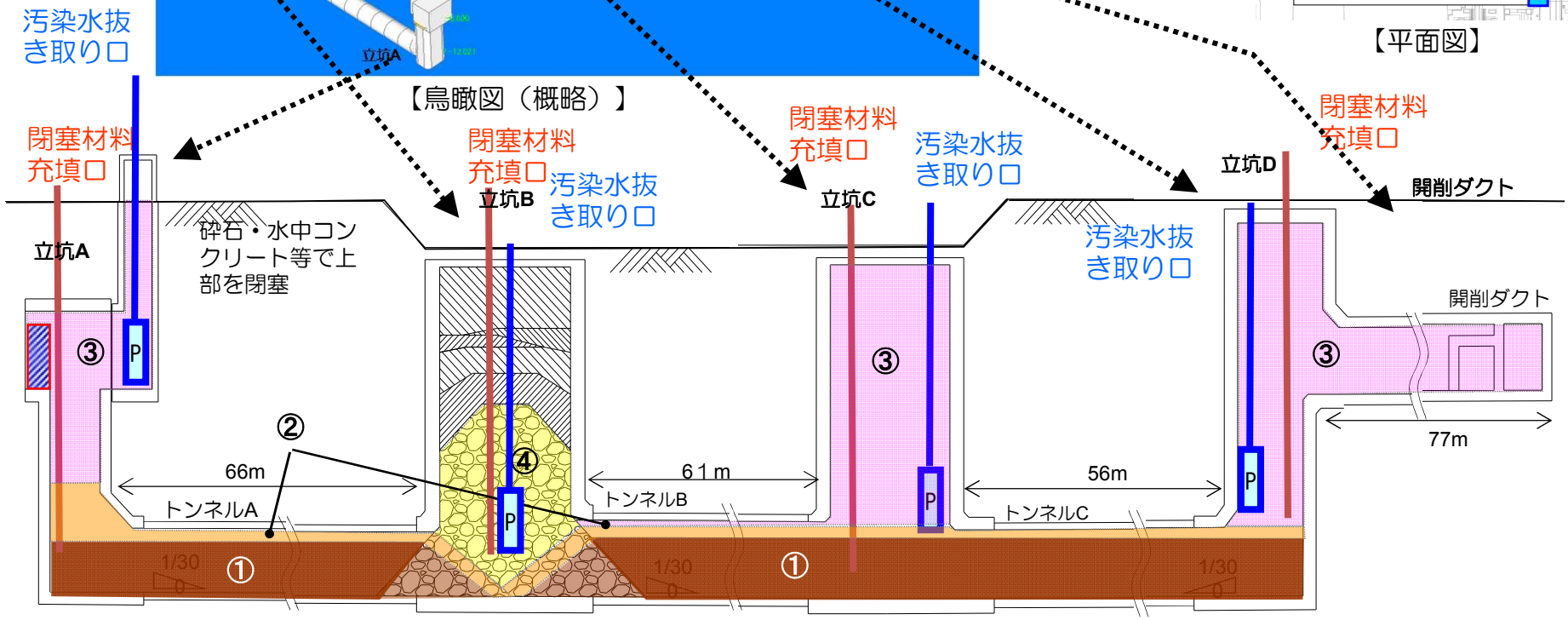
①立坑からの閉塞材料投入により，トンネルの閉塞開始。
②トンネルを閉塞後に、③立坑の閉塞を実施
④立坑Ｂ下部の砕石層を閉塞し、閉塞完了



【鳥瞰図（概略）】

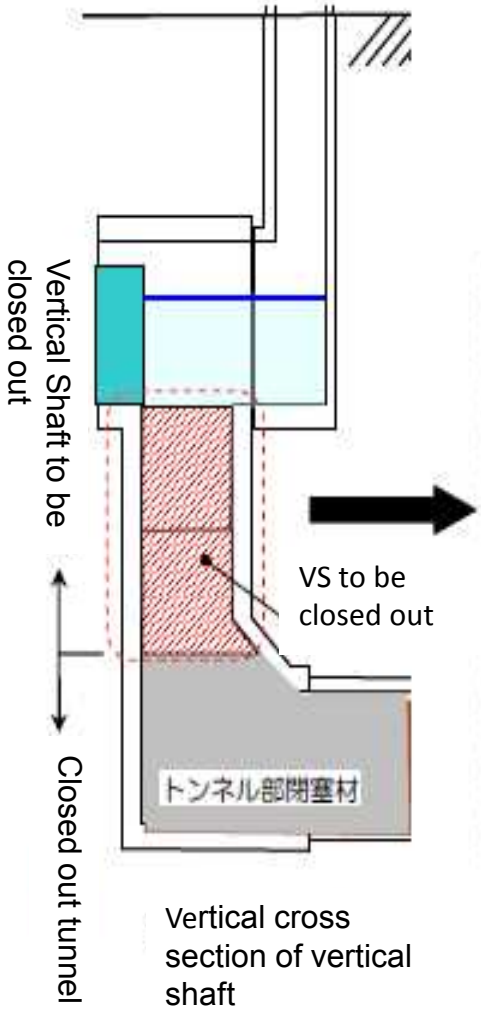
※ポンプで汚染水が抜き取りきれず、残水する可能性が想定され、各立坑に抜き取り口が必要

【平面図】



Source TEPCO

※施工ステップで色分けをしているが同一材料により打設



Vertical cross section of vertical shaft

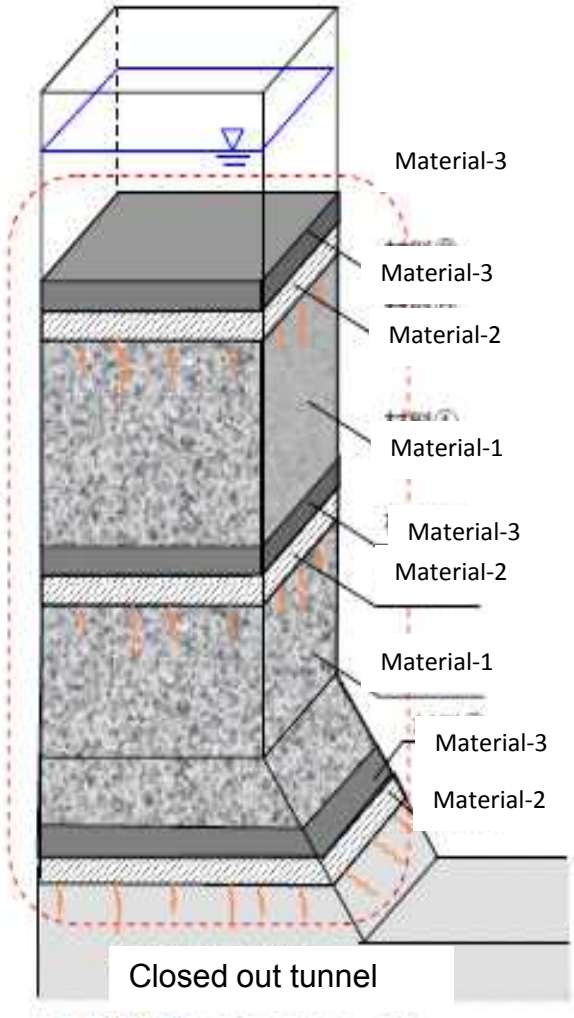
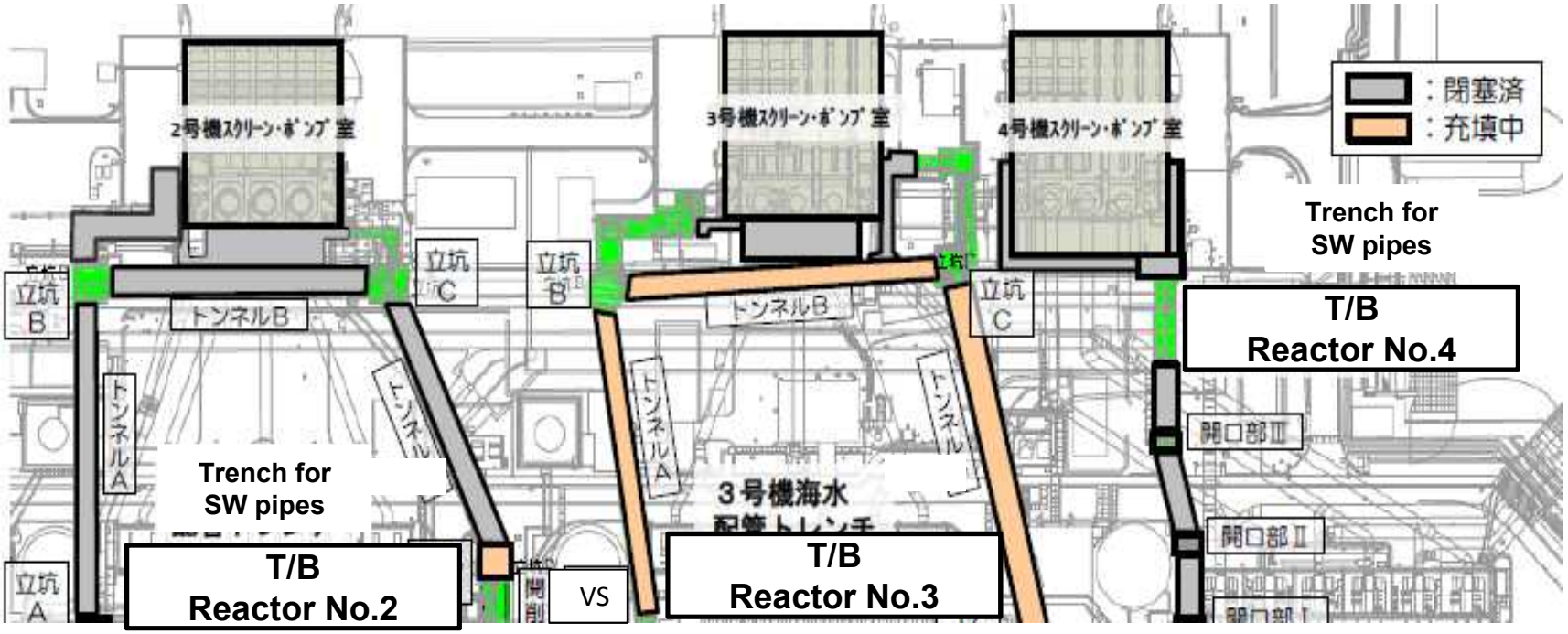


Image of the work closing out with each material

Source TEPCO

Work Progress



as of Mar 23rd

	Unit 2	Unit 3	Unit 4
Residual water	~1,890 m^3	~3,480 m^3	~440 m^3
Cemented	~2,610 m^3	~2,320 m^3	~460 m^3

Source TEPCO

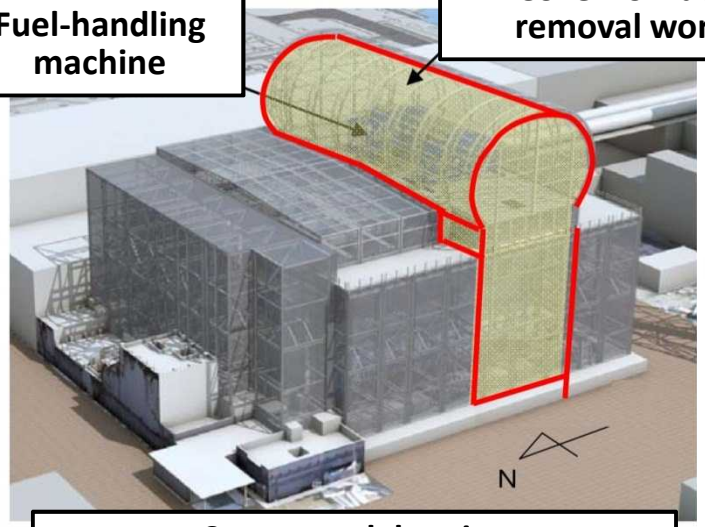
2 Spent Fuel Pool

- ✓ Fuel removal from spent fuel pool of Unit 4 was completed on December, 2014. This corresponds to ~49% reduction of spent fuel assemblies in spent fuel pools of Units 1 thru 4.

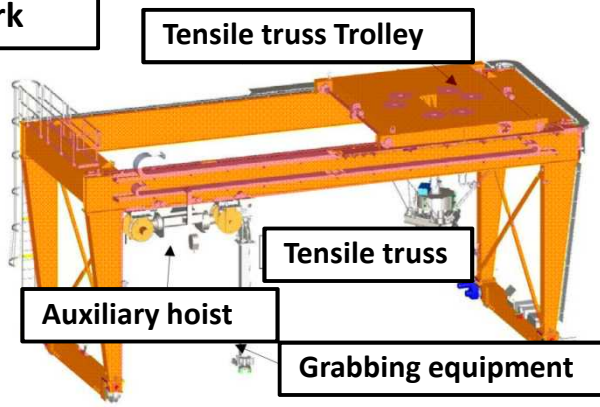
Unit	1	2	3	4
Capacity	900	1240	1220	1590
SFA	**292**	**587**	**514**	**1331**
FFA	100	28	52	202
Total	392	615	566	1533

Source TEPCO

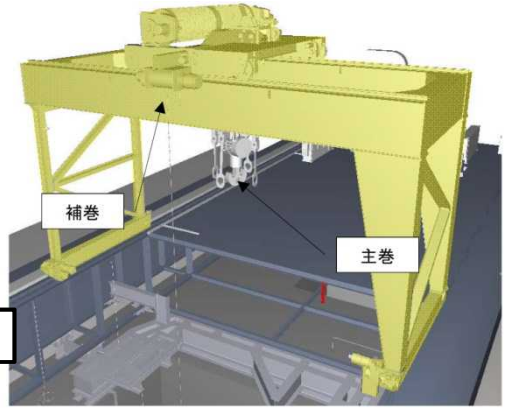
Fuel-handing machine and crane for Unit 3 SFP



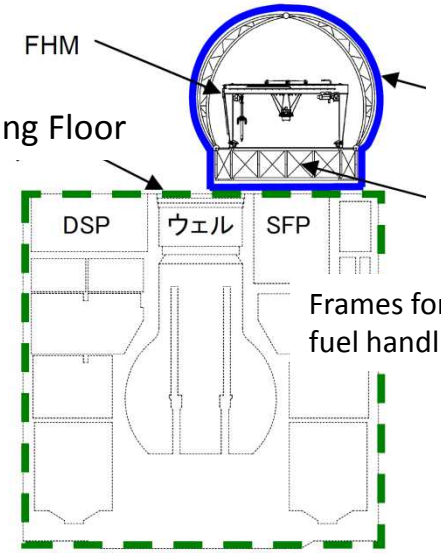
Conceptual drawing



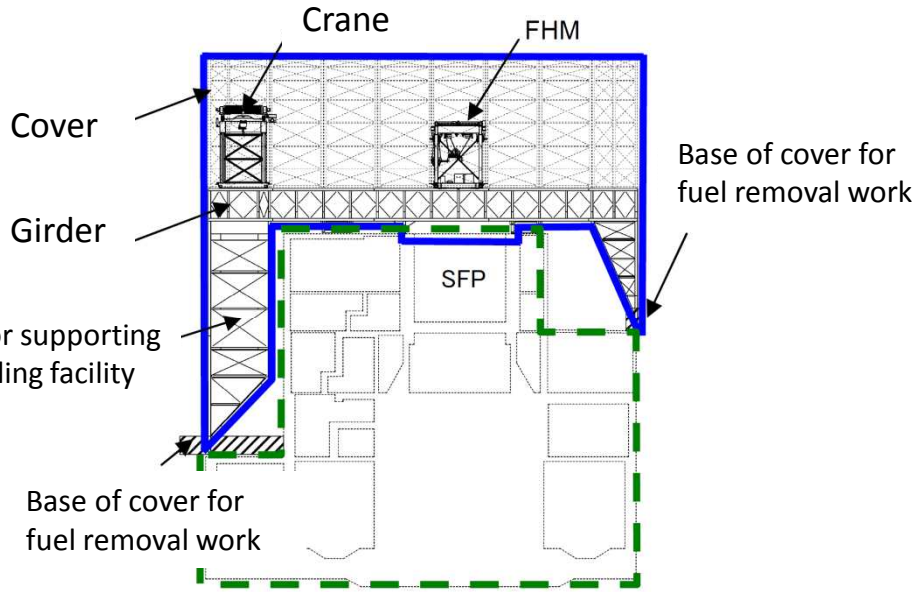
Fuel Handling Machine



Crane



断面図(南北方向)

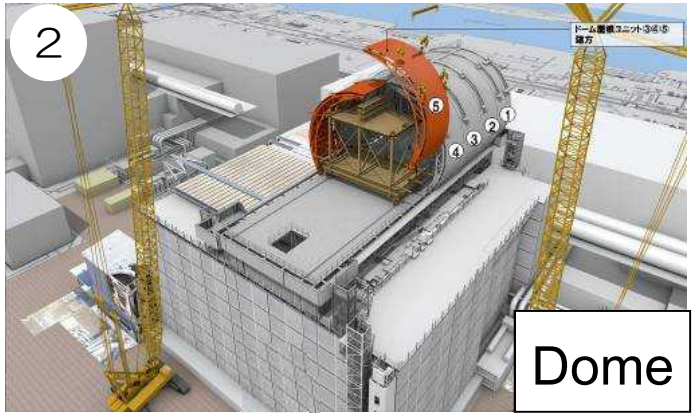


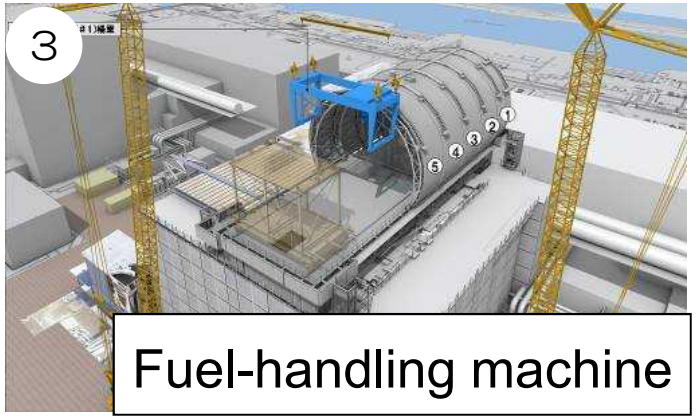
断面図(東西方向)

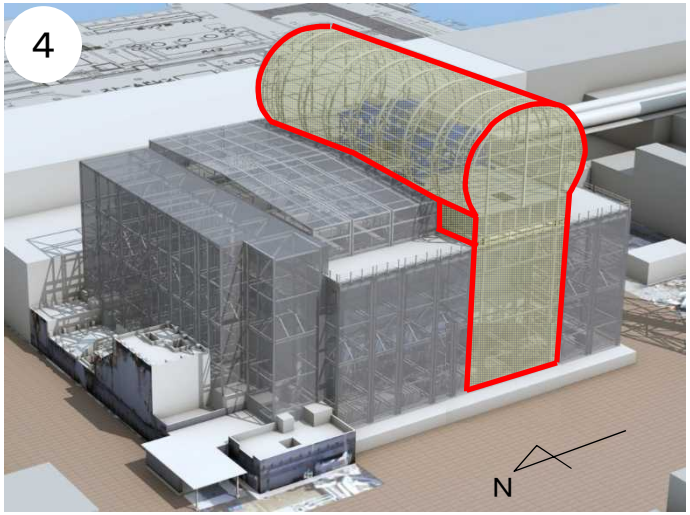
Source TEPCO, Edited by NRA

Fuel-handing machine and crane for Unit 3 SFP

※This is just a plan.



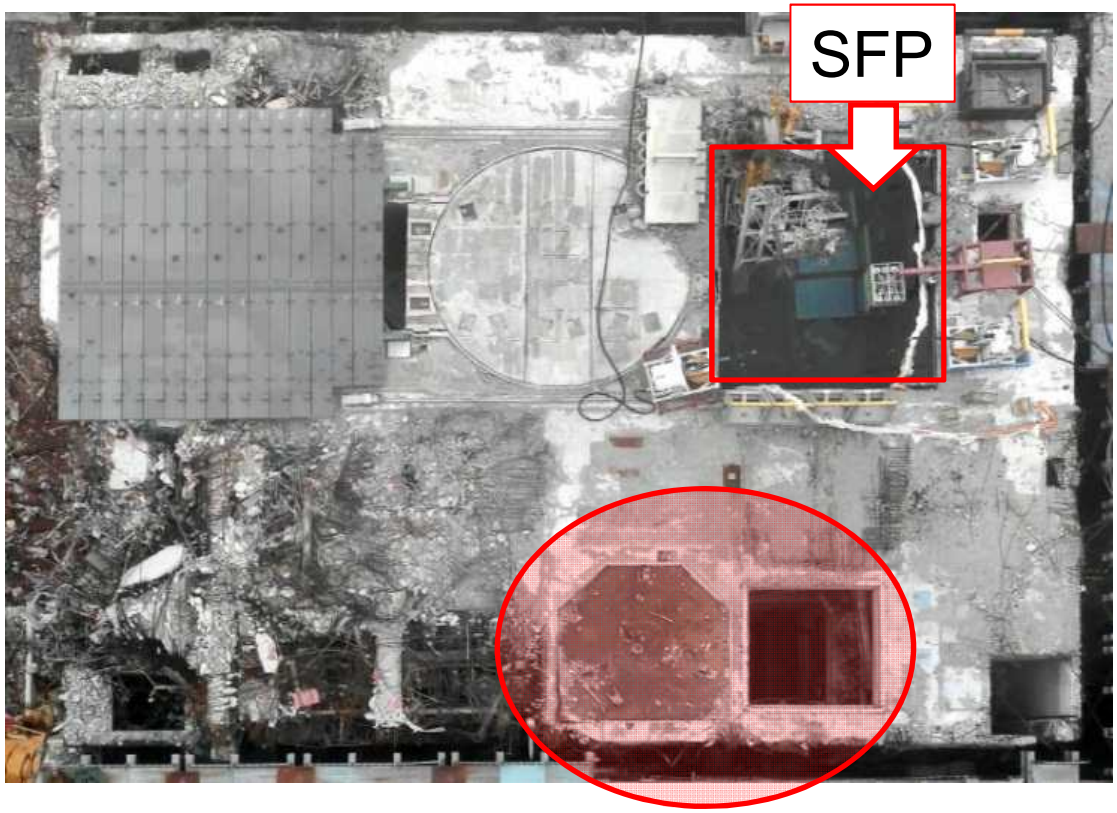




Source TEPCO, Edited by NRA

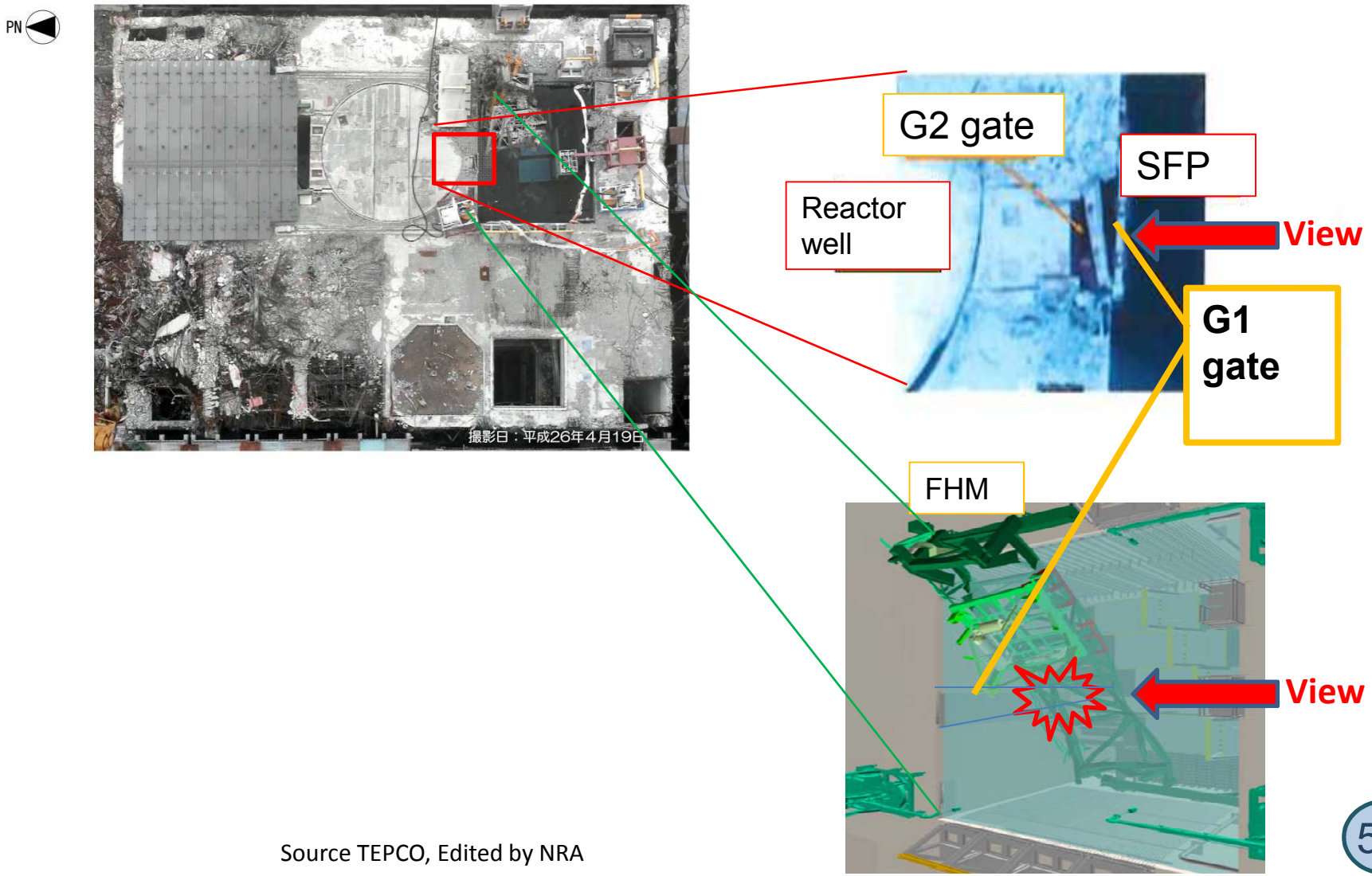
Fuel removal from Unit 3 SFP

- ✓ To be made with remote-control fuel-handing machine and crane
- ✓ Setting up rail and girder requires manned operation, so precedent arrangements, debris removal, decontamination and additional shielding, are needed.



Source TEPCO,
Edited by NRA

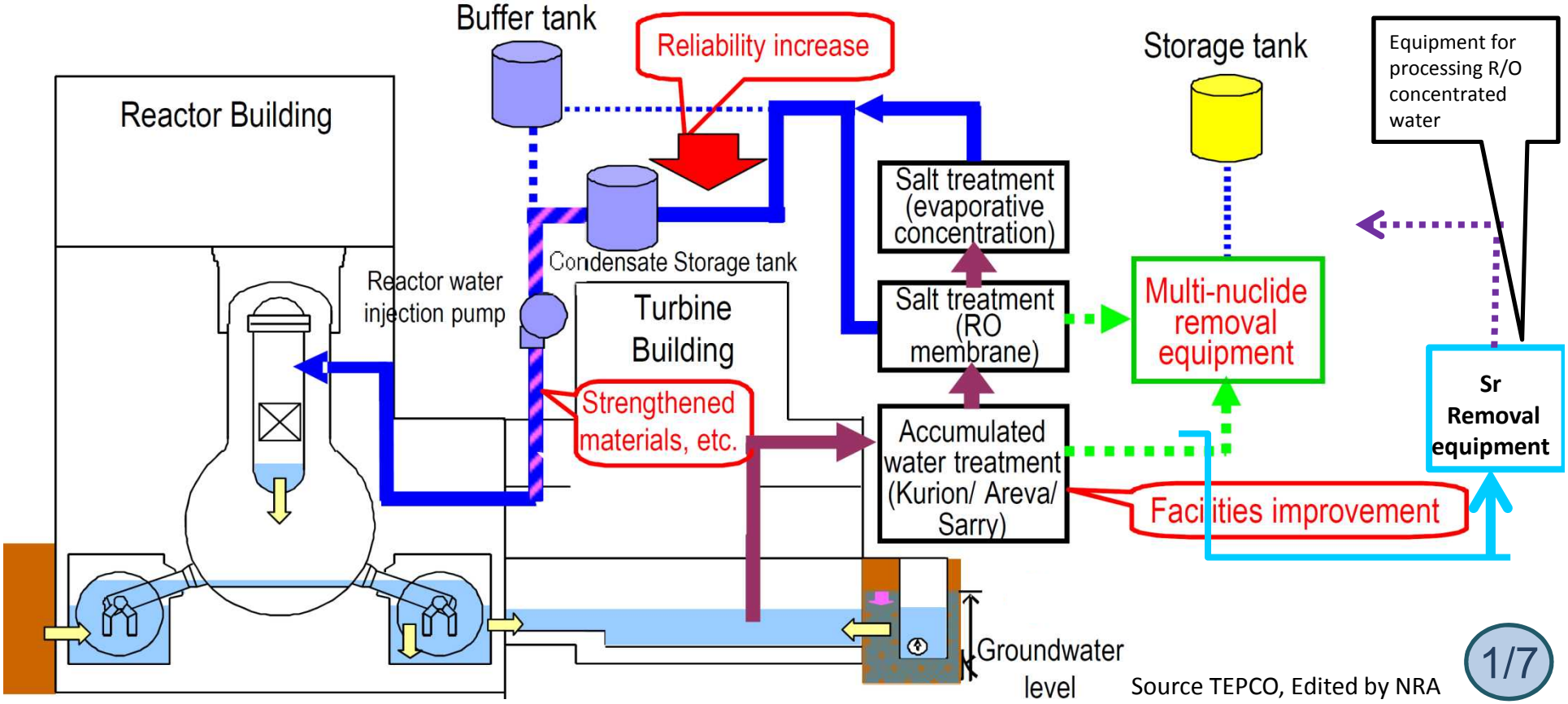
Unit 3 SFP Gate



Source TEPCO, Edited by NRA

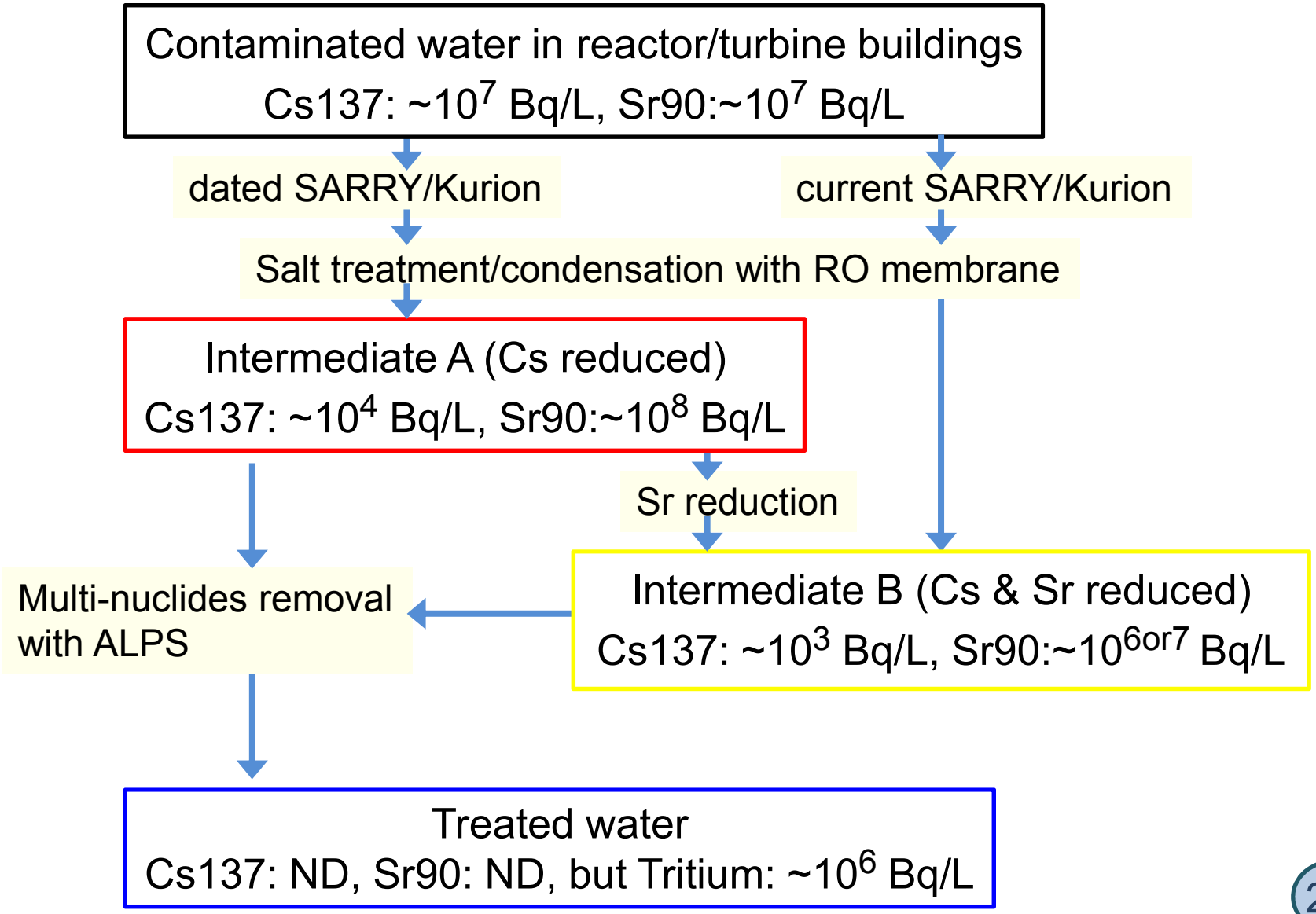
3 Water decontamination

- Contaminated water in R/Bs & T/Bs is treated and injected back to RPVs.
- App. **400m³/day of groundwater** is intruding into R/Bs & T/Bs and it forces the capacity of tanks increase.
- Reactor cooling injection: App.300m³/day



Source TEPCO, Edited by NRA

Water decontamination process

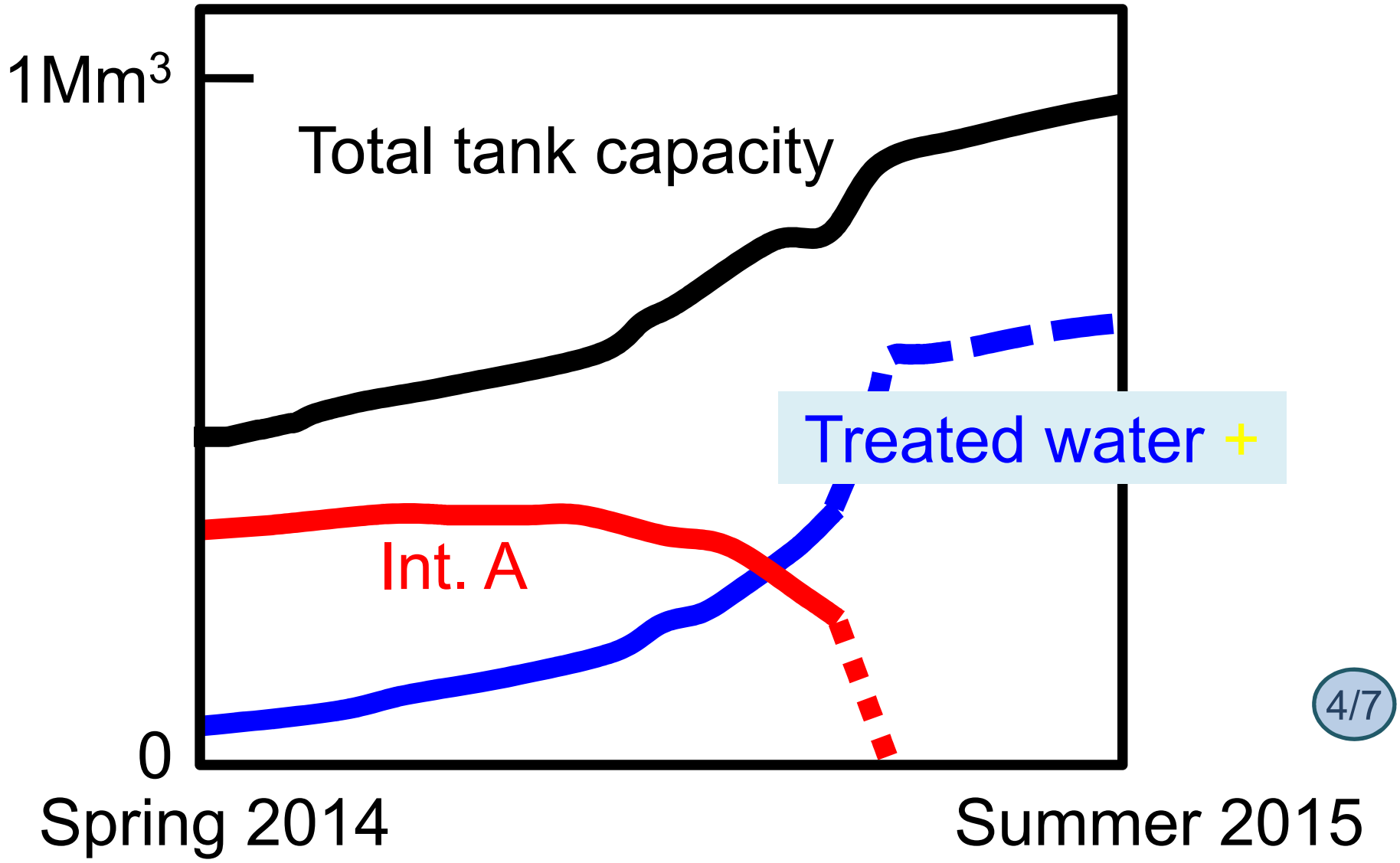


Water decontamination system

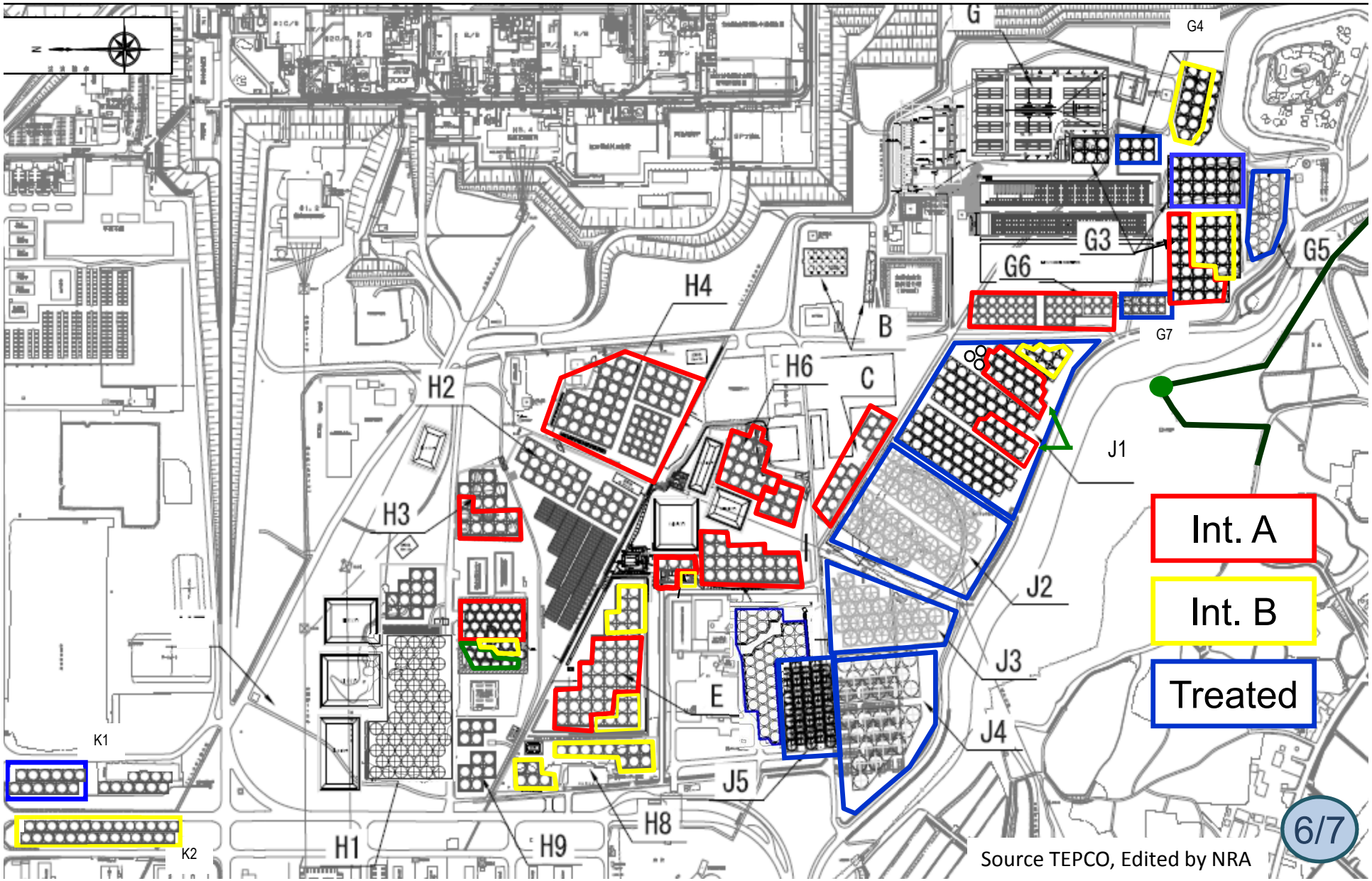
ALPS	250m^3/d x 3 units
Improved ALPS	250m^3/d x 3 units
High-performance ALPS	500m^3/d x 1 unit
R/O water treatment	500m^3/d
Mobile Sr removal*	300m^3/d x 2 units 480m^3/d x 4 units
SARRY	600m^3/d x 2 units
Kurion	300m^3/d x 3 units

*Circulation processing

Water storage

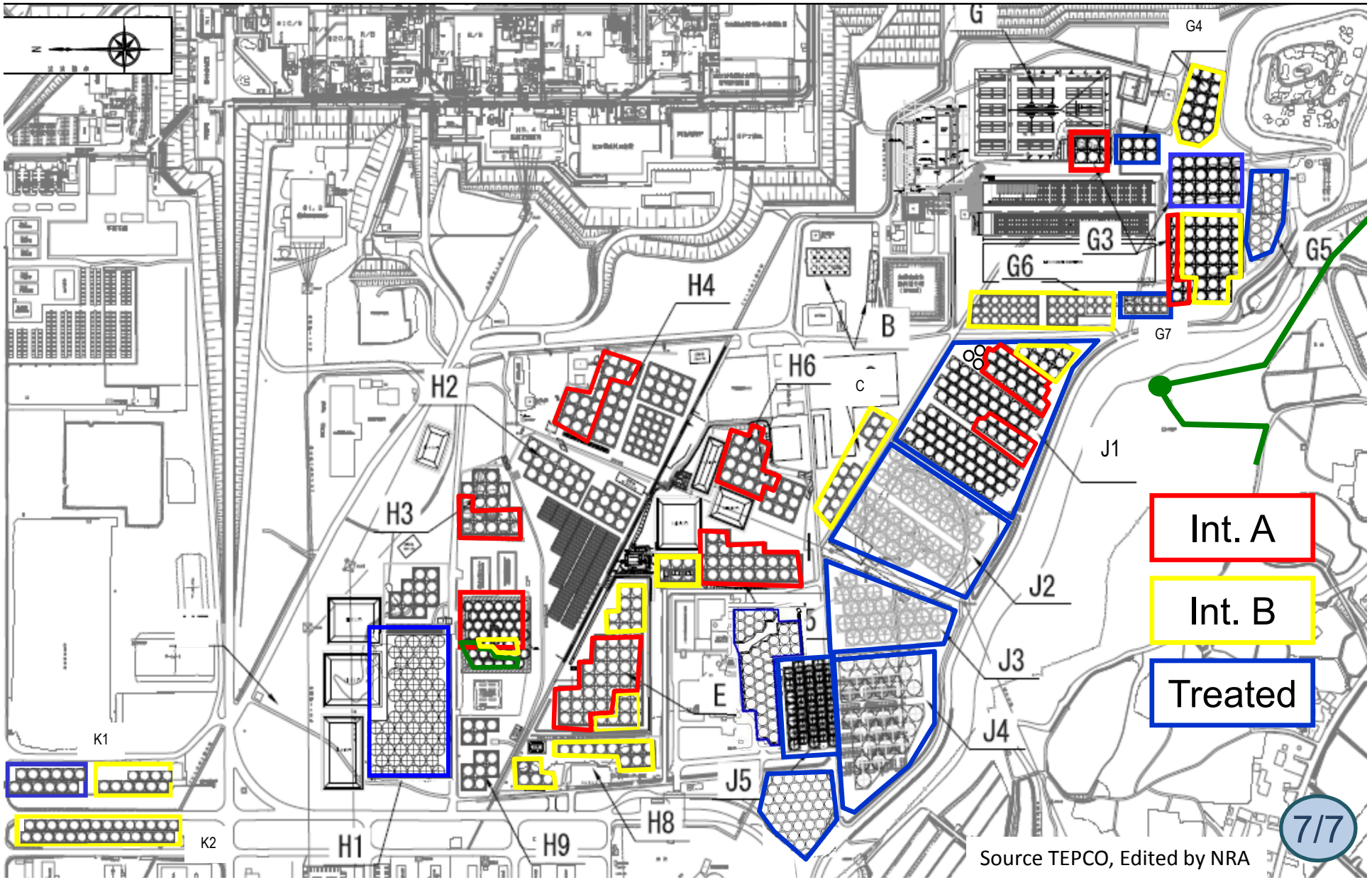


March 12, 2015



Source TEPCO, Edited by NRA

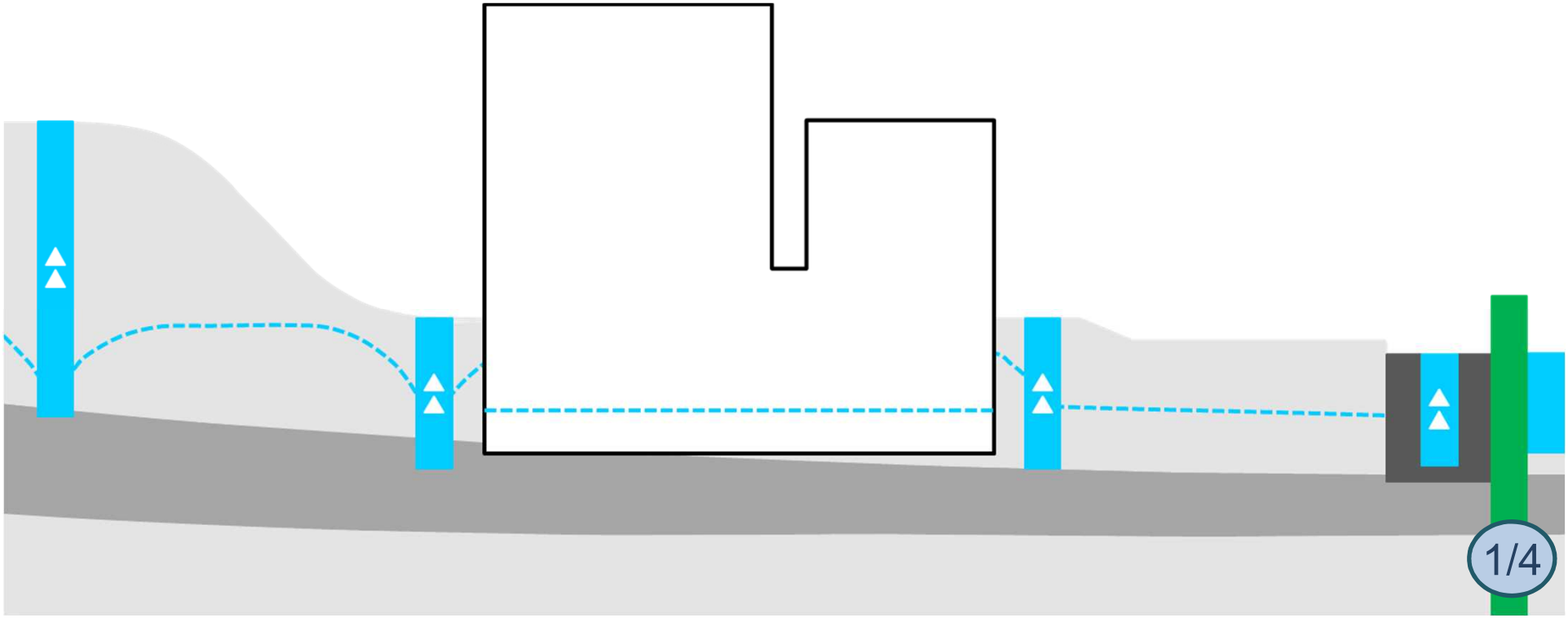
Achieving less than 1 mSv/y at border



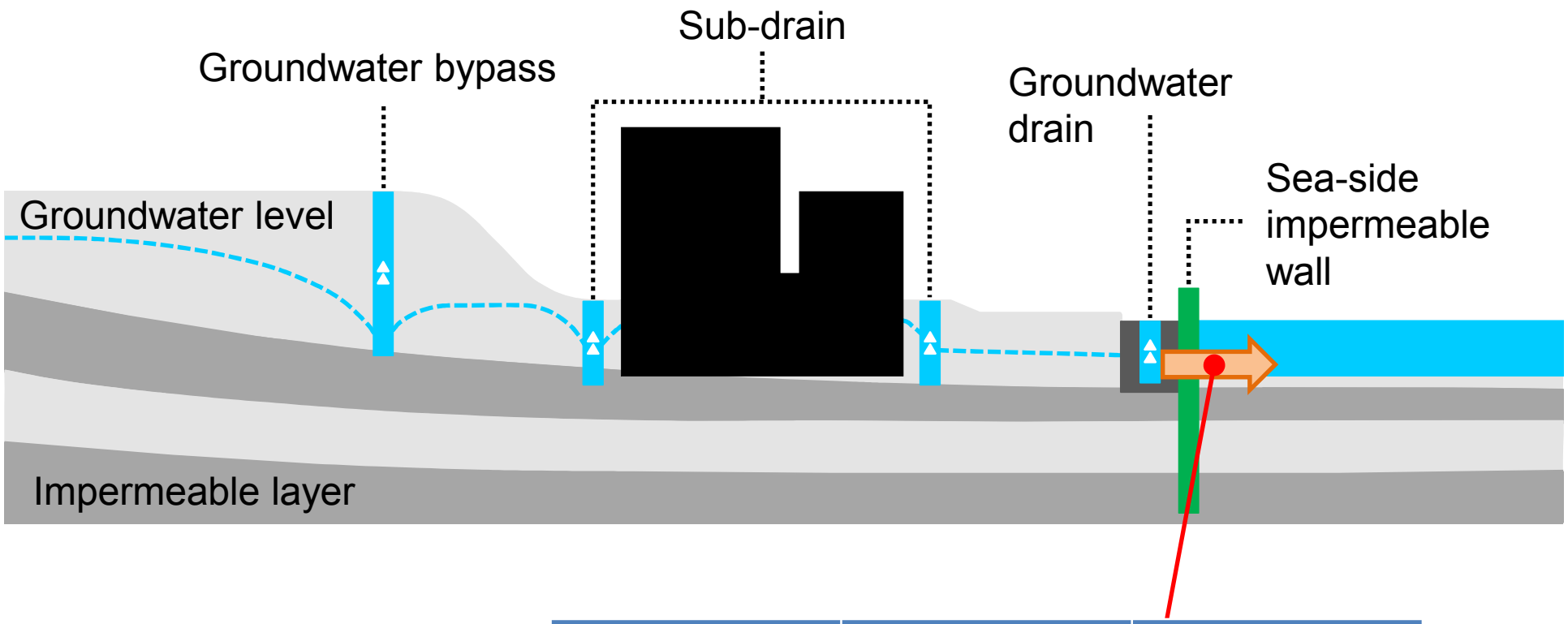
Source TEPCO, Edited by NRA

4 Reduction of groundwater inflow

- ✓ The water level in reactor/turbine buildings must be always lower than ambient groundwater level.
- ✓ The difference between the two levels, however, should be controlled at adequately small in order to reduce the inflow.



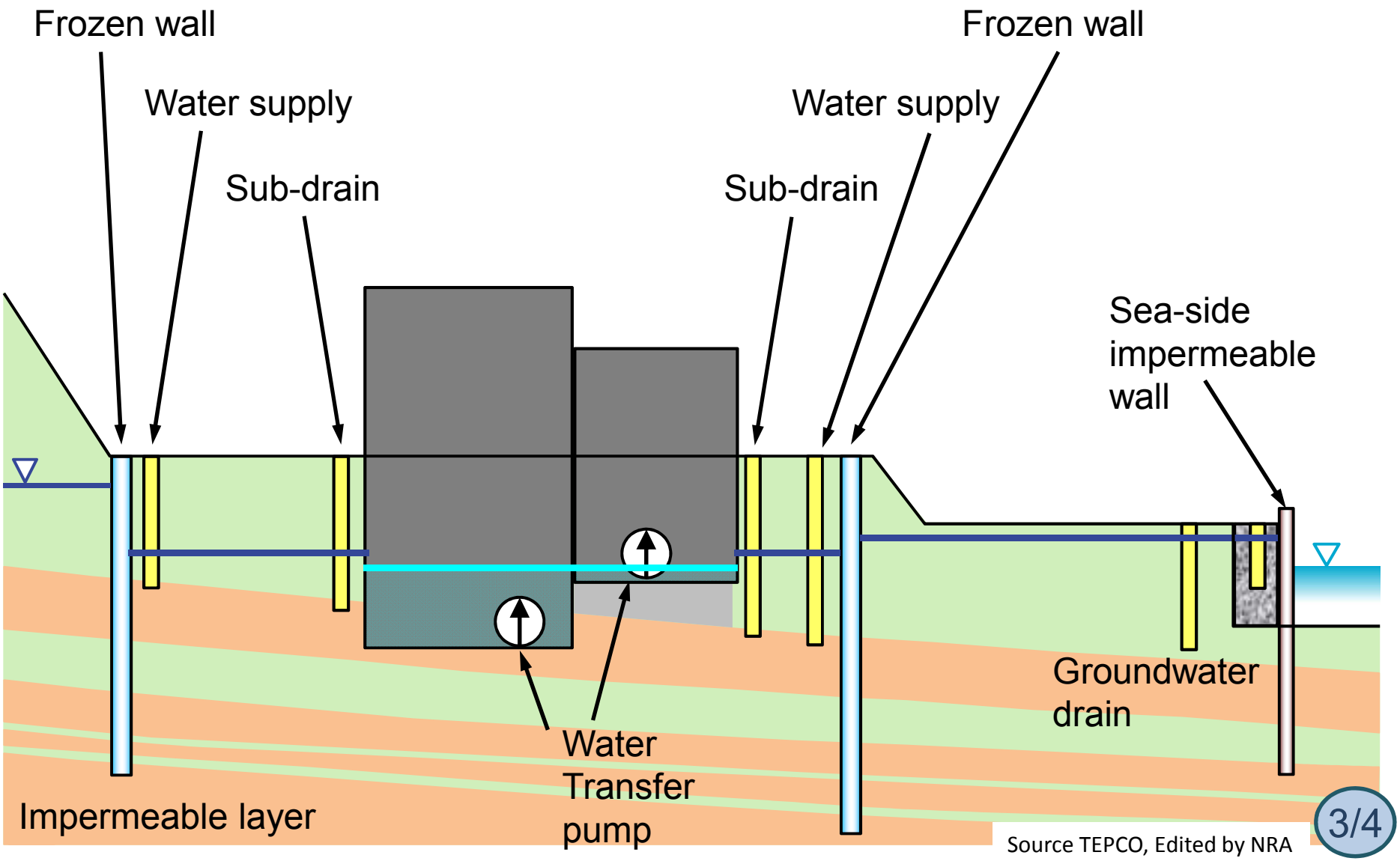
Sub-drain and sea-side impermeable wall



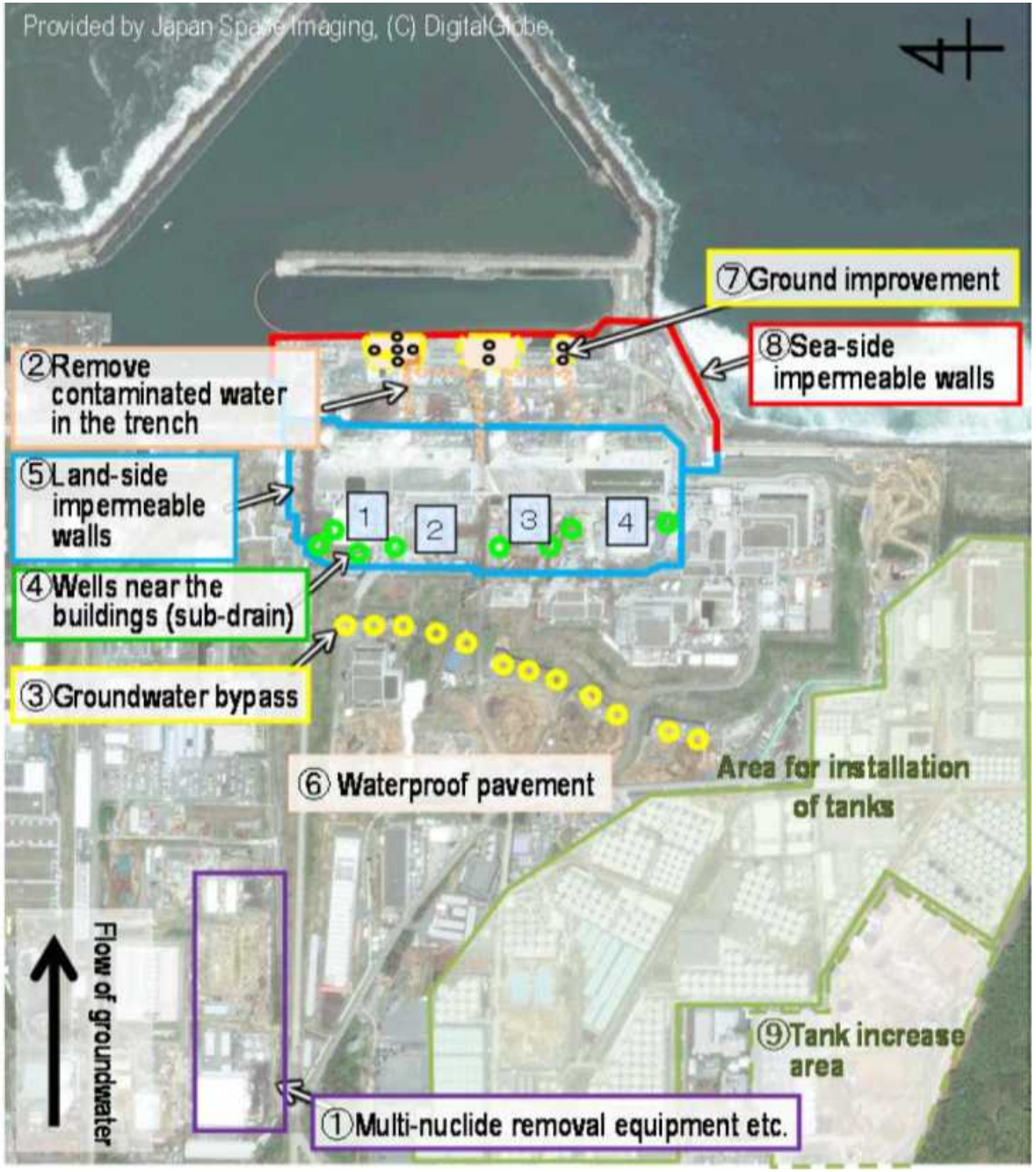
	in 314 days	Bq/day
Cs-137	3.8×10^{11}	1.2×10^{9}
Sr-90	8.5×10^{11}	2.7×10^{9}

Estimation for a period from 4/16/2014 to 2/23/2015

Land-side impermeable walls



Source TEPCO, Edited by NRA



Source TEPCO

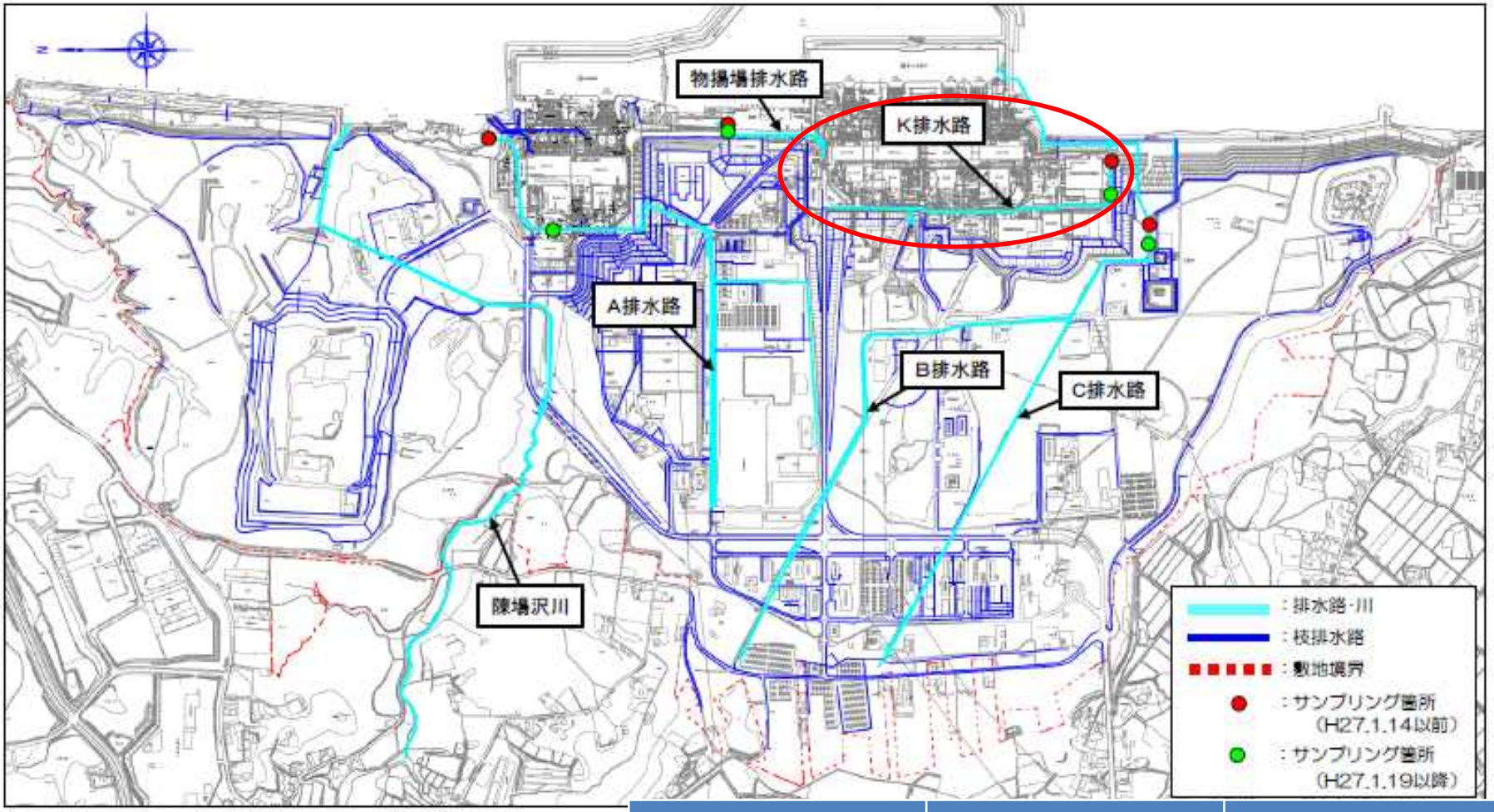
Other issues

- ✓ Protection against earthquake and tsunami
- ✓ Drainage ditches
- ✓ Work environment
- ✓ Facility investigation

Earthquake and tsunami

- ✓ ~270gal and 3.122m; DB at initially licensed in 1966
- ✓ 600gal and OP+14.13m; aseismic design back-check in 2009 and re-evaluation in 2012 for outer-rise earthquake
- ✓ 900gal and OP+26.3m; under evaluation

Water in drainage ditches



Source TEPCO

Ditch “K”	in 314 days	Bq/day
Cs-137	1.5×10^{11}	4.8×10^{8}
Sr-90	1.5×10^{10}	4.7×10^{7}

Estimation for a period
from 4/16/2014 to 2/23/2015

Work environment
e.g., reduction of work area with full-face mask

Action to be made toward designating area colored with pink as an area in which wearing full-face mask is not necessary

(1) Series of dust monitor equipment will be installed at appropriate spots and data from these monitors will be transmitted to the anti-earthquake building so as to monitor dust level in the building. (February or March 2015)

(2) Get permission from the government after confirming that dust level is low enough. (March or April 2015)

(3) Certain area is controlled as an area in which wearing full-face mask is not necessary. (In operation in May 2015)

In tank area, risk of taking concentrated salt water (highly contaminated with Sr) should be considered in addition to the risk regarding dust level.

Full-face mask unnecessary area

Future operation of Full-face mask unnecessary area is considered

●Equipment for monitoring dust level in an area in which wearing full-face mask is not necessary (5 spots)

●Equipment for monitoring dust level at vicinity of reactors (3 spots)

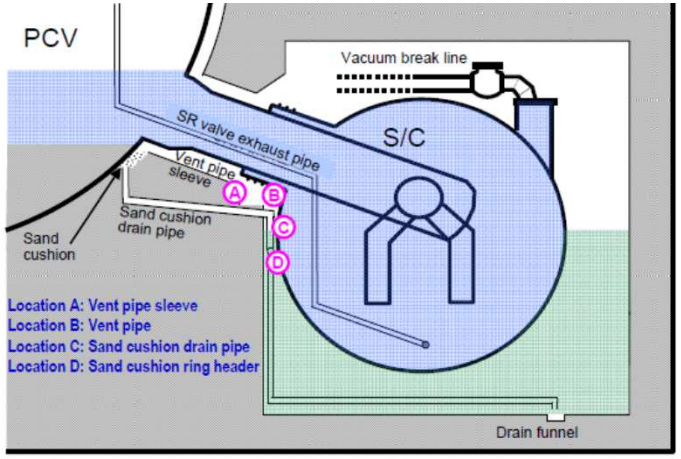
○Equipment to be installed additionally by Mach 2015 (2 spots)

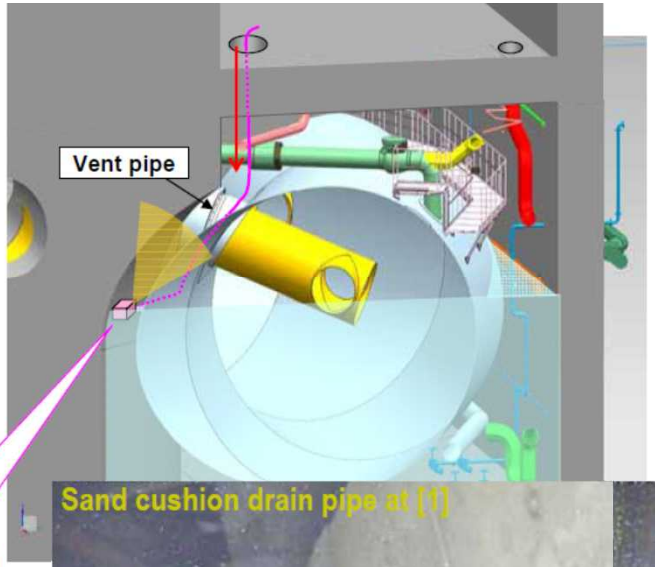
Total of 10 areas are to be monitered

Source TEPCO, Edited by NRA

Examining Inside of the Facilities

- Understanding the inside of R/Bs, Primary Containment Vessels (PCVs) and Reactor Pressure Vessels (RPVs)
  - Investigation of the flow paths in R/Bs, etc.
  - Analysis of water passing through the reactors
  - Analysis of the contamination of the inside of R/Bs, etc.
  - Direct observation of the inside of PCVs and RPVs

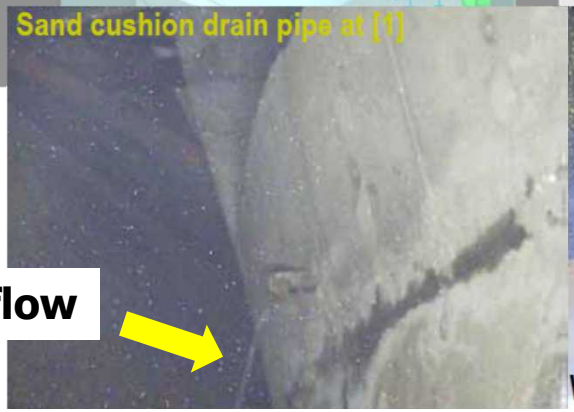




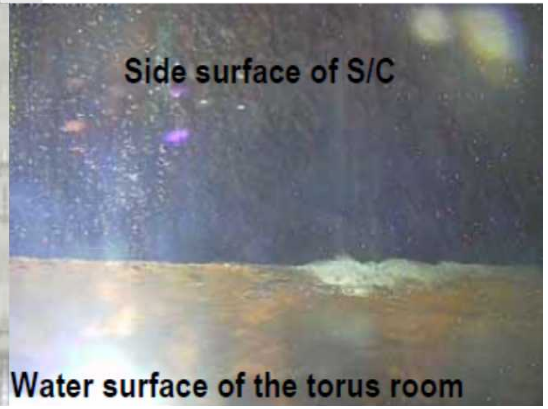
Unit 1

Investigation of water leak location from PCV done by TEPCO

Surface boat



Leak flow



Source: TEPCO handouts_131113_11-e.pdf

NRA's challenge

- ✓ In order to keep reducing the risk existing at the Fukushima Dai-ichi, the NRA should regulate and promote the decommissioning processes at the same time.
- ✓ The important challenge is to maintain harmonization between the implementation and acceleration of the decommissioning and the protection of people and the environment during the processes.