Workshop on Radiation Exposure Control
at TEPCO's Fukushima Daiichi Nuclear Power Plant, etc.

Activities to Reduce Exposure Doses during Disassembly of Bolted Type Tanks

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Overview of the work

The disassembling work of the bolt assembled type tanks used for storing emergency contaminated water from FY 2011 were started from the end of May 2015 associated with the renewal to the replacement with the welded type tanks.

Whole view of tanks

Dimension of tanks

Diameter 12 m

Height 10.5 m

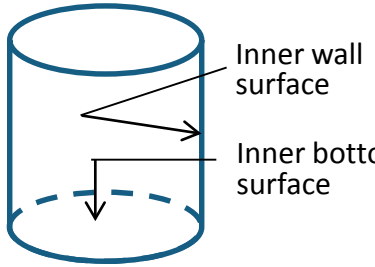
Weight 70 tonnes

Surface dose rate (β + γ): after draining the contaminated water

Inner wall surface 50 mSv/h (Ave.)

Inner bottom surface 40 mSv/h (Ave.) (measured)

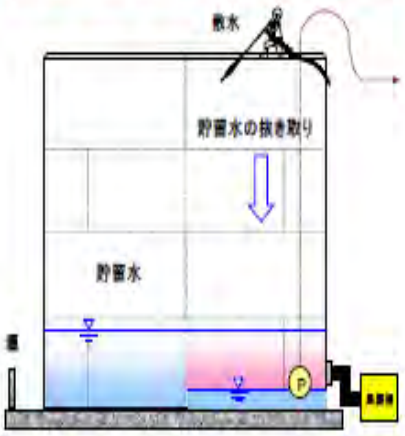
Schematic diagram



Flow diagram of the work

Preparation (water spray/ drainage/ collection of dust/ installation of a corridor)

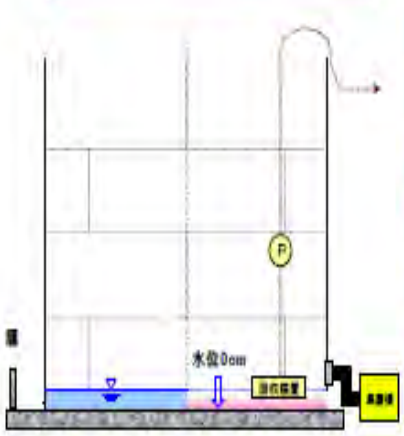
準備工
（散水・水抜き・集塵・歩廊設置）



Pumping water to the tank with a temporary pump to the depth of 10 cm from the bottom

Treatment of remaining water

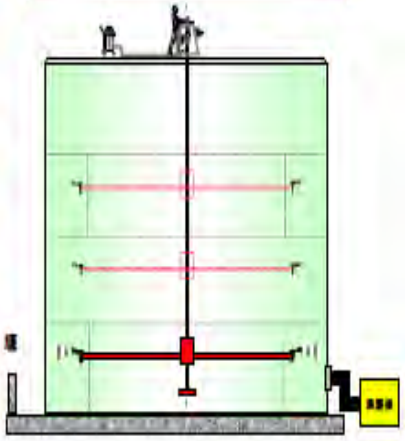
残水処理



Remove the crown and drain remaining water at the depth of 10 cm from the 4th bolted wall.

Pre-painting

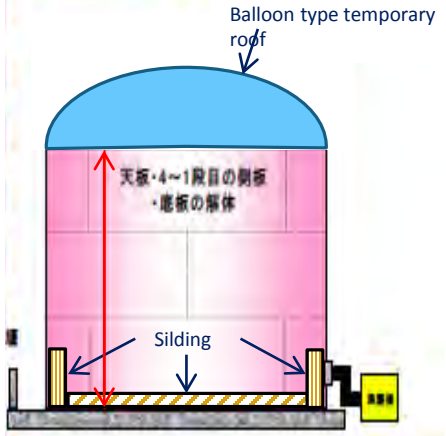
先行塗装



Return the crown and coat the inner surface of the tank

Disassembling:
Crown→Side wall
→ Bottom

天板 → 側板
→ 底板解体

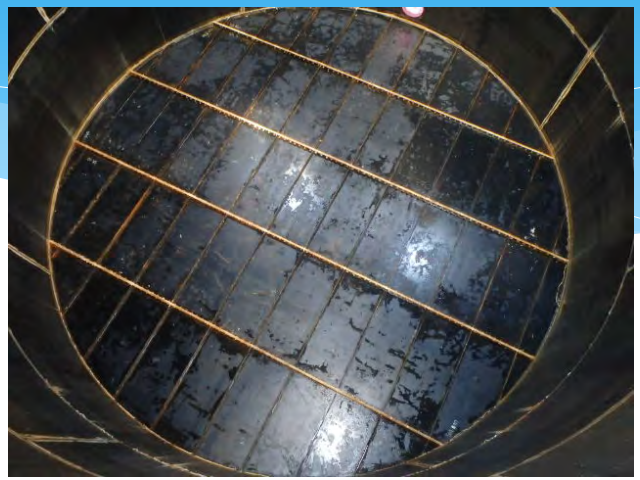


Disassemble the crown and the side wall of the tank
(using temporary balloon type temporary roof during disassembling)

Disassembling works

Disassembling work

Inner surface of the tank (after cleaning)



Equipment for workers

Wear a Tybec suit and anorak

Temporary storage of components in the temporary storage tent

Activities to reduce exposure doses

1. Shortening of working hours by development of a balloon-type temporary roof
2. Unattended construction by development of a pre-painting machine
3. Installation of shielding materials for works inside the tank
4. Safety measures for workers
5. Actions to prevent body contamination and expansion of contamination
6. Exposure dose of workers

1. Shortening of working hours by development of a balloon-type temporary roof

A light-weight balloon type temporary roof allowed lifting a whole roof at once using a crane, leading to a significant shortening of the roof installation/removal working hours, resulting in reduction of the exposure dose of workers.

Balloon blower (pressurizer)

Weight of a roof = 300 kg/unit

1. Shortening of working hours by development of a balloon-type temporary roof

View of lifting a whole balloon type roof

■Actions to reduce exposure doses

●In the case of the installation/removal of a five block steel roof

30 min × 5 piece = 150 min
（0.02 mSv/h × 8 workers × 2.5 h ＝ 0.4 man·mSv）

◎In the case of the installation/removal of a balloon type roof

60 min × 1 piece = 60 min
（0.02 mSv/h × 4 workers × 1 h ＝ 0.08 man·mSv）

Working hours

2.5 h – 1 h ＝ 1.5 h　(reduction of 90 min)

Exposure dose

0.4 man·mSv – 0.08 man·mSv = 0.32 man·mSv

(reduction of 0.32 man·mSv)

1. Shortening of working hours by development of a balloon-type temporary roof

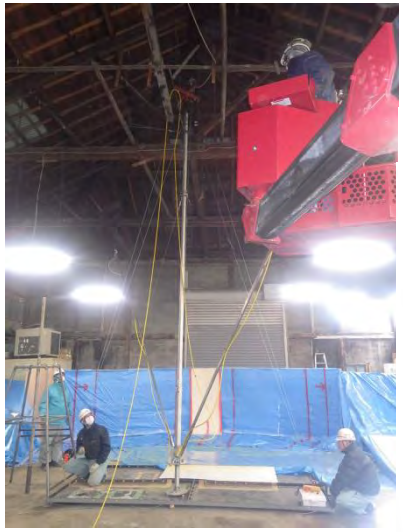
Training for lifting a balloon type roof

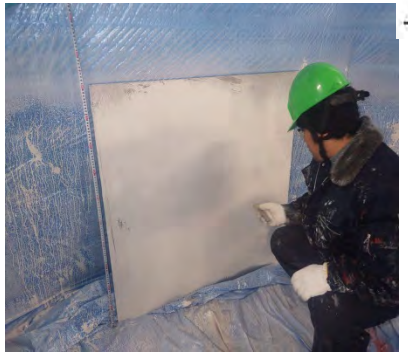
Training in lifting a balloon-type roof for workers to be engaged in the work contributed to the shortening of working hours.

2. Unattended construction using a pre-painting machine (to prevent scattering of dust)

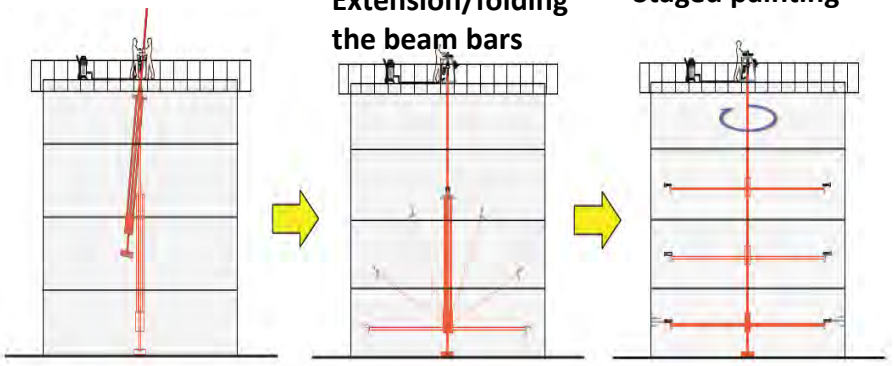
A painting machine allowed the limiting of painting work of the inner surface of the tank to operation from the tank top for workers, without entering the tank where the dose rate was high.

Development of a pre-painting machine



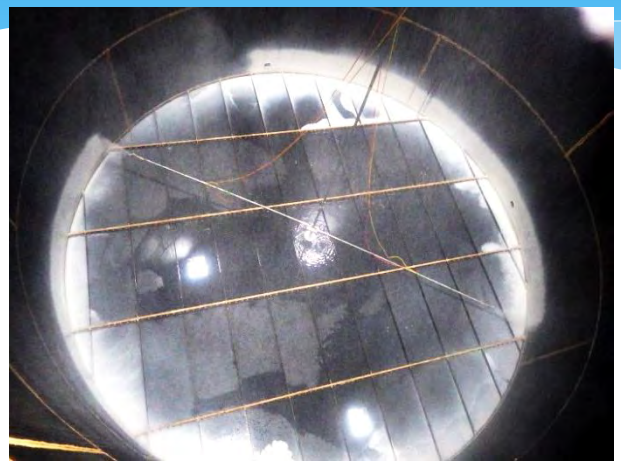


■Installation of a pre-painting machine in the tank



2. Unattended construction using a pre-painting machine (to prevent scattering of dust)

Works inside the tank (painting)



Operation at top of the roof

■Actions to reduce exposure doses

●In the case of painting by manpower

20 min × 21 pieces = 420 min
(0.5 mSv/h × 2 works × 7 h = 7 man·mSv)

* 0.5 mSv/h: dose rate after cleaning the inside of the tank

0.2 to 1 mSv/h

◎In the case of a pre-painting machine (unattended)

90 min × 1 piece = 90 min
(0.02 mSv/h × 4 workers × 1.5 h = 0.12 man·mSv)

* 0.02 mSv/h: dose rate at the top of the roof

Working hours

7 h – 1.5 h = 5.5 h (reduction of 330 min)

Exposure dose

7 man·mSv – 0.12 man·mSv = 6.88 man·mSv

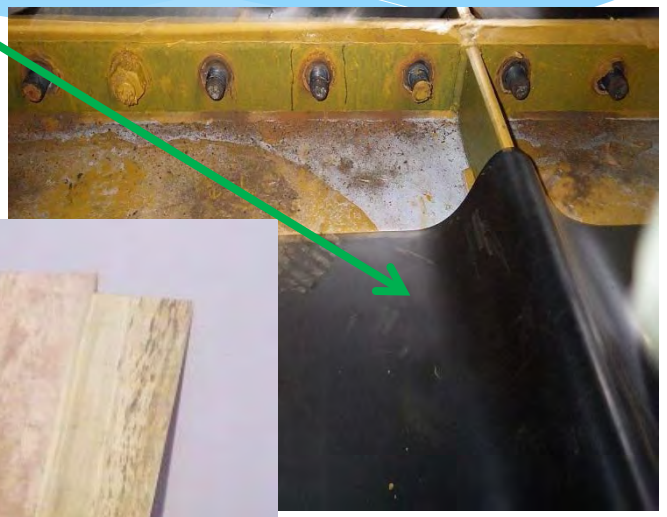
(reduction of 6.88 man·mSv)

3. Installation of shielding materials for work inside the tank

Shielding materials are provided (mainly against beta rays) before workers enter inside the tank because the inner surface of the tank is severely contaminated .

Shielded conditions (whole view)

A rubber sheet (to shield radiation from the bottom)



Composite panels (to shield from radiation from the wall)

3. Installation of shielding materials for work inside the tank

Works to install shielding materials in the tank

Shielding materials

From wall:

Composite panel (t = 12 mm)

From the bottom:

Rubber sheet (t = 2 mm)

Before shielding (β + γ)

Wall surface 50 mSv/h (Ave.)

Bottom surface 40 mSv/h (Ave.)

(including bottom flange)

After shielding (β + γ)

Wall surface 0.2–3 mSv/h

Bottom surface 0.1–10 mSv/h

Reduction rate ≥ 90%

4. Safety measures for workers

1. Measures against heat stroke

○ Exposure dose reduction

Preventing body contamination

⇒ Required to work wearing an anorak.

○ Wearing an anorak • • • WBGT* correction +11° C

⇒ No work allowed during day time in summer due to large burden to the body.

*WBGT :Wet-Bulb Globe Temperature

All works were conducted at night in summer (June–September) to prevent heat stroke.

Work cycle at night

	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	0:00	0:30	1:00	1:30	2:00	2:30	3:00	3:30
Corrected WBGT ≤ 27		Morning meeting		Work 2.5 h					Rest			Work 3.0 h					
		Arrival															
Corrected WBGT ≥ 28	Morning	meeting	Work 1.5 h			Rest			Work 1.5 h			Rest			Work 1.5 h		
	Arrival																

4. Safety measures for workers

2. Measures to prevent falls

Ensure measures to prevent falls, which may be the most significant hazard in the tank disassembling works

Wear safety harness in high places

Full protection against falls at the opening of the top

Lighting at night

5. Actions to prevent body contamination and expansion of contamination

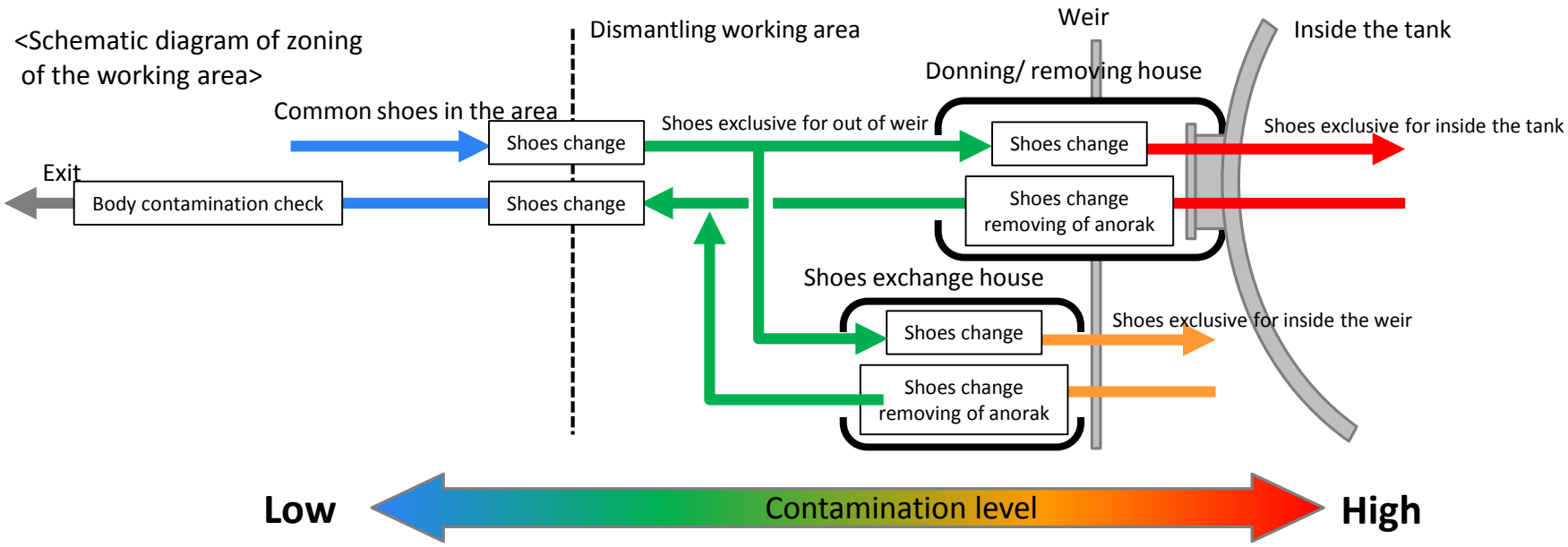
The inside the tank is highly contaminated.

Contaminants on the equipment of workers inside the tank (anorak, working shoes) would cause the expansion of contamination outside the tank.

Work over time will increase contamination level in the area as a whole, leading to a high risk of body contamination.

⇒ Reduction of the body contamination risk by limiting the expansion of contamination within the zone, based on the zoning of working areas, and changing shoes and removing anorak at the border.

Contamination check after work for all workers.



5. Actions to prevent body contamination and expansion of contamination

Donning/ removing house

Shoes exchange house

Inside of the donning/removing house

Body contamination check before and after work

5. Actions to prevent body contamination and expansion of contamination

Mutual visual check of equipment

Allocate clothing check staff (1)

Allocate clothing check staff (2)

Education of donning/removing equipment

6. Exposure dose of workers

Number of workers per one unit of tank: 22 workers

Without measures to reduce exposure doses

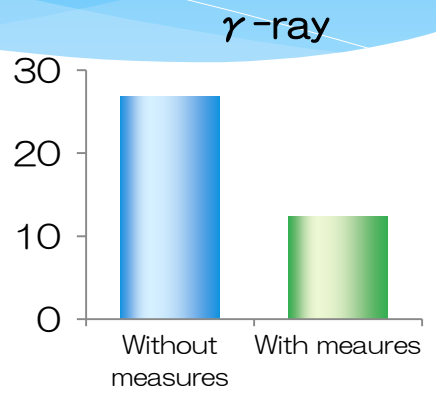
Planned dose per one unit (γ) 26.8 man·mSv

Planned dose per one unit (β) 239 man·mSv

With measures to reduce exposure doses

Planned dose per one unit (γ) 12.4 man·mSv

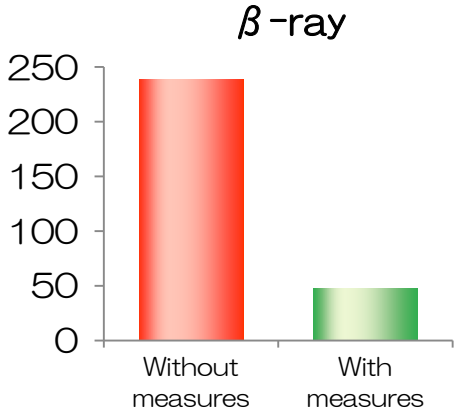
Planned dose per one unit (β) 47.6 man·mSv



γ-ray

26.8 – 12.4 ≒ △14 man·mSv

(reduction of 14 man·mSv)



β-ray

239 – 47.6 ≒ △191 man·mSv

(reduction of 191 man·mSv)