

Workshop on Radiation Exposure Control at the
TEPCO Holdings' Fukushima Daiichi Nuclear Power Plant

Radiation Protection Initiatives for D-Pit Waste Sludge Desalination Facility Installation Work

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- MHI has carried out construction work to install a temporary pump for the purpose of transferring supernatant in a pit that stores high dose rate waste sludge generated since the 2011 earthquake to the underground floor of the main processing building.

- The work site inside the main processing building has high γ -ray and β -ray dose rates and high radioactive contamination.
- It also has many narrow sections, making decontamination by remote controlled decontamination devices, etc. difficult.

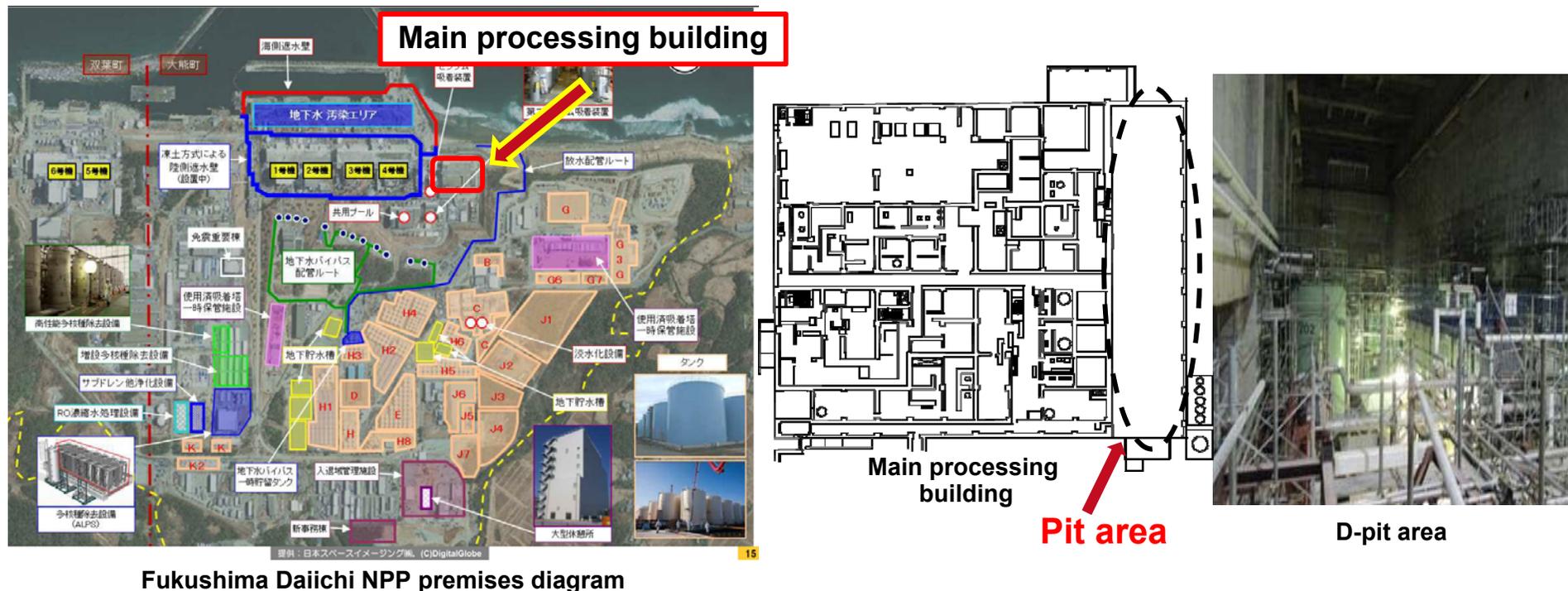


- From the construction work planning stage various radiation protection measures were considered and were implemented at the site.
- The measures and radiation protection initiatives implemented for this construction work are described in this report.

2. Outline of Construction Work (1/2)

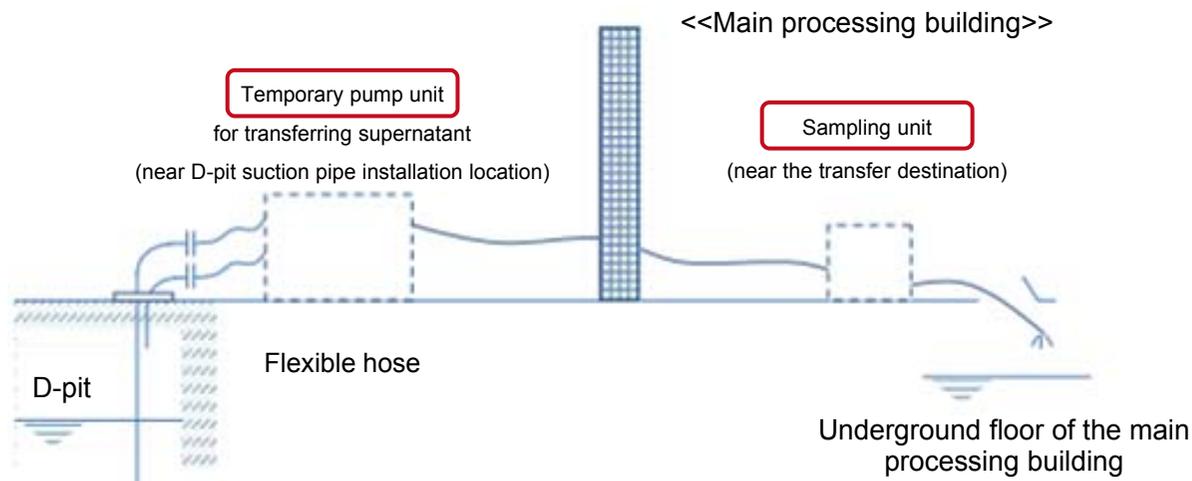
- High dose rate waste sludge is temporarily stored in the granular solid storage tank (D-pit) inside the main processing building. Salts in the liquid phase of the waste sludge have adverse effects on reinforced concrete or carbon steel, and the salt content needs to be reduced to 1/100 or below the current level.

[Main processing building (main work site)]



2. Outline of Construction Work (2/2)

- As part of the dilution operation, a temporary pump unit, sampling unit and hoses and cables were installed as a facility to transfer supernatant of waste sludge stored in D-pit to the underground floor of the main processing building.



Schematic diagram of pumping facility



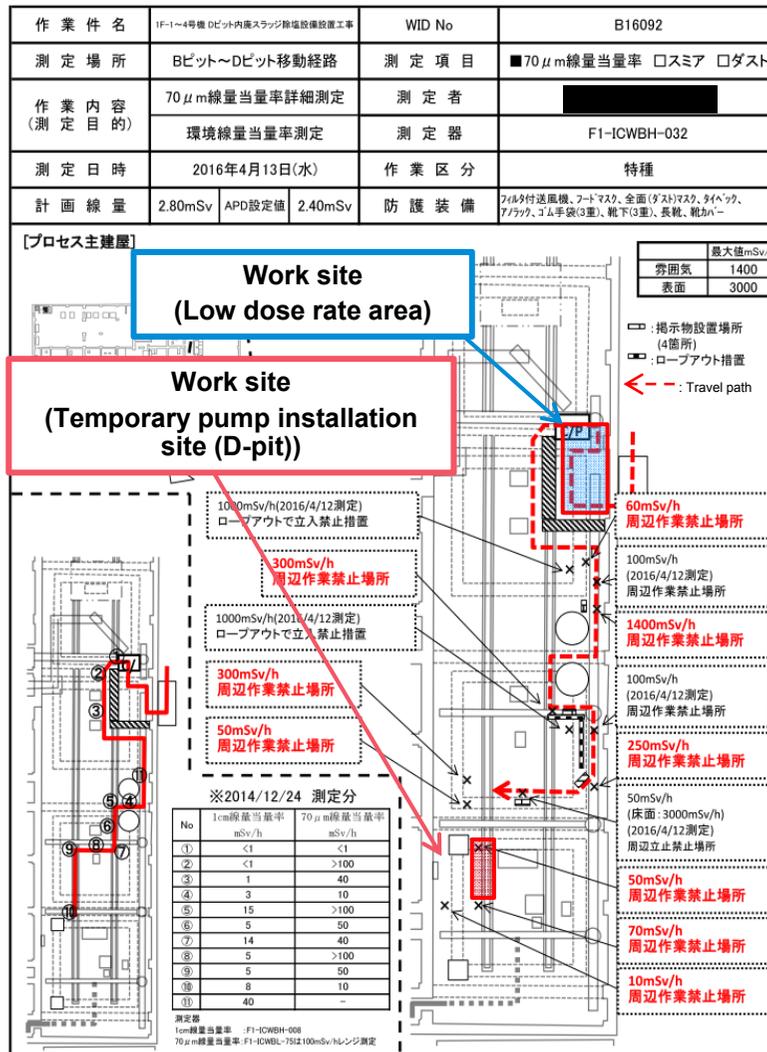
Temporary pump unit



Sampling unit

3. Work Environment

放射線管理記録



三菱重工業株式会社

➤ Pump installation location near D-pit and travel path have:

● **High γ-ray and β-ray dose rates**

Max. ambient rate γ: 40 mSv/h,
β+γ: 1400 mSv/h

● **High radioactive air contamination**

Max. concentration 5×10^{-2} Bq/cm³ or higher



Various radiation protection measures are needed!!

4. Dose Reduction Measures (1/4)

(1) Improving work environment

➤ L-shaped temporary shielding installed

- Dose rate contribution from the main radiation source at the central part of the pit was reduced (**10.0 mSv/h** → **5.0 mSv/h**)

Dose reduction effect: **44.49 person • mSv**



L-shaped temporary shielding

➤ Travel path sectioned (visualized)

- To prevent accidental travel through high dose rate areas, the travel path was sectioned using tapes
- To prevent unnecessary exposure while travelling, travel direction was clarified using arrows



Sectioning by tape



Travel path indicator

4. Dose Reduction Measures (2/4)

➤ High dose rate places clarified (visualized)

- Warning signboards installed



Staying time cut in high dose rate places!

➤ β -ray overexposure prevention measures



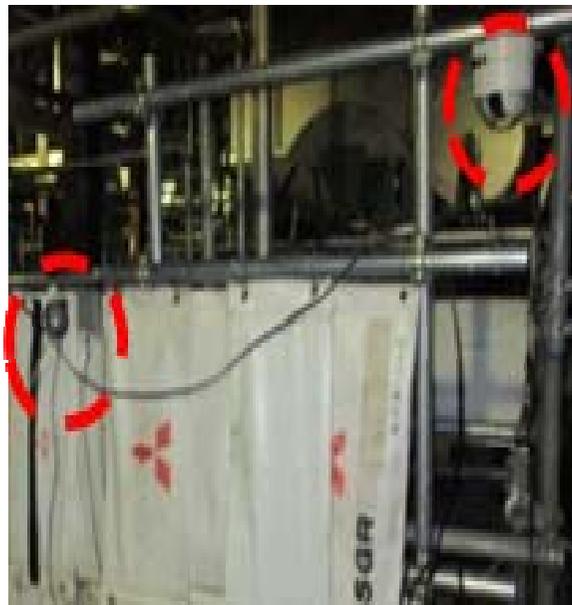
β -ray shielding by rubber mats

- For places with high β -ray dose,
 - Rubber mats placed
- During work,
 - Thick rubber gloves worn

(2) Exposure dose reduction measures for supervisors

➤ Remote-control camera/area monitor installed

- It became possible to **remotely check the work site and give instructions** from the headquarters outside the building; this reduced the time supervisors had to be at high dose rate places.



Remote-control camera installed



Area monitor installed



Checking the work site through a monitor screen

(3) Reducing operation time at high dose rate places

➤ Mockup training

- A situation similar to the actual working environment was reproduced to reduce the operation time.

➤ Assembly work at low dose rate areas

- Assembly of the pump unit takes time (8 days). From the construction planning stage, a method to install the unit after assembling it at a low dose rate area was considered, and implemented.



Training in progress
(cable installation work)



Assembled at low dose rate area
(0.07 mSv/h)



Moved using a crane



Installed at high dose rate place
(5 mSv/h)

5. Personal High Dose Contamination Prevention Measures

(1) Radiation protection education and PPE put-on/removal training



Class on radiation protection education



Personal protective equipment (PPE) put-on/removal training



(2) Specifying PPE put-on/removal areas and allocating helpers

- Inside the Super House is set as a non-contaminated area
 - ➡ PPE put-on room specified
- Near the entrance of heavily contaminated area
 - ➡ Relatively spacious PPE removal area specified
- Helpers allocated for putting on/removing PPE
 - ➡ Appropriate put-on/removal ensured



Room for putting on PPE (inside Super House) specified



PPE removal area specified

6. Measures against High Concentration Radioactive Dust

(1) Wearing appropriate PPE (full face mask + hooded mask)

- High contamination was detected on full face mask filter in the first on-site inspection.



- To assuredly prevent internal exposure, a dual filter system was adopted (Full face mask filter + AP-60 filter)

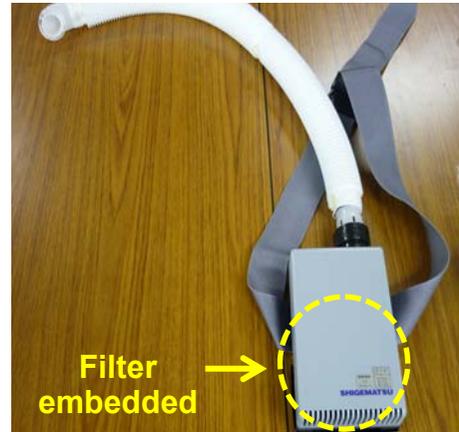
*AP-60 filter collecting efficiency: 99.99%



- During this construction work, no contamination was identified in the filter of any full face masks.

(2) Strict time control (work time restriction)

- Maximum operation time inside the building was set to 15 minutes.
- Not only radiation protection staff but also representative workers were ordered to carry a stopwatch to always be aware of operation time.
- Radiation protection staff carried out time management near the PPE removal area (low dose rate place).
- When the operation time became close to the limit time, a warning was announced using a loudspeaker to raise the awareness.



Blower with filter (AP-60)



Special hooded mask (HD-EFS)



AP-60 equipped

- For the high dose rate work environment, the following multilayered measures were promoted and reduction of external exposure and prevention of internal exposure were achieved.
 - Installing L-shaped temporary shielding, and clarifying travel routes
 - Remotely conducting the work site check and provision of work instructions by supervisors
 - Reducing operation time at high dose rate places through mockup training, etc.
 - Preventing personal contamination of workers through education and training using exposure cases
 - Using personal protective equipment appropriate for the actual work environment (combined use of PPE, operation time management)
- Meanwhile, an environmental survey of the work site conducted to investigate these preliminary measures found a relatively high exposure dose for radiation protection staff members.
- MHI will continue employing creative and original approaches including specific environmental surveys using robots, etc., to realize safer construction work.



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