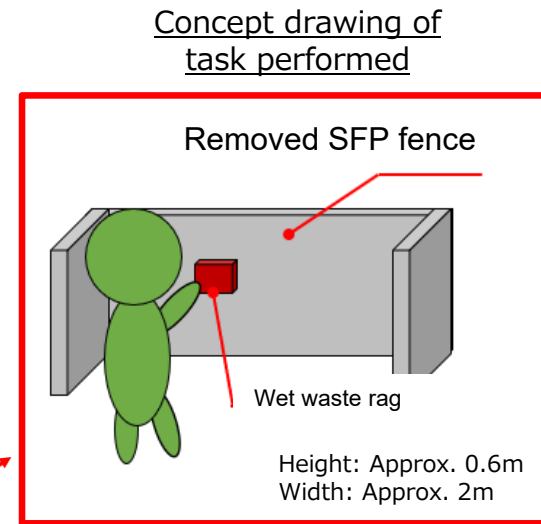
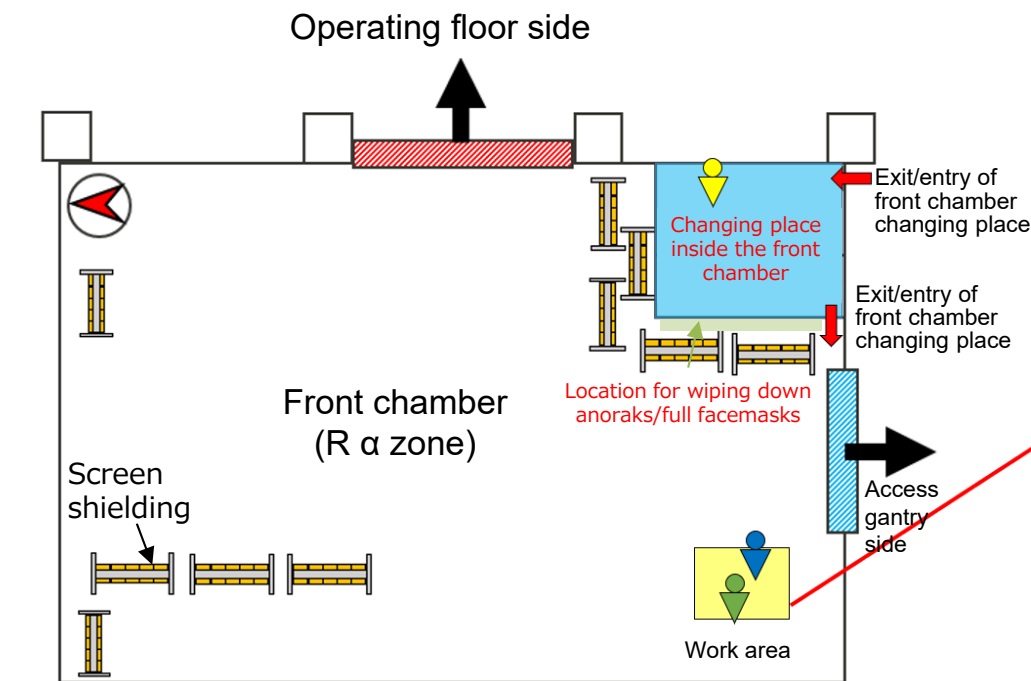


# Causes and countermeasures for the contamination of a worker engaged in environmental improvement work in the Unit 2 reactor building at the Fukushima Daiichi Nuclear Power Station

- On December 11, a nasal smear taken from a worker of the contractor detected contamination ( $\beta$ -rays: Approximately 1,000CPM,  $\alpha$ -rays: 0CPM) and indicated the possibility of intake. The worker had been decontaminating the removed fence used for foreign material exclusion of spent fuel pool in the front chamber at the west side of the Unit 2 reactor building.
- After decontaminating the worker's face of the criteria for allowing exit from the area (radiation other than  $\alpha$ -rays: 4Bq/cm<sup>2</sup>,  $\alpha$ -rays: 0.4Bq/cm<sup>2</sup>) had been met so the worker exited the controlled area. A medical check by the entry/exit control building emergency physician found no abnormalities with the worker's physical condition. <Announced as of December 12th>
- The following provides information on the assumed cause of this incident, countermeasures, and an assessment of the aforementioned worker's internal exposure dose (provisional results).



【 Total number of workers: 3 】  
 Work team leader: 1,  
 worker: 1,  
 radiation control officer: 1  
 (there are no issues with this project team)

## 【Worker's PPE】

The aforementioned work area is an alpha radiation zone \* and as such requires that the following radiation protection equipment must be worn (there are no issues with the PPE)

- Full facemask
- Anorak (top/bottom)
- Coveralls
- Cotton gloves
- Rubber gloves (three layers)
- Socks (three layers)
- Red boots
- Crystalline lens glass badge
- Ring badge

\* Alpha radiation zone  
 Area in which the density of alpha nuclide surface contamination of the floor or equipment/machinery being handled exceeds, or may exceed, 1/10 of the maximum surface contamination density stipulated by law

- Radiation control officer (helps to put on and remove equipment)
- Work team leader
- Worker

Diagram of work being done in the front chamber at the west side of the Unit 2 reactor building

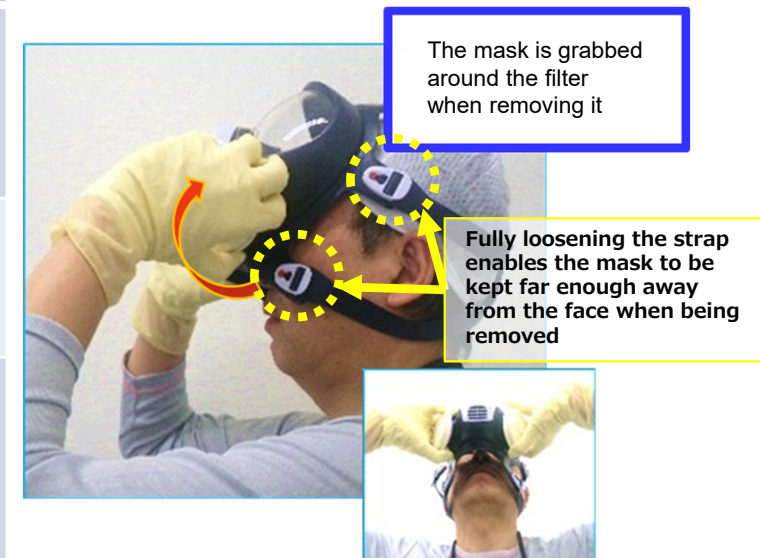
# 1. Assumed causes

- Interviews with the aforementioned worker and other relevant parties have shown that radiation protection equipment was put on and taken off in accordance with procedures \* required to prevent body contamination.

\*Fit check, sealing and checking its condition, changing of rubber gloves, wipe down (decontamination) of full face masks and anorak when exiting the area, and confirmation with smear tests

- However, it was found that when the worker exited the alpha radiation zone, after relocating to the building where his full face mask was to be removed, the aforementioned worker removed his mask without fully loosening the strap.
- Furthermore, smear tests of the full face mask and anorak performed when exiting the alpha radiation zone showed contamination to be at background levels, however during the investigation conducted after the aforementioned incident occurred, it was found that contamination had remained on the chin part and the filter part of the outside of the full face mask, which are difficult to take samples from with the smear filter paper.
- From these facts it is assumed that because the full face mask was taken off without sufficiently loosening of the strap, the worker's fingers, or the chin part of the outside of the full face mask, came in contact with the worker's face (from the chin to the forehead) and transferred contamination.

Factors that could result in facial contamination	Confirmed facts	Possibility of occurrence
Broken mask exhalation filter valve	<ul style="list-style-type: none"> <li>If the valve is broken the area around the mouth will be contaminated but contamination would not be on the forehead as was found.</li> <li>The mask was not found to be damaged.</li> </ul>	No
Insufficient mask seal	<ul style="list-style-type: none"> <li>There are two seals, one between the coverall and the full face mask, and another between the anorak and the full face mask, and these were checked by the radiation control officer.</li> </ul>	No
Contaminants adhered to the mask were transferred to the face when the mask was removed	<ul style="list-style-type: none"> <li>The mask was taken off without fully loosening the strap.</li> <li>Contamination was found on the outside of the full face mask around the filter and the chin part.</li> </ul>	Yes



Example of removing a full face mask

## 2. Countermeasures

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- Countermeasures for remaining contaminants on the chin part and around the filter of the mask

The following will be added to "Special-Education Pertaining to Radiation Zones and Alpha Radiation Zones" materials and will be taught to TEPCO employees and contractors.

- ✓ "The chin part and the filter part of the masks are places where contaminants can easily be overlooked and must be wiped well."

- Countermeasures for the spread of contamination when removing full facemasks

### 【 Short-term countermeasure 】

All TEPCO employees and contractors have been told that they must fully loosen the straps when removing full facemasks in order to prevent facial contamination. (Completed by December 14th)

### 【 Continuous countermeasures 】

During training on the wearing and removal of full facemasks that has been conducted throughout the fiscal year for all workers (including TEPCO employees), educational materials will be used to convey helpful tips for loosening the straps when the trainees are subjected to full face mask wearing tests (to be implemented every fiscal year)

### 3. Dose assessment of the internal exposure for the worker

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#### ■ Committed effective dose<sup>\*1</sup> 【 Provisional result 】

✓ 0.38mSv (Less than recorded level 〈2mSv〉 )

( Provisional calculation method [ Following calculation ] )

- $\gamma$ -rays …………… Assessment value from whole body count measurements taken on December 14th
- $\beta$ -rays,  $\alpha$ -rays… Estimated value from nasal smear analysis and chin part contamination measurements ( $\beta$  rays: 435Bq/cm<sup>2</sup>,  $\alpha$  rays: 0.07Bq/cm<sup>2</sup>)

#### ■ Committed effective dose 【 Finalized results 】

- ✓ In addition to the fact that  $\beta$ -contamination was detected during the nasal smear measurements, since it is possible that strontium-90 may be present in the work environment and a small amount of  $\alpha$ -nuclides was found on the chin, a bioassay<sup>\*2</sup> will be conducted (urine/feces) based on which the  $\beta$  ray and  $\alpha$  ray committed effective dose shall be determined.
- ✓ The analysis will take approximately one month so the final committed effective dose result should be available around the middle of January 2024.

\*1 Committed Effective Dose: The total effective dose that will be received over the 50 years after intake of a radioactive substance

\*2 Bioassay: Analysis of the radioactive substances present in a biological specimen (urine or feces, etc.)