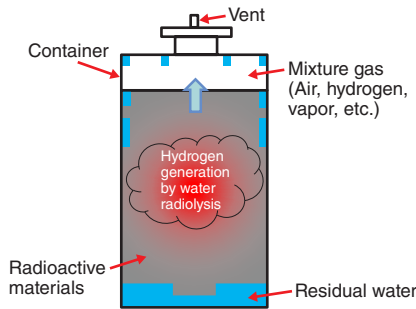
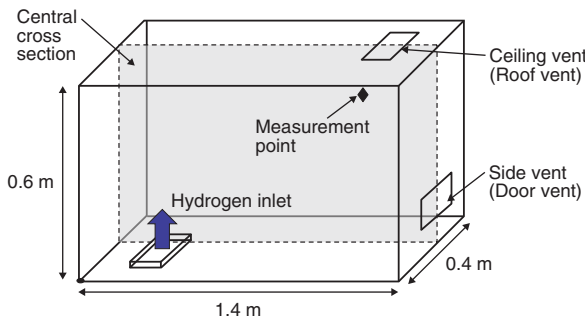


# 8-7 Toward the Safe Storage and Management of Wastes Such as Fuel Debris

## — Research and Development on Hydrogen Leakage/Diffusion Behavior Analysis —



**Fig.1 Interior of the radioactive waste storage container**  
Residual H<sub>2</sub>O inside the container is decomposed by the ionizing radiation emitted from the waste to generate H<sub>2</sub>.



**Fig.2 Room (model) for H<sub>2</sub> leakage experiments**  
A vent was provided in the ceiling and on the side (right), and H<sub>2</sub> leakage was investigated when H<sub>2</sub> was released from the bottom at a rate of 10 L/min for 420 s.

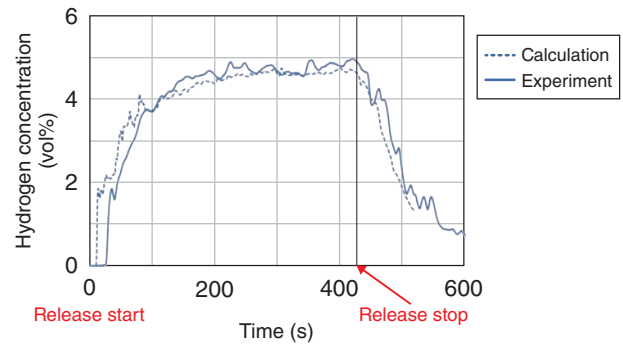
As a part of the efforts toward recoverin from the accident at TEPCO's Fukushima Daiichi Nuclear Power Station, we are conducting research and development (R&D) on the safe storage and management of radioactive waste such as fuel debris, which is scheduled for future retrieval.

Containers of radioactive waste are stored without water. If water remains in the container, radiation from the waste will decompose the water and generate hydrogen (H<sub>2</sub>), leading to the risk of combustion and explosion (Fig.1). Therefore, to prevent accumulation of H<sub>2</sub> generated during storage, measures such as use of catalysts that return H<sub>2</sub> to water and vents with filters that prevent the release of radioactive materials are being considered.

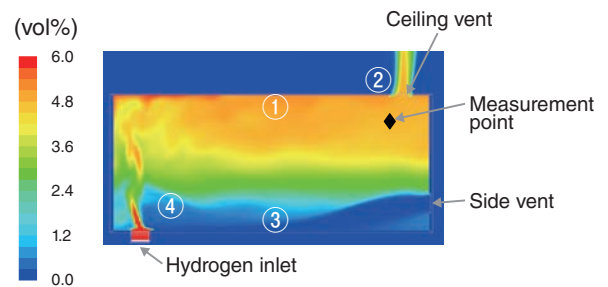
To validate these measures and develop new ones, we use numerical analysis and simulation methods called computational fluid dynamics (CFD) to study H<sub>2</sub> leakage and diffusion. As an example of the study, we introduce the result of reproducing the H<sub>2</sub> leakage experiment and further verifying the ventilation process.

In this study, vents were installed in the ceiling and on the side of the room (Fig.2), and H<sub>2</sub> was discharged from the outlet at the

(a) Time change of hydrogen concentration



(b) Hydrogen concentration distribution



**Fig.3 (a) Time change and (b) distribution of H<sub>2</sub> concentration**  
(a) shows the time change at the measurement point near the ceiling vent. The calculation results reproduce the experimental results well. (b) shows the distribution after stopping H<sub>2</sub> release. H<sub>2</sub> accumulated in the room ① escapes through the ceiling vent ②, but outside air flows in through the side vent ③, allowing natural ventilation, which further reduces the H<sub>2</sub> concentration in the room ④.

bottom at a rate of 10 L/min for 420 s.

Fig.3 shows the (a) time change and (b) distribution of H<sub>2</sub> concentration. The concentration at the measurement point (a) increased from the start of release and rapidly decreased after the end of release. From the perspective of H<sub>2</sub> distribution in the room (b), when there is no wind outside the room, ① H<sub>2</sub> from the outlet quickly reached the ceiling and ② was discharged through the ceiling vent. Simultaneously, ③ air flowed into the room from the side vent, and reached the outlet, resulting in low H<sub>2</sub> concentration ④. When wind blew from right to left, the concentration decreased faster than in the case of no wind because the side vent was on the windward side. When the wind blew in the opposite direction, there was a concern that the concentration would be higher than in the case of no wind.

In the future, we will utilize such analysis and simulation techniques to clarify the behavior of H<sub>2</sub> in the presence of water vapor and oxidants (e.g., NO<sub>x</sub>) and to work on the development of H<sub>2</sub> retention prevention technology using a ventilation system that utilizes atmosphere control.

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**Reference**

Terada, A. et al., Effects of Vent Size and Wind on Dispersion of Hydrogen Leaked in a Partially Open Space: Studies by Numerical Analysis, Nuclear Science and Engineering, vol.197, issue 4, 2023, p.647-659.