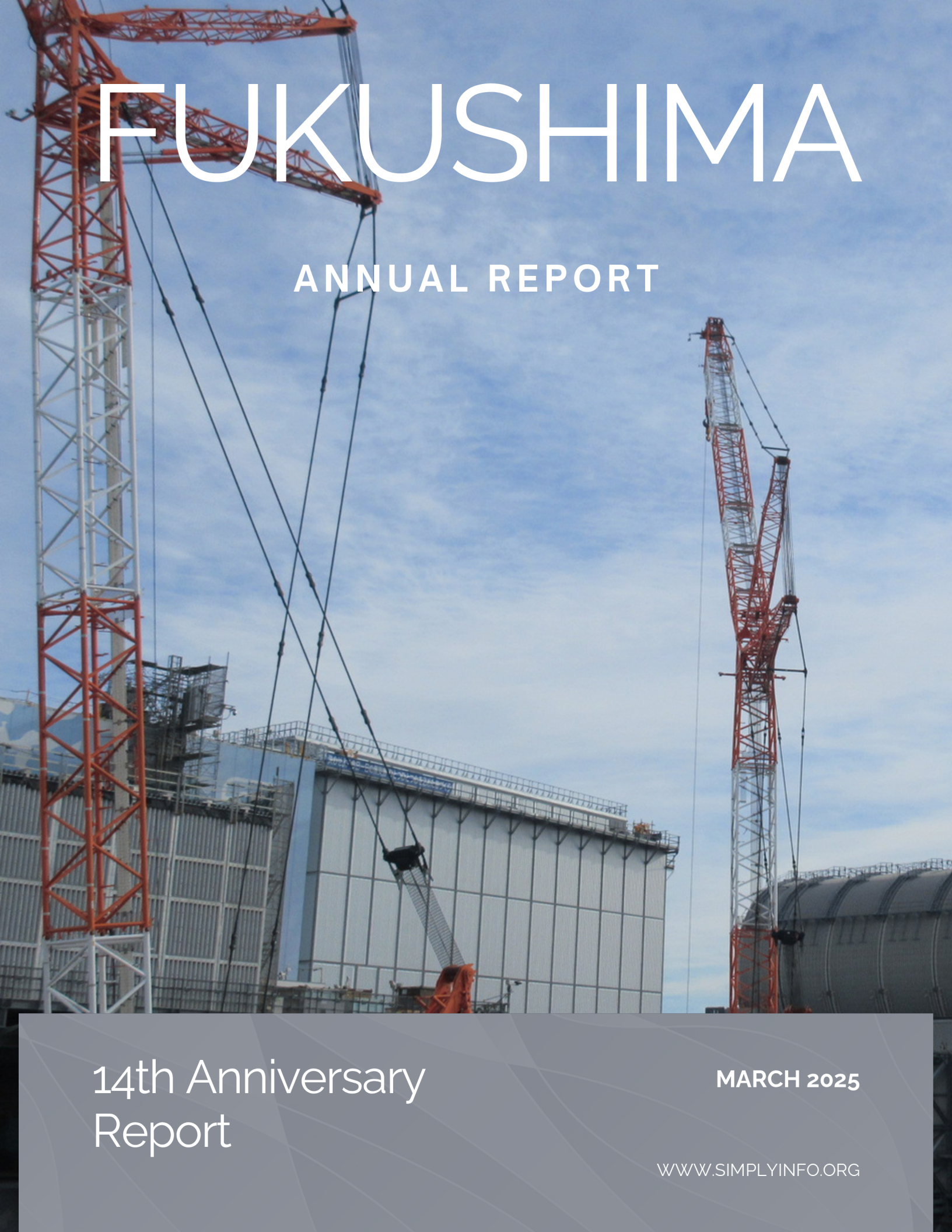


FUKUSHIMA

ANNUAL REPORT

14th Anniversary Report

MARCH 2025

WWW.SIMPLYINFO.ORG

Table of Contents

Introduction

The disaster at Fukushima Daiichi has stretched on for 14 years.
Things change in small increments while many aspects of the disaster
become more permanent over time.

This year's report is smaller than that of many previous years.
This reflects the scope of the work at the plant that has focused
on fewer major activities.

There is still much important work to do at Daiichi and much left to learn.

The SimplyInfo
Research Team

At Daiichi

Contaminated Water

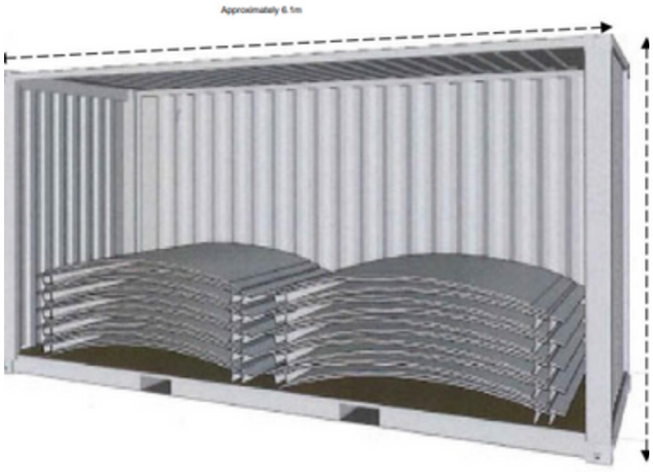
The 2025 plan for releasing contaminated water after it is processed through the ALPS treatment system is to conduct 7 releases throughout the year totaling 54,600 m3 of contaminated water. That water will contain 15 trillion becquerels, this is assumed to only be tritium as that is the only isotope TEPCO regularly tracks for the water they release to the Pacific Ocean.

TEPCO plans to reduce the water levels in containment and the suppression chamber of units 1 and 3 in 2025. This will add some heavily contaminated water to the contaminated water storage and treatment system. The water volume and tritium measurements for each of the units are as follows.

Unit 1: approx. 20 million becquerels/liter, approx. 4,800 m3
Unit 3: approx. 10 million becquerels/liter, approx. 6,600 m3
This does not include contamination from other isotopes.

Work at the contaminated water tank farms is ongoing. Some notable maintenance has taken place this year/

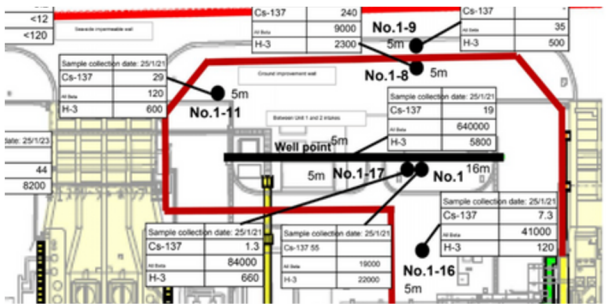
The J8 and J9 tank farms at Fukushima Daiichi are being disassembled. These newer welded tanks are being cut apart and the pieces loaded into storage boxes. The storage boxes will be located in a temporary storage area north of units 5 and 6.



<Image of storage in a 20-foot full-height container>

No mention of what will happen to these dismantled tanks long term. Tank farms J8 and J9 are being cleared to be used as storage space for “fuel debris retrieval facilities” for unit 3. Bolt together tanks in the E tank farm are also being dismantled for a similar facility for unit 2. TEPCO noted that the J8 and J9 tank farms were no longer needed now that they are releasing contaminated water into the ocean.

Work to periodically inspect and repair the remaining tanks on site is in progress. TEPCO aims to drain, inspect and repair tanks once a year to try to prevent corrosion from causing tank leaks.



Contaminated groundwater between the unit 1 and unit 2 water intakes near the sea front remains persistently high all these years after the initial disaster. The location of the highest concentrations was the highest when readings began in 2011, and is still problematically high. Soon after the initial disaster, workers scrambled to plug cable holes that were leaking highly radioactive water in this area. A specific source of this water was never disclosed.

Tepco file photo unit 1. Image Credit TEPCO

Unit 1

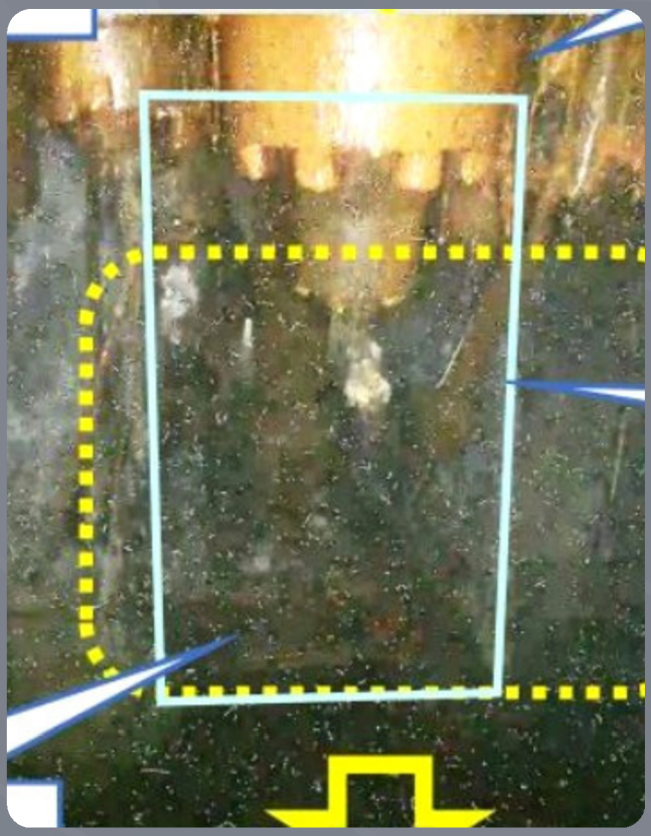
In 2025 “atmospheric” surveys are planned in the containment vessel. Some of those were already underway in 2024 with a scope used to gather data on temperature, radiation and imagery to confirm visibility inside containment.

In late March of 2024 TEPCO used a snake robot and a drone to capture some imagery of the interior of the upper section of the pedestal. This area is closer to the bottom of the reactor than previous surveys that were at the base of the pedestal.

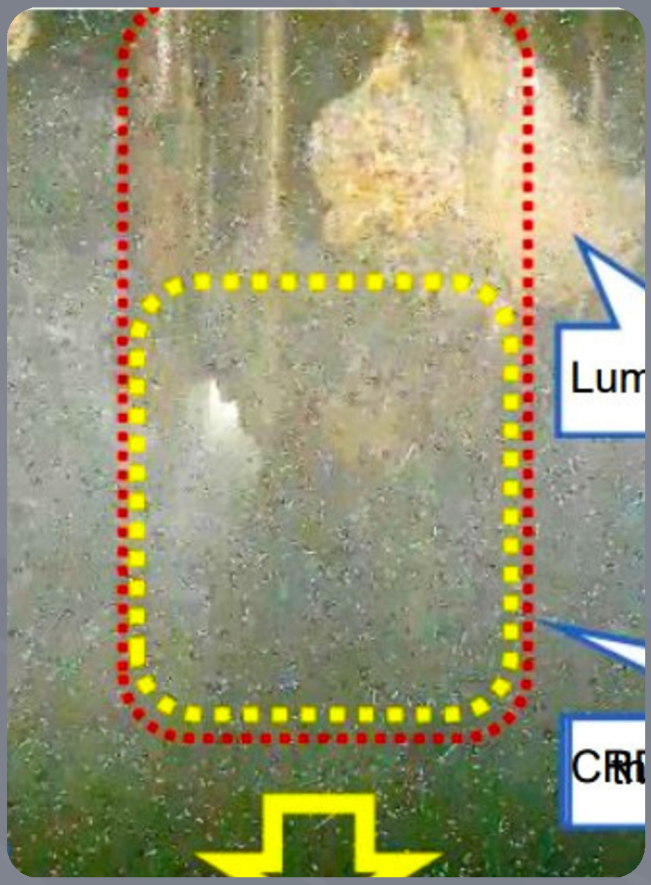
Among the findings were control rod drive units that operate the introduction and withdrawal of control rods into the reactor vessel. At least one of these pieces of equipment was found warped and hanging upside down.

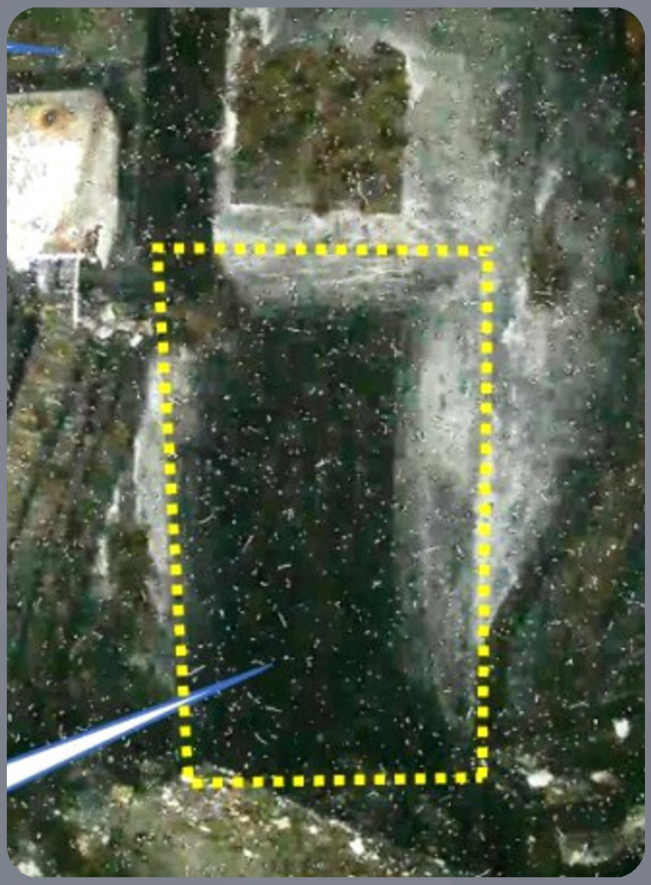
A cluster of TIPs probes were found heavily damaged and melted where they would have routed into the reactor vessel above.

This damage indicates a significant failure of the bottom head of the reactor, something that could be assumed by the fuel debris and damage found at the bottom of the pedestal but further confirmed by these findings.



Enhanced images from inside unit 1 include the underside of control rod drives, the control rod drive opening in the upper pedestal and a lumpy object, likely fuel debris. Images clockwise



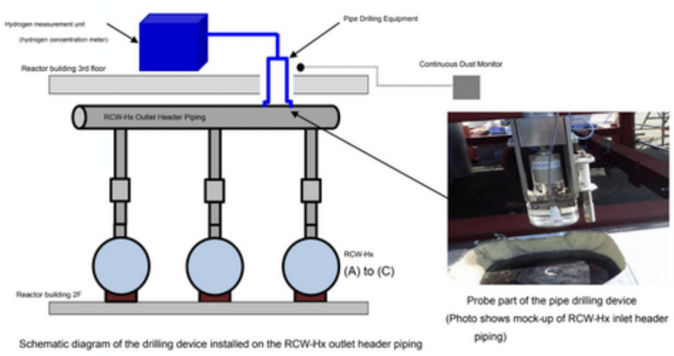


Preparation work towards purging gas from the reactor cooling water heat exchanger took place over the last year. The actual work is scheduled for late February 2025. This system has unusually high radiation levels and is suspected of containing fuel debris from the pedestal sump in the water contained in the pipes. In some areas the system is giving off over 1 Sievert of radiation from the vicinity of the pipe. The inlet header pipe was identified as having a hydrogen concentration around 72%. The gas also contains hydrogen sulfide and Kr-85. A remote rig will be used to cut a hole in the pipe and attach equipment to purge the hydrogen. The hydrogen will be combined with nitrogen to keep the concentration below 4% before releasing via an exhaust pipe on the 4th floor.

Work to install the new cover over unit 1 has been in progress. It is assumed TEPCO plans to have this completed by the end of 2026. Their current roadmap shows removing spent fuel at unit 1 is expected to start in 2027. The completion date is set as 2031, an unusually long time frame compared to spent fuel removal at units 3 and 4. All of this is dependent on completion of the removal of the Standby Gas Treatment System (SGTS) piping between units 1 and 2. Work there is complicated by the lethal levels of radiation at the vent tower base.

Efforts to reduce the water level in the suppression chamber torus tube were conducted in late 2024. The work slightly reduced the water level to reduce seismic risk. As they did this work they noticed that the water level change didn't influence cooling or water levels in containment. They did notice an increase of water in the triangle corner rooms as they reduced the water inside the suppression chamber. They assumed it had some relationship to water pumps in the triangle room that use the suppression chamber as their water source. This water was pumped back into the reactor building basement. Sampling and inspections inside the torus tube are scheduled for 2026.

TEPCO installed a pair of seismometers on the first floor of unit 1 and the 5th floor level. The latter being a temporary installation while they complete clean up work in anticipation of the new cover building. They noted that they want to monitor the soundness of the reactor buildings until fuel and fuel debris removal work is completed. TEPCO cited the soundness of the Unit 1 pedestal as a driving factor for installing the temporary monitor on the 5th floor. We documented last year in our annual report that the base of the reactor pedestal inside unit 1 is essentially gone, with some rebar framework remaining in places. This finding has caused serious concern among researchers, the government and TEPCO that this could lead to a catastrophic event inside unit 1 in the future.



Reactor Cooling Water Heat Exchanger

Seismometers at unit 1

Tepco file photo unit 2. Image Credit TEPCO

Unit 2

In September of 2024, the first fuel debris was retrieved and loaded into a transport container to take for laboratory analysis.

Once the sample was retrieved from containment, it was moved to a glove box unit stationed inside unit 2. Some initial data and readings were gathered before moving the sample into a shielded transport box.

Once the sample was loaded into the specialized transport container and strapped to a flatbed truck it was taken to the JAEA Oarai lab. This work was considered completed by October of 2024.

Fuel debris transport container. Image Credit TEPCO

Images from the fuel debris sample removal work at unit 2. (clockwise)

Workers operating the fuel removal rig at the X6 containment opening.

The X6 containment opening while the fuel removal rig was in use

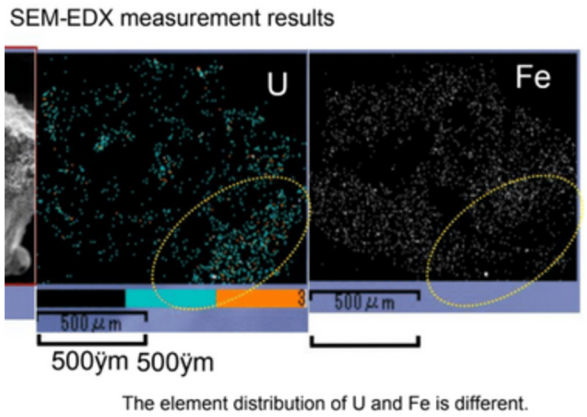
Packing the obtained fuel debris sample in the inner transport container before placement in the transport container

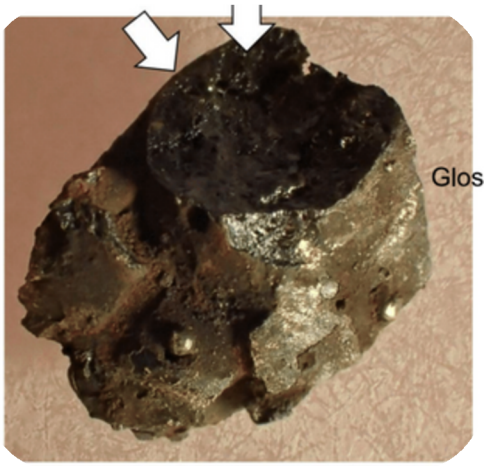
Image credit TEPCO

JAEA released a report on their analysis of the fuel debris sample. They found it to be uneven with voids widely distributed inside and the presence of fuel materials like uranium among other things found in the sample. The sample was collected from the edge of the debris pile inside unit 2's pedestal. This may provide clues to the meltdown progression during the disaster.

The debris sample itself was quite small being only 9mm x 7mm. SEM and WDX analysis were performed. Analysis found uranium, nickel, iron and zirconium in the sample indicating the presence of destroyed nuclear fuel rods. The combination of substances found are assumed to be fuel rods, reactor structural materials and minerals from sea water.
A piece was chipped off of the sample and was able to be crushed with a steel rod for further analysis that will take place over the next six to twelve months. The interior of the fuel debris piece was examined after the chunk was chipped off. The interior is black with small shiny particles. The tests confirmed that the uranium and iron are well distributed in tiny particles within the sample. This seems to indicate that the materials were vaporized before solidifying.

For unit 2's fuel debris removal plan, most of 2025 is scheduled for design and planning. This includes building the fuel debris removal equipment, designing safety systems, and the design and construction of a fuel debris storage facility.

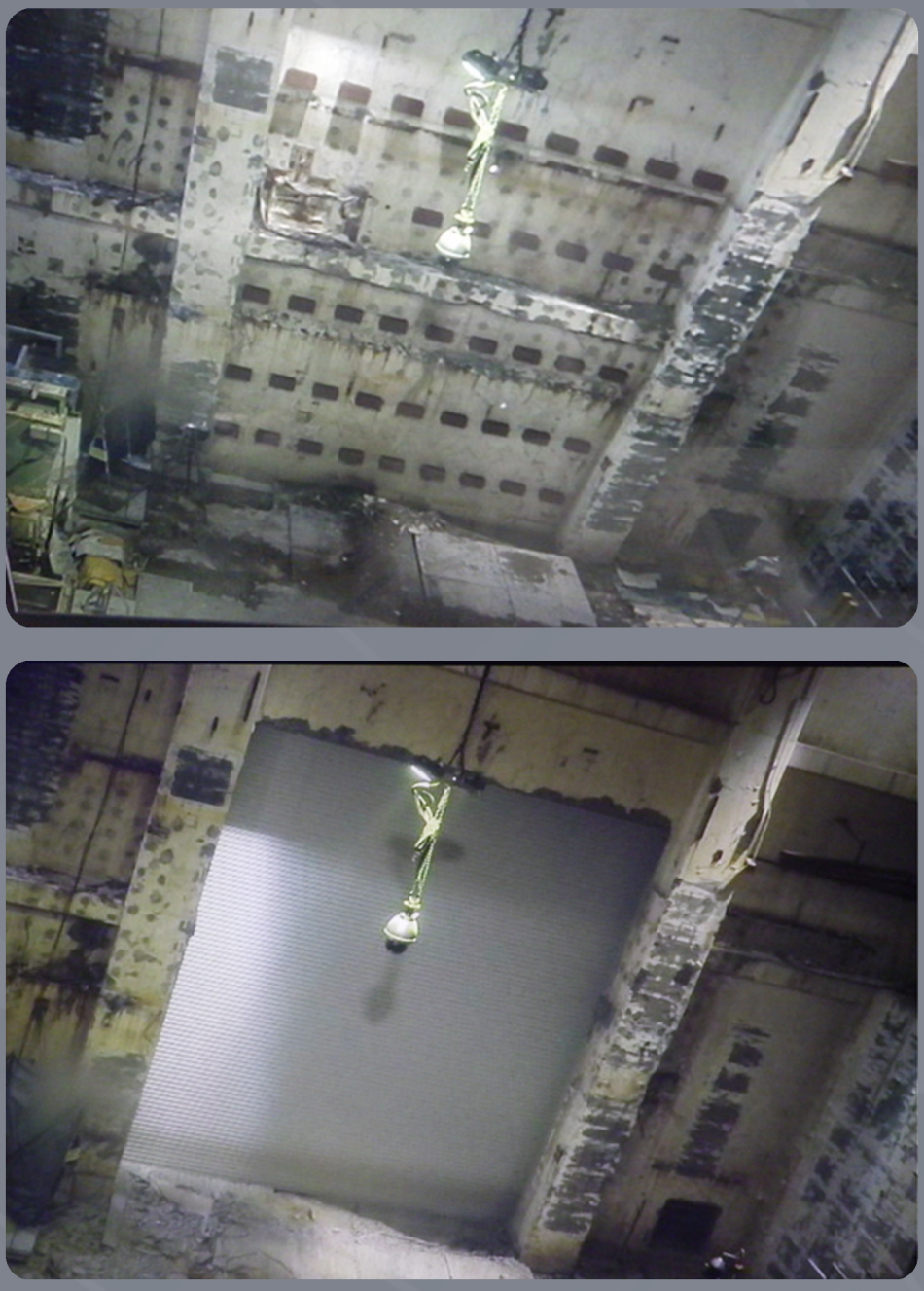




Images top to bottom:
Retrieval of fuel sample from unit 2 pedestal
SEM EDX scan of uranium and iron in the fuel sample
Fuel sample before breaking
Fuel sample after chipping a piece off with a metal rod
All images credit TEPCO

A pipe for the spent fuel pool heat exchanger was found to be leaking in October. TEPCO said it planned to repair the pipe, no further communication about its repair was found. In November 2024, work was underway to cut a doorway in the concrete wall of the refueling floor level to aid access for removing spent fuel. The final work included a steel overhead door to close the opening.

Spent fuel removal at unit 2 is expected to start in late 2025 and run through 2026, but may take longer. TEPCO installed a pair of seismometers on the 1st and 5th floors of unit 2. These were installed to track building integrity over time while fuel and fuel debris removal work takes place.



Images above, unit 2 refueling floor exterior wall before and after cutting to install an overhead door. Image credit - TEPCO

Unit 3

Work towards eventual fuel debris removal at unit 3 includes research into potential access routes and improving the environment in the building to allow work inside. As with units 1 and 2, TEPCO installed a 3. These were installed to track building integrity over time while fuel and fuel debris removal work takes place.
Unit 3 has jumped the line for fuel debris removal. TEPCO mentioned in an interview that the work at unit 2 to understand the fuel debris situation will help inform removal methods to use at unit 3 first. Previously unit 2 had been the candidate for both research and first removal.
TEPCO began scavenging hydrogen trapped in the torus tube back in 2023. They have been routing these hydrogen purges to the containment vessel with the assumption that the nitrogen pumped into containment is sufficient to keep the hydrogen concentrations low enough to not be an ignition risk. In October the amount of remaining hydrogen was low enough that it would not purge by pressure alone, TEPCO began the process to install extraction pumps to move the remaining hydrogen out of the torus tube.

Inspections took place in 2023 to identify radiation levels inside the unit 3 – 4 vent stack. Levels were confirmed to be about 0.165 to 0.352 mSv/h. These levels are quite low by comparison to other locations around the reactor buildings and the unit 1 – 2 vent stack.

Unit 4

The removal of high radiation equipment from the spent fuel pool of unit 4 is expected to take place in 2025 and run through 2030 with an eventual plan to drain the spent fuel pool.

Units 5 & 6

An electrical panel fire in unit 6 in June caused the automatic diesel back up generator to kick in. A purification pump for the spent fuel pool also tripped. Unit 6's spent fuel pool holds a large amount of spent fuel from both unit 4 and unit 6's spent fuel.

Removal of the spent fuel from unit 5 is expected to start in 2025 and run through 2030.

General Plant

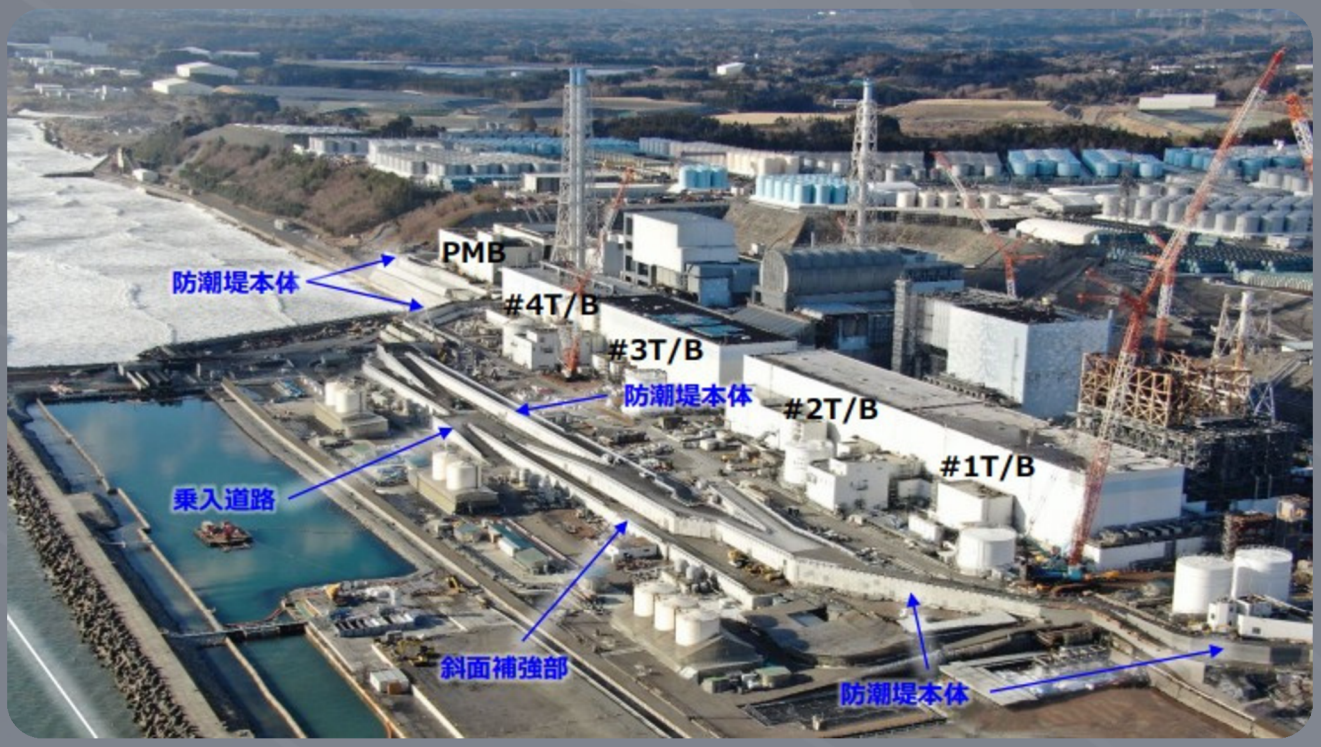
Ongoing work to purchase more spent fuel casks and build a new site bunker building for high level spent fuel storage is underway. Cask production is expected to be completed around 2026 with the new building slated for completion some time around 2030. There is also a plan to build a dry cask storage facility to house all of the spent fuel currently in the common pool. That facility is expected to be ready for use by 2035.

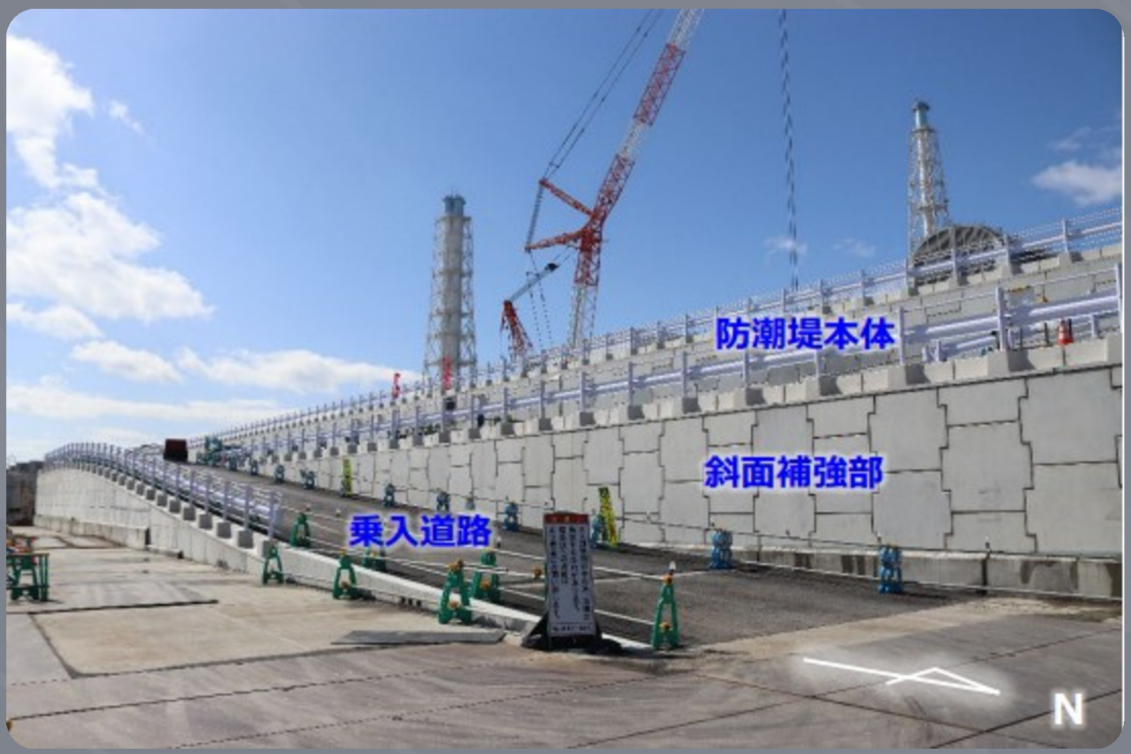
A sea wall was completed in 2024, replacing the temporary sea wall that had been hastily installed in 2011. This new wall of concrete looks similar to sea wall structures installed in communities near the coast in Japan.

Workers

A worker was injured in the basement of the turbine building for unit 5 in December. He hit his head and sustained a concussion and spinal cord injury.

TEPCO claimed the worker wasn't working at the time and provided no other details of the incident. No other significant worker injuries or incidents were reported this year.





Images above: New sea wall at Fukushima Daiichi installed in 2024
Image credit - TEPCO

Environment & Heath

Citizen scientists have had to take it upon themselves to collect data and build maps to identify radioactive hot spots in their communities. In Odaka, ten miles from the Daiichi disaster site, a group of citizens have had to map their own community to help people avoid radioactive hot spots.

In towns like Tsushima, the radiation levels are still so high that people can't return. Only five people have returned to Tsushima so far.
As part of the citizen testing done by Mother's Radiation Lab, they found many soil samples still in the hundreds of bq/kg of Cesium 137 contamination. Some lichen samples were even higher. One such sample from Minamisoma, Fukushima registered at 9820.5 bq/kg of Cesium 137. A wood ash sample from Iwaki City, Fukushima had 1961.5 bq/kg of Cesium 137.

While some environmental levels go down, microparticles of radioactive contamination remain a significant threat. These are high in radiation, insoluble so they are difficult to expel out of the body, and small enough to inhale. The Bulletin of Atomic Scientists published an in-depth article of the scientific findings around cesium bearing microparticles that fell on Tokyo on March 14th and 15th in 2011 after unit 3 exploded.

The additional analysis of the air filter samples collected confirmed that small micron insoluble highly radioactive microparticles fell on Tokyo. The article dives into the years-long battle between researchers, institutions, and government entities in Japan to try to prevent the research findings from being made public.

Image right: black deposit of cesium bearing microparticles on pavement in Tokyo, identified April 2012

The results of the studies confirm that Tokyo did experience this microparticle containing fallout. This helps explain high environmental radiation levels found by residents on those days that were dismissed by the government as being lies or hysteria. The same goes for Tokyo residents who experienced radiation-related illness symptoms. Knowing that people in the area could have inhaled these highly radioactive microparticles, leading to them experiencing higher exposures than were originally assumed explains the divide between people's reports and the official government narrative.

It is also worth noting that Tokyo residents found these "black sand" deposits in Tokyo days and weeks after the fallout event, noting that they were highly radioactive and suspicious, only to be dismissed by officials.

The new understanding from the meltdowns at Daiichi, differs from previous large reactor disasters like Three Mile Island and Chernobyl due to the failure events. Daiichi is the first large-scale nuclear disaster where reactors went into a full meltdown, breached the reactor vessel and burned into the concrete, releasing these volatized particles via hydrogen explosions. These newly understood forms of fallout have significant implications on the understanding and ongoing risk from the disaster and also raise new concerns about the risk of future similar nuclear disasters. The current state of risk analysis, assumed health and environmental implications have not changed to account for this new knowledge.

Food

China agreed in September to end their ban on Japanese seafood and gradually begin importing products again. In early 2024 China had demanded that Japan create a compensation system due to dumping contaminated water into the Pacific. Other countries stayed the course with restrictions they already had in place previously.

Monitoring food products in Japan still largely falls to citizen groups doing their own testing. This citizen run lab in Iwaki is one of the largest. What started with a few machines has turned into a large permanent laboratory with 13 staff. Mother's Radiation Lab has become a key piece of independent oversight on food and environmental contamination.

As TEPCO has begun dumping contaminated water into the ocean, the group has obtained boats to also conduct water sampling.

Mother's Radiation Lab continues to test food and environmental samples for radiation. Most of the produce and fish tested over the last year was below detection.

This is a notable improvement over previous years and shows that many food products have improved as contamination migrates away from farm fields or sinks deeper into the soil.

There were still some notable food products that showed with levels of contamination above the government threshold of 100 bq/kg. Some of those included:

- Shiitake mushrooms that were bed cultivated from Iwaki, Fukushima registered at 39.8 bq/kg of Cesium 137.
- Tsurutake mushrooms from Tamura City, Fukushima registered with 2787.3 bq/kg of Cesium 137.
- Bakamatsutake mushrooms from Iwaki City, Fukushima registered with 6416.9 bq/kg of Cesium 137.
- Red Mushrooms from Iwaki City, Fukushima registered with 806.9 bq/kg of Cesium 137.
- Some low levels of contamination were found in milk samples from Fukushima and Miyagi prefectures.

Finding high levels of Cesium 137 in mushrooms is an expected finding. Wild mushrooms in regions where contamination fell after Chernobyl still test with high unsafe levels of contamination decades after that disaster. The growing conditions for these mushrooms in Fukushima were not noted, but all were purchased, not foraged, making it more likely these were commercially cultivated mushrooms. Seeing levels that high in commercial products that should have less ability to be highly contaminated is a concerning trend.

Meanwhile other mushrooms showed with no detectable levels or were significantly lower in contamination, including some wild cultivated varieties. This year's food testing didn't include some other items expected to stay persistently high in contamination like boar, deer, wild berries and wild forest vegetables like bamboo shoots.

A translated spreadsheet of the testing from Mother's Radiation Lab was compiled, translated and can be found here.

Social & Political

The former chairman of TEPCO Katsumata Tsunehisa died in 2024. He took over in the early 2000s when the current TEPCO executives all resigned over a previous nuclear reactor deficiencies scandal. He was also among the TEPCO executives that have been tried in civil and criminal court for their roles in the Fukushima disaster.

In early March of 2025, Japan's top court dismissed an appeal to charge those TEPCO executives with negligence for their roles in the disaster at Fukushima Daiichi, including ignoring safety risks and the risk of tsunamis hitting the plant.

The restart of the unit 2 reactor at Onagawa Nuclear Power Plant, north of Fukushima Daiichi was suspended in November of 2024 after a neutron detector malfunctioned. This nuclear plant on the pacific coast survived the 2011 tsunami due to having the reactors and critical systems located on a hill above the ocean.

Outside of Japan, geopolitical tensions haven't spared Japan. It was discovered that Russia has plans to attack the nuclear reactor and research facility at Tokai in Japan if war with NATO were to break out. This facility includes nuclear fuel production, nuclear research activities, research reactors and the Tokai Nuclear Power Plant. Both power reactors at Tokai have been offline since the 2011 earthquake.

In the evacuation zones in Fukushima, a few who stayed behind continue to take care of the animals abandoned during the disaster. Some animals are elderly, others, the offspring of the original animals left behind. Toru Akama, currently lives in Namie, having turned his home and his family's nearby home into a long-term animal shelter.

In Tomioka, Naoto Matsumura continues to take care of the remaining cattle and pets left behind. A few elderly residents have returned. NHK follows what life is like for those that returned to the area. One thing that has changed, much of Tomioka's farm fields are now covered with solar panels.

Image above: Solar panels installed on farm fields in Tomioka, Fukushima Prefecture
Image credit - Saki Kobayashi

Conclusion

The path forward looks bleak. The first bits of melted fuel were pulled out of unit 2, 13 years after the initial accident. That debris was about 0.7 grams. The amount of fuel debris contained within units 1 – 3 is estimated to be 880 tons.

TEPCO still hopes to have the decommissioning done by 2051, 40 years after the disaster. Academic estimates put that removal effort at 68 to 170 years. Current estimates conclude it would take 300 years for the site to be sufficiently cleaned, and returned to public use.

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