

*Fukushima-is-still-news*

- vol. 2 -

# **Daiichi Nuclear Plant 2015-2019**



**Odile Girard**



### Référence bibliographique

Odile GIRARD, *Daiichi Nuclear Plant, 2015-2019*, Collection Fukushima-is-still-news, vol. 2, Éditions de Fukushima, 2022, 472 p.

*E-book édité par Les Éditions de Fukushima – <http://www.editionsdefukushima.fr/>*

*ISBN : 978-2-9554247-8-0*

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# INTRODUCTION

J'ai « découvert » l'écologie au début des années 70, croisant dans le même temps la pollution, les luttes paysannes et la malbouffe, la médecine qui avait (déjà) perdu son âme, les mouvements sociaux et bien sûr le nucléaire qui a occupé une grande partie de ma vie.

Après la catastrophe de mars 2011 au Japon, j'ai suivi chaque jour une partie des grands journaux japonais anglophones pour essayer de sauvegarder un maximum d'articles ayant trait à Fukushima. L'idée était de conserver une sorte d'archive accessible à tous, qu'ils soient écrivains, journalistes ou tout simplement intéressés.

Le blog « [Fukushima-is-still-news](#) » a été poursuivi jusqu'en 2019. Ci-dessous la conclusion parue le jour où j'ai décidé d'arrêter mon blog.

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## **End of March 2019: Time to stop this blog**

29 Mars 2019

Rédigé par fukushima-is-still-news et publié depuis Overblog

### **End of March 2019: Time to stop this blog**

I have been collecting and spreading information on the Fukushima disaster for more than 8 years.

More than ever I am convinced that the name of my blog « Fukushima-is-still-news » was aptly chosen. Or perhaps i should have called it « Fukushima should still be news ». What i'm getting at is that i know the disaster is going on and we cannot simply forget Fukushima and turn the page. But the mode of action I chose 8 years ago has its limits and it is time for me to stop this blog.

I don't want the contents to be lost, so I will try and publish the lot with the Éditions de Fukushima so that the information remains available online.

Good bye for now. I am not doing a disappearing act. I'm still there tracking what's going on in the world of nukes.

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C'est maintenant chose faite. Le blog fukushima-is-still-news est désormais disponible aux Éditions de Fukushima. Une fois de plus merci à mon ami Pierre, qui m'a convaincue à l'époque de tenir ce blog et m'a aidée à le lancer.

Le présent volume est le deuxième d'une collection de 16 ouvrages qui seront édités petit à petit.

Vol. 1 : Daiichi Nuclear Plant (1)

Vol. 2 : Daiichi Nuclear Plant (2)

Vol. 3 : Radioactive Fallout And Waste  
No.4 Fuel Removal  
Nuclear Workers  
UN Conference

Vol. 4 : Nuke Safety (1)

Vol. 5 : Nuke Safety (2)

Vol. 6 : Reprocessing  
Storage Nuclear Waste  
Decommissioning

Vol. 7 : Practical Problems For The Japanese Population (1)

Vol. 8 : Practical Problems For The Japanese Population (2)

Vol. 9 : Practical Problems For The Japanese Population (3)

Vol. 10 : Health Effects Of Radiation  
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Vol. 11 : Anti-Nuclear Activity-Opinion

Vol. 12 : Vested Interests - Transparency - Corruption (1)

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January 19, 2015

## TEPCO's water woes

### TEPCO racing against time to process 280,000 tons of tainted water at Fukushima plant

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201501190050>



Shunichi Tanaka, chairman of the Nuclear Regulation Authority, inspects an area lined with tanks holding highly radioactive water at the Fukushima No. 1 nuclear power plant in December. (Asahi Shimbun file photo)

By TSUYOSHI NAGANO/ Staff Writer

Tokyo Electric Power Co. will likely fall short of fulfilling its pledge to process all highly radioactive water stored at the crippled Fukushima No. 1 nuclear plant by the end of March.

Another key TEPCO deadline in March is also on shaky ground because of technical failures and other issues at the site.

Contaminated water has been a persistent problem since the Great East Japan Earthquake and tsunami on March 11, 2011, triggered the triple meltdown at the plant. Every day, tons of groundwater becomes highly radioactive after seeping into the basements of the reactor buildings where melted nuclear fuel remains.

When Prime Minister Shinzo Abe visited the Fukushima site in September 2013, TEPCO promised to process all of the tainted water by the end of March this year to eliminate the possibility of radioactive water leaking into the surrounding sea.

**On Jan. 15, 280,000 tons of radioactive water remained in storage tanks on the plant's premises.**

In spring 2013, TEPCO began running the multi-nuclide removal equipment called ALPS (advanced liquid processing system) to accelerate processing of the contaminated water. But several malfunctions in the system have prevented TEPCO from proceeding with its originally planned operations.

The company introduced additional ALPS systems last autumn to treat up to 1,960 tons of radioactive water a day. The maximum processing capability was still insufficient to complete procedures by the end of March 2015, so TEPCO later in autumn introduced equipment that only removes strontium, which accounts for a large portion of all radioactive substances in the water.

**TEPCO has since been working to meet the target date by regarding strontium-free water as being "processed," even if other radioactive substances remain.**

The utility has argued that it will be able to process all of the contaminated water at the Fukushima No. 1 plant by the end of March by using the strontium-removal systems.

Under its latest plan, **TEPCO will eliminate strontium from 1,800 tons of water daily with the help of an extra strontium-removal device that began operations on Jan. 10. Two additional strontium-removal systems are scheduled to be started by the end of this month to achieve that figure.**

The utility intends to complete the tainted water purifying procedure as scheduled by simultaneously operating the ALPS systems at full capacity.

But even if TEPCO had started using both ALPS systems and the strontium-removal equipment to the full on Jan. 16, it would still not be easy for TEPCO to process all 280,000 tons of tainted water by the end of March, according to calculations.

In fact, the newly introduced ALPS equipment has also experienced a number of problems.

**As of Jan. 18, both ALPS systems and the strontium-removal equipment had yet to start full operations.**

TEPCO is under no legal obligation to keep its promise with Abe.

Although tons of radioactive water will likely remain at the site after the deadline, the water-purifying process will help to reduce radiation exposure of employees working around the storage tanks.

The Nuclear Regulation Authority in February last year ordered TEPCO to lower radiation levels derived from tanks storing contaminated water to below 1 millisievert by the end of March 2015.

**Even after the highly contaminated water is processed, low-level radioactive water would remain on the premises.**

And the problem of highly radioactive water generated every day at the plant will continue unless TEPCO's plans to deal with the issue bear fruit.

The company has set another March deadline in resolving the problem of accumulated contaminated water at the Fukushima No. 1 plant.

The utility is proceeding with work to create an underground frozen wall of soil to divert clean groundwater away from the reactor buildings toward the ocean.

TEPCO aims to start freezing the soil around reactor buildings by March. But preparations have yet to be completed at some locations because of delays in the work schedule.

January 22, 2015

## NRA gives green light to TEPCO



Groundwater is pumped up in areas around reactor buildings of the Fukushima No. 1 nuclear power plant in Okuma, Fukushima Prefecture, on Aug. 26, 2013. (Pool)

## NRA signs off on TEPCO plan to release decontaminated groundwater into sea

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201501220054>

Japan's nuclear watchdog gave the green light to the operator of the wrecked Fukushima nuclear power plant to discharge pumped up groundwater into the sea if radioactive substances in the water are within safety standards.

The Jan. 21 decision by the Nuclear Regulation Authority concerns groundwater from 41 wells, called subdrains, close to the No. 1 to No. 4 reactor buildings at the Fukushima No. 1 plant.

Operator Tokyo Electric Power Co. will be obliged to remove radioactive substances in the groundwater at its decontamination facilities.

The water must meet certain criteria before it is released into the sea.

The conditions per liter of water are: that radioactive cesium is less than 1 becquerel; radioactive substances that emit beta rays are less than 3 becquerels; and the level of tritium is less than 1,500 becquerels.

Although TEPCO does not have the means to remove tritium at its decontamination facilities, the levels of contamination must be within safety limits.

The NRA said the volume of groundwater that flows into the reactor buildings will be reduced by one-half. However, it remains unclear if the plan will be implemented as TEPCO is keen to get the approval of local residents, many of whom depend on fishing for their livelihoods.

The utility has been holding meetings with local fishery cooperatives since the summer to explain what it involved. Some members of the cooperatives seemed receptive to the plan, but others were not.

January 23, 2015

## TEPCO can't meet March (water decontamination) target

### TEPCO delays timetable for water treatment

[http://www3.nhk.or.jp/nhkworld/english/news/20150123\\_29.html](http://www3.nhk.or.jp/nhkworld/english/news/20150123_29.html)

Tokyo Electric Power Company says it will not finish decontaminating water at the Fukushima Daiichi nuclear plant by the end of March as promised.

The firm's President Naomi Hirose reported the delay to the head of the Agency for Natural Resources and Energy, Takayuki Ueda, on Friday.

Hirose said he's very sorry that the firm cannot treat the water as planned. He added that **the matter makes residents very anxious.**

Ueda said the delay is deplorable because the firm's president promised Prime Minister Shinzo Abe to carry out the treatment on time.

The amount of contaminated water stored at the plant increases by 350 tons a day, as more underground water leaks into reactor buildings.

The firm had promised the government that it would remove from the water radioactive substances such as strontium and cesium. But the plant's water treatment system has shut down repeatedly due to operational problems. The company says it will decide on a new timetable for the treatment by mid-March.

### TEPCO to miss March target for Fukushima toxic water cleanup

<http://mainichi.jp/english/english/newsselect/news/20150123p2g00m0dm078000c.html>

TOKYO (Kyodo) -- Tokyo Electric Power Co. said Friday it will fail to fulfill its commitment to process by the end of March all highly radioactive water stored at the crippled Fukushima Daiichi nuclear plant due mainly to equipment troubles, causing further delay in the decommissioning process.

Currently, some 280,000 tons of water needing treatment is stored in tanks, while around 350 tons of toxic water is newly generated every day in the process of cooling reactors that suffered meltdowns in the 2011 earthquake-tsunami disaster.

When Prime Minister Shinzo Abe visited the plant in September 2013, TEPCO President Naomi Hirose pledged that the company would filter all the water kept in tanks by March 31, 2015 to drastically reduce the amount of radioactive materials it contains, but the process has been delayed due to a series of problems with its key water treatment facilities.

Hirose on Friday met with Takayuki Ueda, commissioner of the Agency for Natural Resources and Energy, and said the company now expects to finish treating the water by the end of May at the latest, but will try to complete the cleanup as soon as possible.

"We took the promise with the prime minister very seriously but we cannot fulfill our commitment. The problem of toxic water is the biggest source of concern for the local residents and we are extremely sorry to be unable to keep our word," Hirose said during the meeting.

The water treatment system, which is called the Advanced Liquid Processing System or ALPS, is said to be capable of removing 62 types of radioactive materials except tritium. TEPCO has introduced three such facilities, including one with enhanced performance, but all of them are still running on a test basis.

The buildup of toxic water has proven to be a major challenge facing workers engaged in the plant decommissioning work, while it has been a source of concern with regard to the further spread of pollution. In August 2013, TEPCO said some 300 tons of tainted water leaked from the tanks, followed by leakage of some 100 tons in February last year.

The delay in the plan also comes as TEPCO has halted all decommissioning work at the Fukushima Daiichi complex since Wednesday after two workers died on Tuesday in separate accidents at the Daiichi site and the nearby Daini plant.

## Wastewater disposal, the awesome task

### Treating wastewater making slow progress

[http://www3.nhk.or.jp/nhkworld/english/news/20150123\\_30.html](http://www3.nhk.or.jp/nhkworld/english/news/20150123_30.html)

The amount of highly radioactive water at the plant increases by about 350 tons per day. The water mostly flows in from nearby mountains, and is pumped up and stored in tanks.

As of January 15th, around 280,000 tons were stored in 1,000 tanks. The plant has little room for more.

In August 2013, about 300 tons of contaminated water leaked from one of the tanks. The firm later made the promise to treat the water by March.

But the main water processing system, called ALPS, stopped operating many times due to trouble. The company remodeled it and installed another system that only removes strontium from the water.

The firm considers water processed when strontium is removed.

But even this less ambitious goal required the operator to treat 4,000 tons of water per day to meet the deadline.

Processed water still contains radioactive substances and must be stored in tanks.

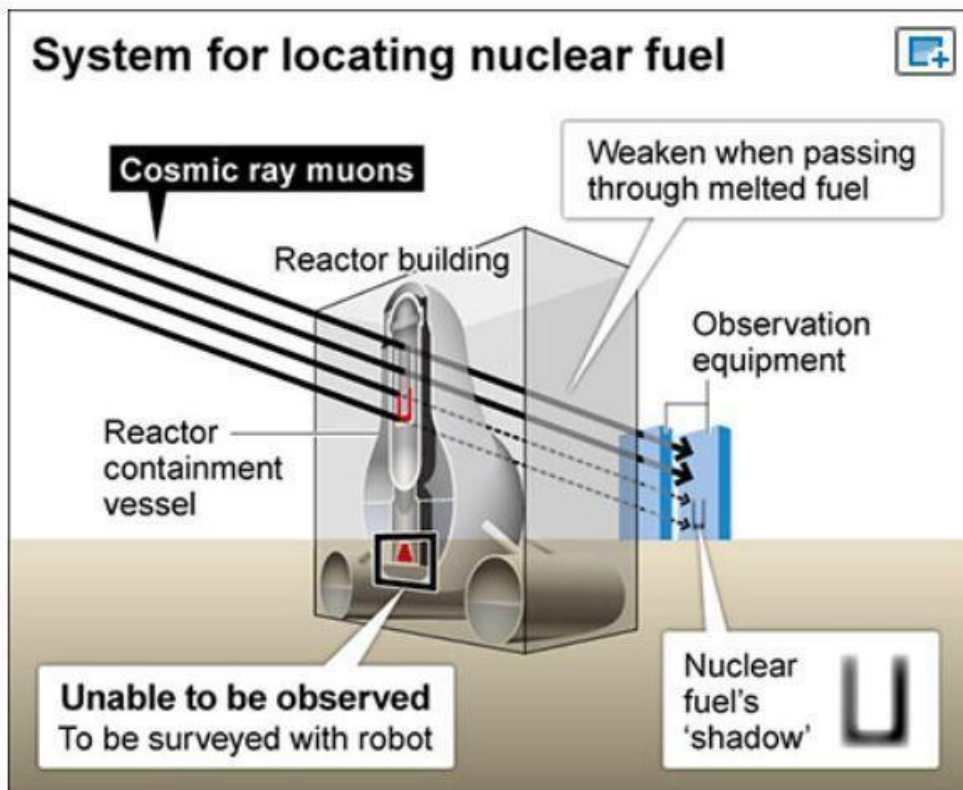
The firm has not decided how to dispose of the water

January 24, 2015

## First try to get an idea of situation inside reactors

TEPCO to rely on cosmic beams to glimpse melted fuel inside Fukushima reactors

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201501240039>



The Asahi Shimbun

By TSUYOSHI NAGANO/ Staff Writer

Tokyo Electric Power Co. will use cosmic rays at the crippled reactors at its Fukushima plant to identify sites with melted fuel.

**TEPCO will install special equipment to observe muon beams, or particles generated when cosmic radial rays collide with the atmosphere.** That will enable it to glimpse inside the reactors, which went into triple meltdown after the March 2011 earthquake and tsunami disaster.

The exercise is intended to generate data that will be useful in deciding how to eventually remove the fuel.

Fuel extraction work will be the most difficult phase in decommissioning the beleaguered plant.

While the muons pass through concrete, iron and other construction materials, they become absorbed more easily in high-density materials such as uranium, thereby creating a "shadow." **Based on these shadows, TEPCO expects to be able to identify the location and shape of nuclear fuel.**

The industry ministry-backed plan will be led by the International Research Institute for Nuclear Decommissioning, an organization comprising TEPCO and atomic facility manufacturers.

**They will first study the No. 1 reactor building and compile results by the end of this fiscal year, estimating how much fuel remains in the reactor.**

While some experts argue that almost all of the fuel has melted and dropped to the base of the containment vessel at the No. 1 reactor, others say half of it probably remains in the reactor core.

**TEPCO and the central government intend to extract the melted fuel after surrounding it with water to block radiation. To do so, the plant operator will need to repair damaged sections of the containers to prevent water leaks.**

An industry ministry official said the survey "will provide important data for deciding how much water to inject into the containers."

However, as there are also limitations to the method, the study represents just the first step in ascertaining what is happening inside the stricken reactors.

For instance, nuclear fuel at the base of the container cannot be seen using the muon technique, because the particles are not coming from below the reactors. As the system's resolution is 30 centimeters to 50 cm, small compounds of fuel will also be undetectable.

**"Many unknown factors remain, such as what sort of obstacles are at play in the reactor buildings,"** said Fumihiko Takasaki, professor emeritus at the High Energy Accelerator Research Organization, which was involved in the development of the observation equipment. "We cannot know whether the efforts will eventually prove successful unless we actually try."

January 30, 2015

## Difficulties with contaminated water ungoing

### **Editorial: TEPCO must settle problems hampering water treatment at nuclear plant**

<http://mainichi.jp/english/english/perspectives/news/20150130p2a00m0na001000c.html>

Tokyo Electric Power Co. (TEPCO) has abandoned its goal of completing treatment of all radioactively contaminated water stored at its tsunami-ravaged Fukushima No. 1 Nuclear Power Plant by the end of



March this year. The decision once again demonstrates the difficulties of treating such highly contaminated water.

The utility made the decision as the Advanced Liquid Processing System (ALPS) that it installed at the plant to remove radioactive substances from the contaminated water is not functioning properly. The situation could affect the company's work to decommission and dismantle reactors at the power station. The government and TEPCO should identify problems relating to the treatment of tainted water and steadily press forward with the treatment of such water.

Numerous tanks to hold radioactive water have been constructed at the Fukushima plant, making it look like an oil storage station. The amount of contaminated water is increasing by about 300 to 400 metric tons a day, as ground water flowing beneath the plant's nuclear reactor buildings comes into contact with nuclear fuel that has melted into the ground. If TEPCO were to continue to store highly contaminated water in tanks, it would increase the risk of such water leaking. Since tainted water emits a large amount of radiation, workers struggling to bring the nuclear crisis under control could be exposed. TEPCO has treated radioactive water using the ALPS and other devices, but over 270,000 tons of water remains untreated.

TEPCO promised to finish treating radioactive water at the plant by the end of fiscal 2014, while Prime Minister Shinzo Abe declared during Japan's 2020 Olympic bid that the crisis at the Fukushima No. 1 plant "is under control." Since taxpayers' money has been used to introduce ALPS, Prime Minister Abe has stated that the national government will take the lead in efforts to treat contaminated water. As such, the government and the prime minister cannot evade responsibility for the delay.

ALPS can remove 62 types of radioactive materials, **excluding tritium**. However, since it employed a newly developed technology, there was no guarantee that it would function as expected. The government and the plant operator should reflect on their lack of foresight.

TEPCO intends to freeze soil around the atomic power station's four reactors by March to block ground water from flowing onto the premises of the reactor buildings. Since the attempt is the first of its kind in the world, many experts have raised doubts as to whether the system will function as designed.

The government and TEPCO are expected to review their road map toward decommissioning the reactors at the plant as early as March. They should take effective measures that reflect the lessons learned from past mistakes rather than getting caught up with abiding by a schedule.

The central government set up Japan's Nuclear Damage Compensation and Decommissioning Facilitation Corp. in August 2014 to increase state involvement in decommissioning the Fukushima No. 1 power plant. There are also other government organizations regulating nuclear plants, such as the Nuclear Regulation Authority. The government should clarify how it will supervise and instruct TEPCO, and state which organizations are responsible for what.

Fatal work-related accidents occurred at the Fukushima No. 1 and No. 2 nuclear plants this month, and work to bring the nuclear crisis under control has been suspended at the No. 1 power station to conduct an emergency inspection of safety measures.

Approximately 7,000 people work at the No. 1 plant a day. The figure is two times higher than two years ago because additional workers have been assigned to work to freeze soil around the plant's reactors. If further work-related accidents were to occur at the power station, it would obstruct efforts to decommission and dismantle the plant's reactors. **Top priority should be placed on the safety of workers.**

January 31, 2015

## TEPCO's safe and steady mantra

### EDITORIAL: Safe and steady needs to be TEPCO's mantra in Fukushima cleanup



Workers wipe water from a cask containing nuclear fuel that was removed from the No. 4 reactor at the Fukushima No. 1 nuclear power plant on Dec. 20. (Pool)

<http://ajw.asahi.com/article/views/editorial/AJ201501310041>

Come March, it will have been four years since the triple meltdown at the Fukushima No. 1 nuclear power plant triggered massive leaks of radioactive material.

Work to remove unspent nuclear fuel from a storage pool at the heavily damaged No. 4 reactor building was completed at the end of last year as planned. Efforts to clear debris, a major source of radiation, from the wrecked nuclear plant have also made progress. As a result, the areas where workers need to wear full-face protection masks have narrowed.

These facts seem to suggest that the Fukushima cleanup work is finally beginning to move smoothly forward.

However, Tokyo Electric Power Co., the operator of the plant, said last autumn that operations to remove spent and melted nuclear fuel from the No. 1 reactor will be delayed by two to five years from the original schedule. Earlier this month, the embattled electric utility also said the disposal of radioactive water stored in on-site tanks will not be finished on schedule.

**Behind these delays is the grim reality that existing technology and expertise is not up to the task of dealing with this unprecedented situation. Things are not going as planned in many ways.**

The crippled nuclear plant still poses all sorts of risks and hazards to workers. TEPCO should place top priority on safety and steady progress in proceeding with cleanup work. What it must not do is adopt a slapdash approach in pursuit of accomplishing the task quickly.

**Some 7,000 workers can be found on any given weekday at the Fukushima No. 1 plant, more than double the 3,000 or so that were there in April 2013.**

The precise locations of the melted nuclear fuel rods of the No. 1 reactor are still not known, nor is their condition. Another unknown is from which part of the reactor the melted fuel can be removed.

**First of all, technology has to be developed to ascertain the state of the nuclear fuel under the high levels of radiation.**

TEPCO has decided to delay to fiscal 2021 the start of the removal of spent fuel from the No. 1 reactor. The work was originally slated to begin in fiscal 2019 under the road map for decommissioning that was unveiled in June 2013 by the government and TEPCO. Similarly, the start of the removal of melted fuel rods will be postponed to fiscal 2025 from fiscal 2020. The situation is more or less the same with the No. 2 and No. 3 reactors.

In September 2013, Naomi Hirose, TEPCO president, promised Prime Minister Shinzo Abe that the disposal of highly radioactive water would be completed by the end of March 2015. But only about 60 percent of the work has been done so far as a raft of problems, including glitches in equipment to filter out radioactive substances, caused delays.

There are special circumstances behind the individual cases of delay.

A worker at the plant died on Jan. 20 after falling into an 11-meter-high water tank during an inspection.

The cause of the accident is under investigation.

**The number of work-related accidents at the plant has increased significantly as TEPCO brought in more workers for cleanup operations.**

The number of accidents in the current fiscal year, which runs through March, grew to 40 as of November, up sharply from 23 for all of fiscal 2013.

This troubling data raises concerns that safety management may have been put on the back burner under pressure to carry out tasks according to schedule. Errors that lead to accidents involving workers could also cause more cases of radioactive contamination.

Last week, the Nuclear Regulation Authority announced a draft medium-term timetable for efforts to reduce risks at the plant. The draft points out that the growing number of work-related accidents is a serious problem. **It calls for a marked improvement in working conditions.**

In order to make sure that cleanup work will be carried out safely and steadily, the NRA and the government need to provide appropriate support based on the actual conditions at work sites, which are often fraught with risks.

February 3, 2015

**No icewall by March**

## Tepco unlikely to complete ice wall by March

<http://www.japantimes.co.jp/news/2015/02/03/national/tepcos-unlikely-complete-frozen-soil-shields-march/#.VNEFtS51Cos>

JJI

Tokyo Electric Power Co. will probably not meet its target of completing by the end of March the first section of frozen soil shields to curb the buildup of radioactive water at the Fukushima No. 1 nuclear plant. Construction is being delayed by two weeks to one month after two deadly accidents at Fukushima No. 1 and No. 2 nuclear plants last month forced the company to suspend work for safety checks, Tepco officials said Monday.

The shields are intended to block groundwater from the nearby mountains from flowing into the reactor building basements and mixing with water that has become highly radioactive after being used to cool the overheating reactors.

Tepco began the construction work last June.

The volume of contaminated water has been increasing by several hundred tons a day due partly to the inflow of groundwater.

Even after the construction is completed, Tepco will need approval from the Nuclear Regulation Authority to start circulating refrigerant to freeze the surrounding soil. The NRA is concerned that the shields may change the flow of groundwater and cause the ground to sink, which could allow contaminated water to flow out of the reactor buildings.

## Can lignin be an answer?

### Plant-Based Molecule ‘May Be Key’ To Fukushima Cleanup, Say Scientists

<http://www.nucnet.org/all-the-news/2015/02/03/plant-based-molecule-may-be-key-to-fukushima-cleanup-say-scientists>

A team of scientists from Japan and the US say they may have discovered a way to remove radioactive caesium from the millions of litres of contaminated water being held at Japan’s Fukushima-Daiichi nuclear power station following the 2011 accident.

The team’s discovery stemmed from their work with **lignin, a component of plant cell walls that is a hugely abundant by-product of pulp and paper production.**

Yuichiro Otsuka, a researcher at the Forestry and Forest Products Research Institute in Tsukuba, Japan, and Tomonori Sonoki, professor of biochemistry and molecular biology at Hirosaki University in Japan, have been working with scientists from Virginia Tech in Blacksburg, Virginia, on ways to use waste lignin to produce more useful “platform chemicals” that can be used as precursors for the production of biofuels and biopolymers.

Through a bacterial fermentation of lignin waste compounds, the team was able to produce **a unique molecule known as PDC, which can be combined with other molecules, or polymerised, into a**

**variety of useful bioplastic compounds.** The team determined the process for making large amounts of PDC from several types of lignin from pulp mills.

Although the targeted PDC molecule was intended as a platform chemical for biopolymer production, a surprising finding by the team led to a discovery that may help clean up radioactive caesium.

“Caesium is a unique compound known as an alkali metal,” said Barry Goodell, professor of sustainable biomaterials in Virginia Tech’s College of Natural Resources and Environment. “Metals like this can be removed from solutions if appropriate binding compounds can be identified, but finding an appropriate compound for the binding of caesium has been very difficult. **The Japanese have been desperate to find an alkali metal binding compound that is specific to caesium.**”

Because of the chemical structure of PDC, the team surmised that it might also be able to bind certain alkali metals. In the lab, when the PDC compound was tested on a nonradioactive isotope of caesium, the scientists discovered that **PDC is especially good at both binding to caesium and pulling it out of a solution in a manner so that it could be readily collected.**

**When tests of the PDC were done with mixtures of other metal salts such as sodium chloride, the common table salt that is also the major salt in seawater, caesium was selectively bound by the PDC, allowing it to be pulled out of the solution for selective disposal.**

“This could be a finding of major importance for the cleanup of the Fukushima-Daiichi reactor disaster,” a statement on Virginia Tech’s website said.

Japanese researchers are now exploring how the PDC compound can be further scaled up and how it can be applied to wastewater in Japan contaminated with radioactive caesium.

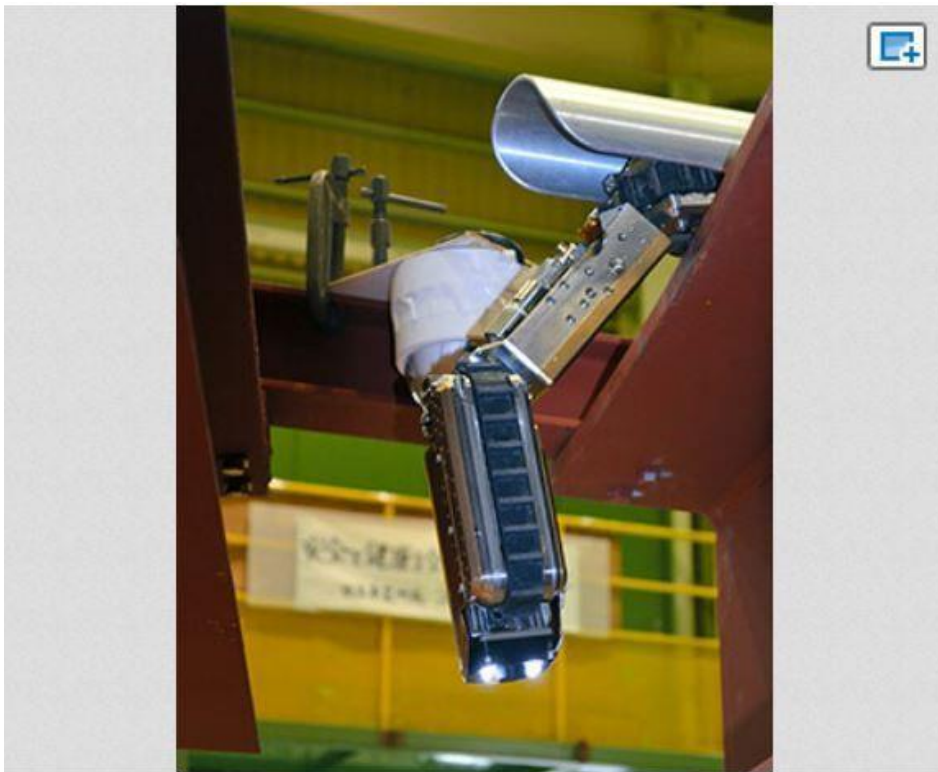
Details are online: [www.vtnews.vt.edu/articles/2015/01/012815-cnre-nuclearcleanup.html](http://www.vtnews.vt.edu/articles/2015/01/012815-cnre-nuclearcleanup.html)

February 6, 2015

## **New transformer robot for Fukushima Daiichi**

**New 'transformer' robot changes shape to access deadly Fukushima nuclear facilities**

<http://ajw.asahi.com/article/business/AJ201502060059>



The new shape-changing robot developed by the International Research Institute for Nuclear Decommissioning is put through tests in Hitachi, Ibaraki Prefecture, on Feb. 5. (Tsuyoshi Nagano)

By TSUYOSHI NAGANO/ Staff Writer

HITACHI, Ibaraki Prefecture--A new shape-changing robot has been rolled out that can chart previously inaccessible areas of the damaged containment vessels at the crippled Fukushima No. 1 nuclear power plant.

The new device was demonstrated Feb. 5 at a plant owned by Hitachi-GE Nuclear Energy Ltd., one of the firms involved in its development. The International Research Institute for Nuclear Decommissioning, an

organization made up of electric power companies and nuclear power plant manufacturers, developed it with a government subsidy.

The probe was conceived as a way to examine the containment vessels, which are too radioactive for humans to enter. It is scheduled for deployment at the No. 1 reactor building, which contains melted fuel, this spring.

The tubular-shaped robot, measuring 60 centimeters long in its normal state, can transform itself depending on the space it is trying to enter and the task to perform.

In the demonstration at the factory, the robot, in its tubular form, made its way through a pipe with a diameter of 10 cm. On the other side of the pipe, it changed shape to crawl around and capture images of the area.

The plan is to have the probe access the containment vessels through the holes in the wall through which electrical power lines pass.

Because strong radiation is harmful to electronic machines as well, the robot's camera is only guaranteed to function for 10 hours. The device can also take radiation and temperature readings.

### **Crawler robot to inspect Fukushima reactor vessels**

[http://www3.nhk.or.jp/nhkworld/english/news/20150206\\_16.html](http://www3.nhk.or.jp/nhkworld/english/news/20150206_16.html)

Japanese engineers have unveiled a shape-changing crawler robot designed to inspect crippled reactors at the Fukushima Daiichi nuclear plant.

Hitachi-GE Nuclear Energy, a Hitachi subsidiary, and others developed the robot to probe the interior of reactor containment vessels.

The remote-controlled machine measures roughly 20 centimeters long, 30 centimeters wide and 10 centimeters high in its rectangular configuration. It can transform into a rod-like form to crawl through narrow pipes, such as those leading to the containment vessels.

The robot is equipped with a camera, dosimeter and thermometer.

The company showed the robot on Thursday to reporters in Hitachi City, northeast of Tokyo. The machine rearranged itself into a rod-like shape and went through a pipe 10 centimeters wide and 5 meters long.

It then changed back into its rectangular form, moved down to the floor, and traveled across the uneven surface.

Hitachi-GE officials say the robot will be used at the No.1 reactor at Fukushima Daiichi in April or May.

Radiation levels inside containment vessels there are too high for humans due to the 2011 nuclear accident.

Hitachi-GE Nuclear Energy engineer Yoshinori Takahashi said it will be the first inspection of a container

vessel by a self-propelled robot. He expressed hope that the robot will collect a variety of data to help with decommissioning work at the Fukushima reactors.

February 7, 2015

## New robot for Fukushima Daiichi (2)

### Robotic snake set to examine innards of melted Fukushima reactor

<http://www.japantimes.co.jp/news/2015/02/07/national/robotic-probe-set-examine-inside-melted-fukushima-reactor/#.VNxn4C51Cos>

AP

HITACHI, IBARAKI PREF. – A snakelike robot designed to examine the interior of one of the three meltdown-hit reactors at the Fukushima No. 1 nuclear power plant is ready to begin its expedition. Assessing the damage in the reactors is a crucial step in decommissioning the poorly protected plant, which was crippled by core meltdowns triggered by the Great East Japan Earthquake and tsunami in March 2011.

Remote-controlled robots are essential for the job because the radiation in the reactors chambers is so high it would kill any person who got close.

Using information gathered by the robot, Tokyo Electric Power Co., the plant operator, plans to repair the damaged chambers enough so they can be filled with water in preparation to remove the melted radioactive debris, an operation planned to begin in about a decade.

The 60-cm-long robot, developed by electronics giant Hitachi and its nuclear affiliate Hitachi-GE Nuclear Energy, was demonstrated this week at a Hitachi-GE facility northeast of Tokyo. It is expected to enter the No. 1 reactor as early as April, officials said.

It has a lamp at the front and is designed to crawl like a snake through a 10-cm-wide pipe into the containment vessel. From there it must dangle and descend onto a platform just below the reactor core's bottom, an area known as the pedestal.

There, the robot is to transform into a U-shaped crawler and capture live images and temperature and radiation levels and transmit them to a control station outside the building.

Expectations for the robot probe are high after earlier efforts at assessment met with limited success.

“Depending on how much data we can collect from this area, I believe (the probe) will give us a clearer vision for future decommissioning,” Hitachi-GE engineer Yoshitomo Takahashi said.

After its exploratory trip, which will make the robot extremely radioactive, technicians plan to store it in a shielded box. They have no plans to reuse it.

Different robots must be designed for each reactor, since each is slightly different.

According to computer simulations, all of the fuel rods in unit 1 probably melted and pooled at the bottom of the containment chamber, but there had been no way of confirming that until now.

A brief fiberscope observation conducted in 2012 produced images that were scratchy and of limited use.



To assess the debris at the bottom of the damaged reactor chambers, which are usually filled with water, an amphibious robot is being developed for deployment next year.

The damage from the melted fuel burned holes in the reactors, thwarting efforts to fill them with cooling water. As a result, water must be pumped into them continuously, producing an endless stream of radiation-contaminated water that is hampering the plant's cleanup process.

February 9, 2015

## Using muons to get a peek inside reactors

### Elementary particle 'X-Ray' for Fukushima reactors

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Experts will use elementary particles bombarding the Earth to try to determine the location of melted nuclear fuel at the troubled Fukushima Daiichi nuclear power plant.

The project is aimed at finding clues as to the location of the melted fuel, a step that is indispensable to its removal from the damaged reactors, in order to continue with decommissioning work.

Three reactors at the plant suffered meltdowns following the massive earthquake and tsunami that struck the area in March of 2011. Extremely high radiation levels have been preventing experts from locating and determining the state of the melted fuel.

The experts will soon make use of a type of elementary particle called the muon to get a peek inside the reactors.

Workers wearing protective gear used a crane on Monday to install an observation device outside the Number 1 reactor building. The time they could devote to the task was limited, since radiation levels outside the reactor building are as high as 500 microsieverts per hour.

Muons are created when cosmic rays from space collide with the Earth's atmosphere. Scientists say about 10,000 muons per square meter reach the Earth's surface every minute.

Experts hope that observing the particles passing through the reactor building will create images of the nuclear fuel, in the same way an X-ray works.

After workers install another device at the Number 1 reactor on Tuesday, experts will conduct observations until March. It is believed that almost all the fuel in the reactor has melted and fallen down.

Experts also plan to use muons in a different way to probe the Number 2 reactor.

Fumihiko Takasaki, professor emeritus with the High Energy Accelerator Research Organization, led the development of the observation devices.

He said the project, which was started soon after the disaster happened, is finally being used at the plant. He said he hopes the technology will help with the decommissioning of the reactors by **determining whether the fuel is still in them.**

See also :

<http://www3.nhk.or.jp/nhkworld/english/news/features/201501271820.html>

**Getting an Inside Look (January 27, 2015)**

## Icewall delayed again

### **Fukushima ice wall plan delayed by 2 weeks**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the Fukushima Daiichi nuclear power plant says a plan to fill in underground tunnels at the defunct facility will be delayed by 2 weeks.

TEPCO officials announced the new schedule at a meeting with the Nuclear Regulation Authority, or NRA, on Monday. The new timetable will start late this month.

TEPCO had initially planned to remove highly-radioactive water from the tunnels after building an ice wall to stop the water from leaking out of reactor buildings.

The workers poured cement into the tunnels while draining contaminated water. But **blocking the water was not successful as it continued to flow through the buildings.**

The officials said in the new plan, they will fill in areas where unblocked tunnels and reactor buildings join to stop the tainted water from seeping out.

NRA regulators mostly approved the plan. They will continue to probe what else is necessary to do.

The setback for water blocking effort is likely to affect the plan to build the ice wall.

TEPCO officials say the plan is already 2 weeks to a month behind schedule due to a fatal accident at the plant.

They say they do not yet know how the latest delay will affect the whole decommissioning project. They are still studying the next steps they need to take.

February 12, 2015

## Muons again

### **TEPCO turns to cosmic rays to get peak inside Fukushima reactors**

<http://mainichi.jp/english/english/newsselect/news/20150212p2a00m0na017000c.html>

Fukushima No. 1 nuclear plant operator Tokyo Electric Power Co. (TEPCO) is turning to cosmic rays to get a look inside the stricken power station's wrecked reactors, and help decide how to extract the melted nuclear fuel inside.

Since the March 2011 triple-meltdown nuclear disaster at the Fukushima No. 1 plant, due to high radiation levels it's been impossible to see inside the three reactors affected to ascertain the state of the fuel -- specifically how much is left in the pressure vessels and how much melted through to the containment vessel. As poking a hole in the reactor vessels would be far too dangerous, TEPCO is turning to a technique similar to X-ray exams at a doctor's office: muon detectors.

Muons are subatomic particles produced when cosmic rays strike Earth's atmosphere, and rain down constantly onto the planet's surface. Muons pass through most materials, including concrete and steel, unhindered, but they are blocked by very dense substances such as nuclear fuel. As such, the melted fuel in the Fukushima No. 1 reactors will block muons passing through the pressure vessels, and show up as shadows on a muon detector readout. The same technique is used to study magma in volcanoes.

By Feb. 10, TEPCO had set up two muon detectors next to the Fukushima plant's No. 1 reactor -- one each on the north and northwest side of the reactor building -- and was scheduled to begin taking readings on Feb. 12. TEPCO calculates that most of the fuel in the No. 1 reactor melted through the bottom of the pressure vessel and onto the floor of the containment vessel. The lower part of the containment vessel is below ground level, so the muon detectors won't be able to detect the fuel there. The pressure vessel, however, is above ground, meaning TEPCO can check how much fuel remains.

According to the Tsukuba, Chiba Prefecture-based High Energy Accelerator Research Organization (KEK), which developed the muon detectors, the devices can pin down the position of nuclear fuel 30-50 centimeters in size.

TEPCO and its partners plan to take about a month's worth of measurements, and finalize the results in late March.

"It will be very important simply to confirm the hypothesis that the fuel is no longer in the pressure vessel," said KEK professor emeritus Fumihiko Takasaki. A TEPCO spokesperson commented, "If we can ascertain the position of the nuclear fuel debris, we'll be able to decide to some extent how we should go about extracting it (from the reactors)."

February 13, 2015

## Using muons (3)

### **Tepco starts using cosmic rays to grasp condition inside damaged reactors**

<http://www.japantimes.co.jp/news/2015/02/13/national/tepcos-starts-using-cosmic-rays-grasp-condition-inside-damaged-reactors/#.VN3Ori51Cos>



This handout picture taken by Tokyo Electric Power Co. on Monday shows a measuring device of cosmic rays, to be used to look inside crippled reactors, being installed at Tepco's Fukushima No. 1 nuclear plant at Okuma, Fukushima Prefecture. The device will use muons to check fuel debris inside the reactors. | AFP-JIJI/TEPCO

Kyodo

The operator of the disaster-hit Fukushima No. 1 nuclear plant on Thursday began experiments using cosmic rays in an effort to look at the condition of the damaged reactor cores, hoping it will help determine how to remove the melted fuel they hold.

During the process of decommissioning the plant, which is expected to take up to 40 years, the eventual removal of fuel debris from the three reactors that suffered meltdowns in the 2011 earthquake-tsunami disaster is the hardest part. But the exact condition of the melted fuel inside the reactors is unknown, as high radiation levels have prevented anyone from obtaining data.

So Tokyo Electric Power Co. is now turning to technology utilizing muons, a type of cosmic ray that constantly showers down on the Earth's surface. While muons pass through most objects, they are blocked by heavy substances such as uranium, which is used in nuclear fuel. This means muons can be used to create an image of the condition of the fuel inside the reactors similar to an X-ray, the operator said.

Tepco has installed devices — developed by Japan's High Energy Accelerator Research Organization — around the reactor 1 building and began collecting data on Thursday. The same technology has been used to identify the condition of magma inside a volcano, the utility said.

Tepco plans to collect data for about a month and announce its results in March. But there are limitations to the muon technology and the operator aims to grasp the rough condition of the melted fuel as the first step.

The utility believes that most of the fuel in reactor 1 melted through the bottom of the pressure vessel, but details remain unknown nearly four years after the outbreak of the nuclear crisis.

February 21, 2015

## **New drone for Fukushima Daiichi**

### **Japan's 1st mass-produced drone takes maiden flight**

<http://ajw.asahi.com/article/business/AJ201502210031>



By RYO SHIMURA/ Staff Writer

MINAMI-SOMA, Fukushima Prefecture--The nation's first mass-produced drone underwent a test flight here Feb. 20 ahead of work assisting cleanup crews near the stricken Fukushima No. 1 nuclear power plant.

The drones will be manufactured just north of the stricken Fukushima plant and some of them will be used to record radiation levels during cleanup and decontamination work in areas affected by the 2011 nuclear disaster.

The drone was developed by the Autonomous Control Systems Laboratory, which is headed by Kenzo Nonami, a robotics professor at Chiba University.

The production base for the drones is a factory in Minami-Soma owned by Kikuchi Seisakusho Co. of Hachioji, Tokyo. The company is a major manufacturer of precision parts.

The plan calls for producing 400 drones this year. Each drone will be 90 centimeters in diameter, weigh 3 kilograms and be capable of carrying a load of up to 6 kg.

The drones will navigate via a global positioning system and will be able to fly continuously for about 30 minutes.

Each drone will cost between 2 million and 3 million yen (\$16,800 and \$25,200).

There are currently an estimated 2,000 drones flying in Japan, but most are foreign-made robotics that cost about 100,000 yen. Most of the foreign-made drones are flown by drone enthusiasts as a hobby and lack the durability to be put to practical uses.

"We want to engineer a comeback (for Japan) by using a domestic model," Nonami said.

February 22, 2015

## Shut the gates to the port!

### Strontium-90 levels spike alarmingly at Fukushima No. 1 plant

[http://www.lemonde.fr/planete/article/2015/02/22/nouvelle-fuite-d-eau-radioactive-a-fukushima\\_4581211\\_3244.html](http://www.lemonde.fr/planete/article/2015/02/22/nouvelle-fuite-d-eau-radioactive-a-fukushima_4581211_3244.html)

JJI

The Nuclear Regulation Authority said Sunday that an alarm went off at the Fukushima No. 1 nuclear plant signaling high radioactivity levels in drainage ditches.

According to the NRA and plant operator Tokyo Electric Power Co., the first alarm sounded at around 10 a.m., and another alarm 10 minutes later indicated much higher levels. Officials said **contaminated water may have been discharged into the ditches.**

**The levels of beta ray-emitting substances, such as strontium-90, measured 5,050 to 7,230 becquerels per liter of water between 10:20 a.m. and 10:50 a.m.** Tepco requires radioactivity levels of groundwater at the plant discharged into the sea to remain below 5 becquerels.

**Since the drainage ditches are connected to the port of the No. 1 plant, the NRA has instructed Tepco to shut the gates there,** officials said.

Tepco confirmed that no leaks from tanks containing radioactive water were found, but said it was investing further.

## Spike in radioactivity on Sunday

### Fukushima radioactive contamination sets off alarm

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the Fukushima Daiichi nuclear power plant says it has detected high levels of radioactive substances in a drainage channel on the plant's premises on Sunday. The Tokyo Electric Power Company is investigating the cause.

TEPCO says the plant's alarm system went off around 10 AM. It showed a rise in radioactivity in the channel that leads to a nearby port.

Measurements showed that levels of beta-ray emitting substances, which are not detected under normal circumstances, had risen to up to 7,230 Becquerels per liter.

The figure is 10 times higher than when rain causes the level to rise temporarily.

The utility suspects that contaminated water in the channel may have leaked into the port.

It has suspended all operations to transfer contaminated water and closed a gate of the channel by the port.

The drainage channel used to be connected to a section of coast beyond the port. TEPCO rerouted it after a series of leaks in 2013.

The company says the water level in a tank that contains contaminated water remains unchanged, showing no signs of leakage, and drain valves that keep water from leaking near the tanks remain closed.

The utility is investigating the cause of the rise of radioactivity in the channel.

February 23, 2015

## TEPCO investigates cause of radiation spike

### TEPCO trying to identify cause of high radiation

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>



The operator of the Fukushima Daiichi nuclear plant says it has yet to identify the cause of a rise in radioactivity in a drainage channel.



Tokyo Electric Power Company detected high levels of beta-ray-emitting substances in the channel on Sunday morning.

Measurements showed that levels of the substances had risen as high as 7,230 becquerels per liter -- 10 times the usual level.

The utility suspects that contaminated water in the channel may have leaked into the port.

TEPCO officials say their investigations have so far found no leaks in the tubes and tanks storing radioactive water on the premises. They also say the levels of the radioactive substances went down to 20 becquerels per liter on Sunday night.

The drainage channel is designed to discharge rainwater, as well as water used in various operations, into the port.

TEPCO officials say workers removed accumulated mud from the channel on Saturday, the day before the event. But they say they do not know whether the removal is related to the rise in radiation levels.

The company says there has been no leakage of the substances outside the port and that radiation levels of the water in the port are within the normal range.

## Toxic water at Fukushima plant leaked into nearby bay

<http://mainichi.jp/english/english/newsselect/news/20150223p2g00m0dm041000c.html>

TOKYO (Kyodo) -- Highly radioactive water at the crippled Fukushima Daiichi nuclear plant has leaked into a nearby bay, but the cause and amount of the leakage have yet to be investigated, Tokyo Electric Power Co. said Monday.

A company official said the bay is surrounded by fences and the plant operator believes the water did not flow into the ocean outside the bay, but details remain unknown.

According to TEPCO, radiation levels more than 70 times greater than usual were detected in a gutter on the premises of the complex on Sunday. The levels of beta ray-emitting substances, such as strontium, measured up to 7,230 becquerels per liter as of Sunday morning, but fell to 20 becquerels by around 10 p.m. the same day.

**TEPCO had shut the gutter, which drains rain water into the bay, but the firm opened the gate on Monday after confirming that radiation levels have lowered.**

The problem of radioactive water building up at the Fukushima site remains a major challenge in the process of decommissioning nearly four years after the outbreak of the nuclear crisis. In December, TEPCO said around 6 tons of radioactive water leaked into the ground, in a series of recent mishaps at the plant.

February 24, 2015

## TEPCO's report on radiation "incident"

### Fukushima Daiichi NPS Prompt Report 2015

[http://www.tepco.co.jp/en/press/corp-com/release/2015/1248327\\_6844.html](http://www.tepco.co.jp/en/press/corp-com/release/2015/1248327_6844.html)

### Fukushima Daiichi NPS Prompt Report (Feb 24, 2015) Recent Topics: TEPCO INVESTIGATING CAUSE OF BRIEF WATER INCIDENT AT FUKUSHIMA

#### *No workers believed exposed in brief rise in radioactivity in drain water*

FUKUSHIMA, February 24, 2015-The Tokyo Electric Power Company is investigating the cause of a brief rise in the radioactivity of drainage water on Sunday and will make its findings public.

No workers are believed to have been exposed when measurements of the "gross beta" nuclides (total amount of nuclides that emit beta rays such as Strontium90) rose from below 1,500 to between 5,050 and 7,230 becquerels per liter of water. Although some of the water is believed to have reached the sea, measurements of radioactivity in the port area adjacent to the plant did not show any significant increase. The company also patrolled each tank facility and confirmed no leakage. Recent water radioactivity measurements are posted at [http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2015/images/handouts\\_150223\\_01-e.pdf](http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2015/images/handouts_150223_01-e.pdf).

TEPCO will increase the frequency of some ocean water sampling from once a week to daily during the investigation period. Ordinarily, TEPCO requires that any water discharged into the sea have "gross beta" levels below 5 becquerels per liter.

Plant operators were automatically alerted to the increase in radioactivity by sensors designed for that purpose. The air radiation dose monitored in the vicinity of drainage route at the time of the alarm did not show any significant changes. After confirming that the measurement results of the water pumped up from the drainage has returned to normal, TEPCO resumed drainage operations.

The company is investigating the potential causes of the event and will report its findings promptly.

For the location of the drainage and related materials, please go to

[http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2015/images/handouts\\_150222\\_01-e.pdf](http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2015/images/handouts_150222_01-e.pdf) and

[http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2015/images/handouts\\_150222\\_03-e.pdf](http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2015/images/handouts_150222_03-e.pdf)

February 25, 2015

## New "likely" leak into the ocean

## Highly toxic water leaks into ocean from Fukushima plant

<http://mainichi.jp/english/english/newsselect/news/20150225p2g00m0dm041000c.html>

TOKYO (Kyodo) -- Highly radioactive rainwater at the crippled Fukushima Daiichi nuclear plant has likely leaked into the Pacific Ocean, Tokyo Electric Power Co. said Tuesday, in the latest of a series of mishaps at the complex.

TEPCO said contaminated rainwater accumulating on the rooftop of the No. 2 reactor building is highly likely to have flowed into the ocean through a gutter. The company learned of the possibility last May but failed to take measures immediately.

The level of radioactive cesium in the rainwater measured 29,400 becquerels per liter, while that of beta ray-emitting substances, such as strontium, measured 52,000 becquerels, according to the plant operator. TEPCO said no major changes in radiation levels have been observed so far in the ocean outside a bay adjacent to the plant. It will take measures such as placing sandbags with materials that can absorb cesium to prevent further pollution.

In a separate incident, TEPCO said recently that highly contaminated water leaked into the nearby bay through a different gutter, but the company claimed the water did not flow into the ocean outside the bay. The cause and the amount of water leakage remain unknown.

February 25, 2015(Mainichi Japan)

## TEPCO knew

### No measures taken for radioactive water leak

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the Fukushima Daiichi nuclear plant **did not take any measures to prevent radioactive water that accumulated on the roof of one of the reactor buildings from flowing into the Pacific Ocean.**

Tokyo Electric Power Company said on Tuesday that **rainwater with relatively high levels of radioactive substances has collected on the roof of the No. 2 reactor building.**

It said the contaminated water may have flowed into a drainage channel whenever it rained and could have spilled into the Pacific Ocean beyond the plant's port.

**TEPCO was aware of these rises in the concentration of radioactive substances in the drainage channel as long ago as April last year.**

But it did not make the information public or take any measures to stop the water from spilling into the ocean.

TEPCO has not installed floodgates or equipment in the drainage channel that would warn of rising concentrations of radioactive substances. **The utility says there are no radioactive standards for the rainwater it is allowed to discharge into the ocean and it does not plan to install any devices in the**

**channel.**

The operator says no major changes have been observed in the levels of radioactive substances in nearby seawater.

But local residents, including workers in the fishing industry, may react sharply to the news. The drainage channel flows into the sea beyond the port. **TEPCO had earlier explained that the contaminated water only affected the port area.**

## **TEPCO knew (2)**

### **TEPCO admits it failed to disclose cesium-tainted water leaks since April**

<http://www.japantimes.co.jp/news/2015/02/25/national/tepcO-admits-failed-disclose-cesium-tainted-water-leaks-since-april/#.VO17iS51Cos>

Jiji

Tokyo Electric Power Co. said Tuesday it has failed to disclose leaks into the sea of rainwater containing radioactive substances from a drainage ditch linked to a building at its stricken Fukushima No. 1 nuclear power plant although it became aware of the leaks in April last year.

The building is highly contaminated with radioactive substances such as cesium that have been released from the plant since it was damaged in the March 2011 earthquake and tsunami.

As the drainage ditch in question is connected to the roof of the reactor 2 building, **29,400 becquerels of radioactive cesium per liter were detected from water accumulated on the rooftop**, Tepco said.

**The water also contained 52,000 becquerels of beta ray-emitting radioactive substances such as strontium-90.**

The drainage ditch is linked to the Pacific Ocean. Some 1,050 becquerels of radioactive cesium and 1,500 becquerels of beta ray-emitting radioactive materials per liter were detected near an outlet leading to the sea.

Tepco said that there have been no major changes in the amount of radioactive substances detected in seawater collected from an area about 1 km from the drainage outlet.

The company saw water contaminated with high levels of radiation flowing to the plant's port through another drainage ditch Sunday.

## **Shocked fishermen feel betrayed**

### **Shocked' at silence over water leak at wrecked Fukushima No. 1 plant**

<http://www.japantimes.co.jp/news/2015/02/25/national/tepcO-admits-failed-disclose-cesium-tainted-water-leaks-since-april/#.VO3IYy51Cos>

Fishermen in Fukushima Prefecture slammed Tokyo Electric Power Co. on Wednesday after it emerged that water containing cesium and other radioactive isotopes has been draining into the Pacific near the Fukushima No. 1 plant and that Tepco did nothing to prevent it despite learning of the leak last May.

“I don’t understand why (Tepco) kept silent even though they knew about it. Fishery operators are absolutely shocked,” Masakazu Yabuki, chief of the Iwaki fisheries cooperative, said at a meeting with Tepco officials.

Local fishermen have already given Tepco approval to dump groundwater into the ocean before it becomes tainted, to reduce the volume of water stored in tanks at the site. The operator is now doing this, pumping water from wells, monitoring it and piping it into the ocean.

The latest incident threatens to delay a second round of approval that Tepco wants the fishermen to provide.

The utility admitted Tuesday it failed to disclose leaks of rainwater containing radioactive substances from a drainage ditch at the stricken plant even though it was aware of high radiation in the water last spring.

The ditch receives runoff from the roof of the No. 2 reactor building, which is highly contaminated with radioactive substances such as cesium.

Tepco has said it recorded 29,400 becquerels of radioactive cesium per liter in water pooled on the rooftop.

The water also contained 52,000 becquerels of beta-ray-emitting radioactive substances such as strontium-90. It also detected some 1,050 becquerels of radioactive cesium and 1,500 becquerels of beta ray-emitting radioactive materials per liter near an outlet leading to the sea.

Tepco said there is no major change in the concentration of radioactive substances in seawater it sampled about 1 km from the drainage outlet.

Meanwhile on Sunday, Tepco reported water contaminated with high levels of radiation was flowing into the ocean at the plant’s port through another drainage ditch.

Yuji Moriyama, a Tepco spokesman said the utility did not disclose the information because there is no evidence of environmental impact.

“We were aware that the levels of radioactive materials around the drainage ditch were higher than other places,” Moriyama said, adding that they have been investigating the sources of contamination since last spring.

### **Fishermen accuse TEPCO of betrayal**

[http://www3.nhk.or.jp/nhkworld/english/news/20150225\\_24.html](http://www3.nhk.or.jp/nhkworld/english/news/20150225_24.html)

Fishermen are accusing the operator of the crippled Fukushima Daiichi nuclear power plant of betraying their trust. The power company has admitted it did not take steps to prevent some contaminated rainwater from spilling into the Pacific Ocean.

Tokyo Electric Power Company officials said on Tuesday the water had accumulated on the roof of the No.2 reactor building. They said the water contained relatively high levels of radioactive substances, and that it may have leaked into the sea through a drainage channel.

TEPCO officials said they were aware last April that the density of radioactive substances in the channel rose when it rained. But they did not make that information public, or take steps to prevent the water from leaking into the sea.

A TEPCO official on Wednesday apologized for the spill at a meeting of the heads of local fisheries cooperatives. But he said the company found no major changes in the level of radioactive substances in the sea near the plant. He said radiation levels in the drainage channel were lower than those in the water on the roof.

Some fisheries chiefs said they felt betrayed after working with TEPCO to settle the problem.

They said the firm's repeated concealment of information has helped fuel the rumors that are hurting the local fishing industry.

## **NRA demands thorough investigation**

### **NRA demands TEPCO probe radioactive water leak**

[http://www3.nhk.or.jp/nhkworld/english/news/20150225\\_26.html](http://www3.nhk.or.jp/nhkworld/english/news/20150225_26.html)

Japan's nuclear regulator has demanded that the operator of the Fukushima Daiichi nuclear plant thoroughly investigate a recent leak of radioactive drainage water that may have entered the sea.

The Nuclear Regulation Authority on Wednesday heard a report on the incident saying levels of beta ray-emitting substances rose sharply in a drainage channel at the plant on Sunday. It also said some of the contaminated water likely spilled into the plant's port facing the Pacific Ocean.

Tokyo Electric Power Company, or TEPCO, has been unable to determine why the radioactivity levels spiked.

Authority Chairman Shunichi **Tanaka criticized TEPCO for leaving the channel's gate to the port open for as long as 90 minutes after an alarm went off.**

Tanaka said TEPCO might not have had a plan to follow after detection of radiation spikes. He said **the utility should have in place a system to automatically shut the water gate in case of irregularity.**

On Tuesday, Tokyo Electric reported another radioactive water leak. The firm said contaminated

rainwater that had accumulated on the roof of the plant's No. 2 reactor building leaked into the sea outside the port through another drainage channel.

## Reroute drainage channel to avoid leaks into sea

### TEPCO may reroute wastewater drainage channel

[http://www3.nhk.or.jp/nhkworld/english/news/20150225\\_30.html](http://www3.nhk.or.jp/nhkworld/english/news/20150225_30.html)



The operator of the crippled Fukushima Daiichi nuclear power plant is **considering a plan to reroute a drainage channel so that contaminated rainwater will not leak outside the facility's port.**

Tokyo Electric Power Company said on Tuesday that the water had accumulated on the roof of the plant's No. 2 reactor building. The firm added that rainwater with relatively high levels of radioactive substances spilled into the Pacific beyond the plant's port through a drainage channel.

Following an outcry by local fishers, the utility said it will consider **altering the channel so that water will drain in the port.**

The firm is also considering a tentative plan to pump up water near the mouth of the channel and release it in the port through another channel.

**TEPCO knew last April that the density of radioactive substances in the channel rose when rain fell. But it did nothing to prevent contaminated water from leaking directly out to sea, nor did it make the finding public.**

## TEPCO reveals another leak (NHK video)

<http://www3.nhk.or.jp/nhkworld/english/news/features/201502251616.html>

It has taken TEPCO almost a year to make this information public...

February 27, 2015

## On-site investigation

### Fukushima officials conduct on-site probe at crippled plant

<http://mainichi.jp/english/english/newsselect/news/20150227p2g00m0dm070000c.html>

TOKYO (Kyodo) -- Officials from Fukushima Prefecture, including nuclear experts, conducted an on-site investigation at the crippled Fukushima Daiichi complex on Friday, following the recent revelation of another toxic water leakage into the Pacific Ocean.

The move follows Tokyo Electric Power Co.'s announcement Tuesday that highly radioactive rainwater accumulating on the rooftop of a reactor building has flowed into the adjacent sea through a gutter. TEPCO has been aware since last April that radiation levels in the gutter rise every time it rains, but did not disclose the data for 10 months.

The officials are expected to look at the gutter and around the No. 2 reactor building where the contaminated rainwater was found.

Trade, Economy and Industry **Minister Yoichi Miyazawa said at a press conference Friday that the government "may have been a little bit careless" in failing to oversee TEPCO properly on this issue.**

Fishermen in Fukushima met with Miyazawa the same day and called for a "radical review of measures against radioactive water," saying that "the anger among local fishery operators is immeasurable."

### Fukushima investigates radioactive water leakage

[http://www3.nhk.or.jp/nhkworld/english/news/20150227\\_47.html](http://www3.nhk.or.jp/nhkworld/english/news/20150227_47.html)

Experts and officials sent by Fukushima Prefecture have made an on-site investigation into the flow of radioactive water from the crippled Fukushima Daiichi plant into the sea.

Tokyo Electric Power Company said on Tuesday that radioactive water that had accumulated on the roof of the No. 2 reactor building had spilled into the sea outside the plant's port.

20 members from **a panel of experts and local government officials** entered the plant compound on Friday.



Utility officials explained the underground drainage channel in question.

The panel members checked another channel through which tainted water is believed to have flowed into the port on Sunday.

They examined equipment that shows levels of radioactive substances and viewed gates to prevent outflow into the sea.

On Friday the utility started piling sandbags containing chemicals to absorb radioactive substances.

The company says it plans to introduce pumps in March to prevent contaminated water from flowing into the sea outside the port.

The panel members urged the utility to investigate whether the roofs of other reactor buildings are the sources of tainted water. They also asked the company to step up its surveillance of drainage channels and seawater.

March 3, 2015

## Water purification will have to wait at least another year

### Purification of contaminated water to be delayed by a year at Fukushima plant

<http://mainichi.jp/english/english/newsselect/news/20150303p2a00m0na003000c.html>

The planned completion of the purification of highly radioactive water stored at the Fukushima No. 1 Nuclear Power Plant is expected to be pushed back to sometime around May next year, more than a year later than initially planned, it has been learned.

Naohiro Masuda, chief decommissioning officer at the Fukushima Daiichi Decontamination & Decommissioning Engineering Co., disclosed the anticipated delay during an interview with the Mainichi Shimbun. The company was established by plant operator Tokyo Electric Power Co. to handle reactor decommissioning and contaminated water at the crippled plant.

While the purification process had initially been scheduled to be wrapped up by the end of this month, company officials gave up on achieving that goal in January following **a series of malfunctions of the water purification system, called Advanced Liquid Processing System, or ALPS.**

According to TEPCO, there is approximately 200,000 metric tons of contaminated water stored in tanks on the plant's premises. In addition to the ALPS system that is capable of removing 62 types of radioactive materials including strontium, a newly installed apparatus that can single out strontium for removal is also in operation.

Masuda said during the interview that his company will **prioritize the processing of strontium, which he says bears the largest influence**, and aims to complete the process by the end of May.

Once strontium is got rid of, the concentration of radioactive materials in contaminated water would be trimmed to around one part per 1,000, he said. Because other types of radioactive substances will still remain in the contaminated water, purification of the entire amount of water is expected to finish around May next year, he said.

March 4, 2015

## **NRA orders TEPCO to check every possible source of toxic water**

### **TEPCO ordered to check all sources of toxic spill**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Japan's nuclear regulator has ordered the operator of the crippled Fukushima plant to check every possible source of contaminated water that flowed through a drainage channel into the sea.

Tokyo Electric Power Company announced in late February that radioactive water that had accumulated on the roof of the No. 2 reactor building had made its way into the sea.

TEPCO officials presented plans to prevent a similar recurrence at a hearing of the Nuclear Regulation Authority on Wednesday. They said they will pump radioactive water from the current drainage channel to another channel leading to the plant's port by early April.

They said they will also change the course of the current channel to carry water to the port instead of the open ocean by April 2016.

The panel ordered the utility to continue investigating whether radioactive water flowed through other drainage channels as well.

**TEPCO officials said there was a delay in reporting the problem because the information was not shared by officials working at the site.**

**The panel ordered the utility to carefully check whether the officials failed to share other data.**

March 5, 2015

## **Radioactive ditch water spilled into sea**

## **Fukushima plant ditch water found radioactive**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the crippled Fukushima Daiichi nuclear plant has found relatively high levels of radioactivity in water collected from a ditch in the upper part of a drainage channel at the complex.

Tokyo Electric Power Company says its workers discovered that the water collected on Tuesday contained 1,900 becquerels per liter of beta-particle-emitting substances.

**The utility's officials suspect water from the ditch spilled into the sea through the drainage channel.**

The ditch runs near a tank storing highly radioactive water. TEPCO workers have checked the tank, but found no evidence of a leak. But they are still investigating the possibility of a leak of contaminated water from the tank to the ditch.

Last month, the density of radioactive substances in the lower portion of the drainage channel briefly soared to more than 10 times the normal figure.

The firm also recently revealed that tainted rainwater flowed from the roof of a reactor building into the sea via another drainage channel.

March 6, 2015

## **Radioactive ditch water (2)**

### **Radioactive water detected again at Fukushima plant, source unknown**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201503060036>

A relatively high level of radioactivity was detected in ditch water around tanks at the Fukushima No. 1 nuclear plant, but Tokyo Electric Power Co. has not pinpointed the cause of the latest contamination. TEPCO said on March 5 that the tanks store water containing high concentrations of radioactive materials, but no leaks have been found in them.

Some of the contaminated water that has accumulated in the side ditches is believed to have flowed through a drainage ditch to an enclosed harbor in the sea after rain fell on the night of March 3, the company said.

According to TEPCO, its workers took water samples from the side ditches on March 3 and detected 1,900 becquerels of beta ray-emitting radioactive materials per liter.

The water levels in the tanks were unchanged.

Monitoring equipment installed on a downstream portion of the drainage ditch showed radioactivity levels of about 100 becquerels or lower on March 3, the same as on conventional days.

March 8, 2015

## Over 258,000 cubic meters of radioactive waste and nowhere to go

### FOUR YEARS AFTER: Radioactive debris continues to stack up at Fukushima No. 1 nuclear plant

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201503080013>



Bags containing radioactive debris accumulate in the compound of the Fukushima No. 1 nuclear power plant on Feb. 24. (Satoru Semba)

by HIROMI KUMAI/ Staff Writer

FUTABA, Fukushima Prefecture--**With nowhere to put it, refuse and debris contaminated with radioactive materials continue to pile up at the crippled Fukushima No. 1 nuclear power plant here.**

A total of **258,300 cubic meters of radioactive debris** was produced from the March 2011 accident to the end of this January in the plant, where decommissioning work is under way.

The amount is equivalent to the capacity of about 650 25-meter-long swimming pools.

Of the 258,300 cubic meters, **178,600 cubic meters were mainly debris that had been scattered around reactor buildings, wood refuse produced in the work in the plant and protective suits used by workers,** according to the plant's operator, Tokyo Electric Power Co.

The remaining 79,700 cubic meters were trees that were felled to create space for tanks storing radioactive water. There were also 1,846 objects that absorbed radioactive materials from contaminated water.

According to the road map worked out by the government and TEPCO, the basic plan for disposing of the radioactive waste will be released in fiscal 2017.

March 9, 2015

## Fukushima Daiichi struggle continues

### Echoes of 3.11: Fukushima Daiichi Struggle Continues

<http://www3.nhk.or.jp/nhkworld/english/news/nuclearwatch/20150309.html>

Noriko Okada

The March 11, 2011 earthquake and tsunami killed more than 15 thousand people. About 26 hundred others are still listed as missing. The disaster triggered one of the worst nuclear accidents in history. The Fukushima Daiichi power plant suffered three meltdowns and three hydrogen explosions. Radioactive contamination forced tens of thousands of people to leave their homes. Evacuation orders are still in effect for large areas. Work is underway to decommission the plant. Experts say the process will take 30 to 40 years. The operator of the facility, TEPCO has made some progress. But it continues to face setbacks. Akira Ono, the plant's chief, says, "We have to be even more careful as the work progresses." Spent fuel is a problem, even at reactors that suffered less damage. Workers in December completed the removal of spent fuel rods from the No.4 reactor building. The material needs to be cooled continuously if it's to remain safe. This is being done in a separate building, since the No.4 building was damaged by hydrogen explosions. The next step will be to remove fuel from the buildings where reactors suffered core meltdowns.

An even more challenging task is removing molten fuel. It is believed to have dried and hardened. Researchers are still trying to find a way to remove it.

"This is a huge challenge," says Toshiharu Muramatsu of the Japan Atomic Energy Agency. "We have to combine techniques in ways that we have never tried before. Some combinations will work. But in other cases, we will have to make fundamental adjustments."

The decommissioning process is behind schedule. Problems involving radioactive water have been the biggest cause of delays. Last month, TEPCO executives admitted contaminated rainwater has been leaking into the Pacific Ocean.



They said they knew about the situation as early as last April, but never revealed it. The utility's behavior has infuriated local fishermen. People continue to question the sincerity of its apologies. At a press conference, TEPCO official Tsunemasa Niitsuma said, "We are truly very sorry for the worry and trouble we've caused the fishing industry."

Masakazu Yabuki of the Iwaki Fisheries Cooperative Association responded: "Why didn't you tell us honestly about what was going on, when you knew about it since last year? We can't trust you anymore." Another ongoing problem is groundwater that mixes with highly radioactive water that has been injected inside the crippled reactor containers. Every day, about 300 tons of contaminated water accumulates at the facility. TEPCO has set up nearly 1,000 massive storage tanks. But once they fill up, there will be little space for more.



The problem with radioactivity is, it can't just be thrown away. Piles of black bags sit on the sides of roads, and in the backyards of homes. They hold radioactive soil and other waste collected during decontamination work. The mountains of waste have bogged down the entire rebuilding effort.



Local leaders in Fukushima have finally allowed the central government to begin building short-term storage facilities in the area. Officials in Tokyo hope they will start accepting waste this month. But even if they do, this will only go a small way toward a solution. In total, the government plans to build intermediate storage sites across some 16 square kilometers. But so far, it has received permission to use only two sites. These are so small they'll be able to hold only one-tenth of one percent of the accumulated waste.



Desperate government officials are negotiating with over 2,000 landowners in an attempt to buy more land. But so far, no one has agreed to sell.

March 11, 2015

## **Hundred of tons of radioactive water seep into soil**

## **FOUR YEARS AFTER: Tons of radioactive rainwater seeps into soil at Fukushima plant**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201503110070>

By HIROMI KUMAI/ Staff Writer

Tokyo Electric Power Co. reported a massive leak of radioactive rainwater at its crippled Fukushima No. 1 nuclear power plant on March 10.

It said **hundreds of tons of contaminated rainwater breached barriers surrounding storage tanks for highly radioactive water and seeped into the ground.**

According to TEPCO, the level of rainwater accumulating behind the outside weir of two barriers around storage tanks for contaminated water was **15 centimeters** as of 10:30 p.m. on March 9. But the water level had dropped to 7 cm by a little past 8 a.m. on the following day.

Based on the decrease, TEPCO estimated that 747 tons of radioactive rainwater seeped into the soil.

The plant operator measured levels of beta-ray-emitting materials in the leaked water and detected a maximum reading of 8,300 becquerels per liter at one location. The average level of radioactivity at five sample locations was 2,300 becquerels per liter, according to TEPCO.

**Highly contaminated water also leaked from the same area and seeped into the ground in summer 2013. As a result, TEPCO paved the surrounding area with asphalt to prevent a recurrence in the event of radioactive water spilling out.**

In the latest leakage, workers discovered bubbles at the junctions of side ditches in the area. Officials said this indicated that contaminated rainwater had seeped through the junctions and into the ground.

According to the plant operator, although highly contaminated water with radioactive levels of tens to hundreds of millions of becquerels per liter is stored near the leakage site, no problems have been reported with the tanks and pipes of those nearby storage facilities.

## **Radioactive rainwater leak at Fukushima plant**

[http://www3.nhk.or.jp/nhkworld/english/news/20150311\\_08.html](http://www3.nhk.or.jp/nhkworld/english/news/20150311_08.html)

The operator of the Fukushima Daiichi nuclear plant says an estimated 750 tons of rainwater with relatively high levels of radioactivity has been leaked. But company officials say they believe this water has not flowed into the Pacific Ocean.

Tokyo Electric Power Company says its workers discovered the leakage in an area called H4 in the western part of the complex where radioactive water is stored in 58 tanks. **The rainwater had leaked from a dam surrounding these tanks.**

**The H4 area is located on the hillside of the plant, near the No. 4 reactor building.**

Workers had closed a valve for a drainage channel last week following the detection in the area of rainwater with relatively high levels of radioactivity.

TEPCO officials said the rainwater was 15 centimeters deep at 10:30 PM on Monday, but the figure had fallen to 8 centimeters shortly after 8 AM on Tuesday.



Workers traced the leak after finding 2 puddles of radioactive water outside the dam.

They say the water inside the dam contained up to 8,300 becquerels per liter of beta-particle-emitting substances.

TEPCO officials say all the water has now been collected. They say the drainage channel to the ocean is buried underground and it is unlikely that the water flowed into the ocean.

## Water: TEPCO's never-ending battle

### Fukushima No. 1's never-ending battle with radioactive water

<http://www.japantimes.co.jp/news/2015/03/11/national/fukushima-1s-never-ending-battle-radioactive-water/#.VQAJw-HkeXs>

by Kazuaki Nagata  
Staff Writer

The disaster that struck four years ago may have abated for most of the Tohoku region, but the nightmare continues at Tokyo Electric Power Co.'s Fukushima No. 1 nuclear plant, which suffered three reactor core meltdowns and is plagued daily by increasing amounts of radioactive water.

Tepco hopes to improve the situation via two key measures: a 1.5-km-long sunken wall of frozen soil encircling stricken reactors 1, 2 and 3 and the damaged reactor 4 building to keep groundwater from entering and mixing with coolant water leaking in the reactor building basements, and "subdrain" wells around the buildings to pump up the tainted groundwater for treatment and ultimate discharge into the Pacific.

The utility hopes these steps will drastically reduce the amount of radioactive water, which is now increasing daily by some 300 tons.

Many experts, however, say Tepco can't expect smooth sailing as a wall of underground ice of such magnitude has never before been attempted.

And Tepco's plans to pump up tainted groundwater via the subdrains and discharge it into the sea after removing most of its radioactive components also appears iffy. The company has already lost the trust of fishermen over its failure to disclose the extent of the radioactive water flowing into the Pacific.

The crippled complex has to contend with some 300 tons of new tainted groundwater every day, and part of the process has entailed a nonstop effort to build steel storage tanks. The groundwater, mainly rain that seeps into the soil both at the complex and at locations farther inland, flows toward the sea, including into the basements of the buildings housing the three wrecked reactors.

There, the groundwater mixes with radioactive water that is leaking from cracks in the reactors. Tepco must keep pumping new water into the reactors to cool the melted fuel rods within. The basements are too radioactive to enter.

The problematic groundwater flow used to amount to 400 tons daily, but the utility has taken some steps, including paving over part of the complex with asphalt to keep rainwater from seeping underground. To stop the increase of tainted water, Tepco must keep all, or at least nearly all, groundwater from flowing into the basements.

The sunken ice wall is considered critical to this goal and Tepco has been setting up pipes to run coolant underground to freeze the soil — a process the utility hopes to start at the end of this month if it receives approval from the Nuclear Regulation Authority.

Although Tepco said it will take several months to completely freeze the soil into a solid ice wall, it expects the wall to reduce the amount of groundwater flowing into the reactor buildings to 50 tons a day from 300 at present.

One “problem will be how long it will take to freeze soil evenly (to make an ice wall without holes), and we have already seen this problem when Tepco attempted to make ice walls inside the underground trench (connected to the reactor turbine buildings),” said Shigeaki Tsunoyama, an education and research special adviser at the University of Aizu.

“I’m worried that the same thing might happen with the ice wall (encircling the reactor buildings),” said Tsunoyama, who sits on a panel formed by the NRA to oversee the decommissioning of the nuclear plant. Fukushima No. 1 has a maze of underground trenches connected to the reactor turbine buildings to run cables and pipes, and they are now filled with highly radioactive water leaking from the turbine buildings. To remove the water in the trenches, Tepco tried for months to block the tainted water running from the buildings by freezing it before abandoning the effort last year.

Kiyoshi Takasaka, an adviser on nuclear issues to the Fukushima Prefectural Government, also said there are many unknown technical factors regarding the ice wall, including areas where the uneven groundwater flow is fast and underground cable and pipe conduits that may impede the freezing effort. Then there’s the plan to pump up groundwater from dozens of subdrain wells built around the reactor buildings and dump it into the sea.

This is different from the so-called groundwater bypass, which is already underway and aimed at intercepting clean groundwater before it arrives at the plant and pumping it into the ocean directly. If the subdrain well plan works effectively along with the ice wall, Tepco estimates it will be able to effectively stop the groundwater from reaching the reactor buildings.

Ending the increase is a pressing issue because the utility has been endlessly making tanks to store the tainted water at the site, and some of those tanks have leaked.

Tepco already has more than 500,000 tons of tainted water on its hands. As this amount grows, so does the possibility of leaks. Also, the amount of high-level radioactive waste derived from the cleaning process will also increase.

Meanwhile, the groundwater pumped up from some of the subdrain wells likewise contains highly radioactive materials.

Tepco says it will scrub the water with treatment systems to lower the levels of radioactive substances to less than the legal limits before discharging it into the sea.

This plan was authorized by the NRA in January, but Tepco has been unable to get fishermen to approve it. People in Fukushima “do not want Tepco to dump the water into the sea. The most troubling thing is . . . harmful rumors,” said Tsunoyama, who is also an adviser to Fukushima Prefecture on nuclear issues. “You can’t really persuade people to ignore harmful rumors,” he said.

The subdrain well plan is also not a cure-all, as it was revealed last month that Tepco knew radioactive rainwater has been leaking from the roof of a reactor building into the sea since last spring but did not think it necessary to disclose this information.

Some of the fishery groups in Fukushima were about to agree to the plan, but Hiroshi Kishi, chairman of the National Federation of Fisheries Cooperative Associations, said fishermen no longer have any trust in the utility — and this will make it even harder for Tepco to get them on board.

Tsunoyama and Takasaka both said Tepco won't be able to start the subdrain well plan anytime soon, so the ice wall will be a vital step in slowing the increase of radioactive water.

Takasaka said that although such an ice wall has been used before in civil engineering work, the scale of the project at Fukushima No. 1 will be unprecedented.

Takasaka and Tsunoyama said Tepco's measures have tended to be ad hoc, so it has always had to come up with extra measures. The utility must make careful plans, including identifying spots expected to be tough to freeze, and take precautions to avoid unexpected problems in creating the ice wall, they said.

## **The Fukushima Disaster, four years on**

[http://www.beyondnuclear.org/storage/publications/OnLine\\_Thunderbird\\_BeyondNuclear\\_March2015.pdf](http://www.beyondnuclear.org/storage/publications/OnLine_Thunderbird_BeyondNuclear_March2015.pdf)

What is new at the stricken Fukushima site since the March 11, 2011 nuclear disaster there began? What really happened? And what are the health implications, both in Japan and for the U.S. if a similar nuclear disaster happened here? The newly released spring edition of the Beyond Nuclear newsletter, The Thunderbird, looks at these issues and more. Free to download and distribute widely.

## **747 tons water leak**

### **Another contaminated water leak found at Fukushima nuke plant**

<http://mainichi.jp/english/english/newsselect/news/20150311p2a00m0na003000c.html>

Some 747 metric tons of contaminated rainwater has leaked from a water storage tank area at the Fukushima No. 1 nuclear plant, Tokyo Electric Power Co. announced on March 10.

According to the plant operator, there are two layers of barriers around the groups of storage tanks built to hold radioactively contaminated water generated at the shattered nuclear station. The problem was first detected on the morning of March 10 by a TEPCO worker on a regular patrol around the storage tank group, who noticed the depth of rainwater collected between the outer and inner barriers had dropped by about 5 centimeters. The water valves in the outer barrier were closed, and the worker found two puddles forming outside the perimeter.

TEPCO stated that analysis of water samples from five points between the inner and outer barriers found contamination of up to 8,300 becquerels of beta radiation-emitting material per liter. The utility said that the water that had leaked through the barriers -- likely through the tie holes in tarps that have been lashed together -- was being absorbed into the ground and was not flowing to the ocean. TEPCO also suggested that the base of the barriers could be damaged. The barriers range from 30 to 50 centimeters tall.

"There is no change in the water levels in the tanks, so this contaminated water leak is not from the tanks themselves," the TEPCO announcement stated.

## **Hundred of tons of radioactive water seep into soil (2)**

March 11, 2015

### **Another contaminated water leak found at Fukushima nuke plant**

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TEPCO stated that analysis of water samples from five points between the inner and outer barriers found contamination of up to 8,300 becquerels of beta radiation-emitting material per liter. The utility said that the water that had leaked through the barriers -- likely through the tie holes in tarps that have been lashed together -- was being absorbed into the ground and was not flowing to the ocean. TEPCO also suggested that the base of the barriers could be damaged. The barriers range from 30 to 50 centimeters tall.

"There is no change in the water levels in the tanks, so this contaminated water leak is not from the tanks themselves," the TEPCO announcement stated.

## **Toxic waste water out of control**

### **Contaminated wastewater yet to be controlled**

[http://www3.nhk.or.jp/nhkworld/english/news/20150311\\_26.html](http://www3.nhk.or.jp/nhkworld/english/news/20150311_26.html)



[http://www3.nhk.or.jp/nhkworld/english/news/20150311\\_26.html](http://www3.nhk.or.jp/nhkworld/english/news/20150311_26.html)

Contaminated wastewater continues to accumulate at the crippled Fukushima Daiichi nuclear plant in northeastern Japan.

The amount is increasing by about 350 tons a day as groundwater seeps into the plant's No.1 through No.4 reactor buildings and mixes with highly radioactive wastewater pooled there.

The plant's operator, Tokyo Electric Power Company, or TEPCO, pumps up the wastewater to store it in tanks. 600,000 tons, including processed water, is stored at the facility. This plus wastewater pooled in the buildings brings the total to 680,000 tons.

The government and TEPCO have been pumping up groundwater to keep it out of the plant, and releasing it into the sea since last May. They say this has reduced the daily inflow of groundwater by about 100 tons.

Also underway are efforts to keep groundwater out of the site by freezing soil around the buildings and surrounding them with a wall of ice 1,500 meters long. TEPCO plans to start making the ice wall this month.

But a plan to pump up groundwater from a monitoring well near the buildings, filter it and release it into the sea has been fiercely opposed by local fishers.

TEPCO has installed 3 systems to remove almost all radioactive substances from the wastewater. But their processing rate remains below an initial estimate.

The utility had planned to finish processing the water this month, but gave up on doing so. It now estimates that removing some of the radioactive substances will take until May. The water must then be reprocessed, to lower risks.

It was revealed last month that contaminated rainwater that had pooled on the roof of the No. 2 reactor

building had been leaking out to sea through a drainage channel.

TEPCO knew as far back as April last year that radiation levels in the channel rose every time it rained. The firm's failure to disclose this has drawn strong protests from local fishers and municipalities.

March 12, 2015

## 30-fold radiation spike in groundwater after leak

### Groundwater radiation levels surge after leak

[http://www3.nhk.or.jp/nhkworld/english/news/20150312\\_11.html](http://www3.nhk.or.jp/nhkworld/english/news/20150312_11.html)

The operator of the Fukushima Daiichi nuclear plant says levels of radioactive material in groundwater have surged 30-fold, apparently after contaminated rainwater leaked outside a barrier.

Workers at Tokyo Electric Power Company, or TEPCO, discovered the problem on Tuesday at an area in the hillside part of the complex where radioactive water is stored in tanks.

TEPCO says rainwater that is pooled outside the double barrier surrounding the complex had spread and apparently seeped into the ground.

The company estimates the leak at about 750 tons of rainwater, and it says levels of beta ray-emitting substances in water inside the barrier registered a maximum 8,300 becquerels per liter.

On Wednesday, TEPCO measured 11,000 becquerels per liter in groundwater from nearby monitoring wells. That's up from 370 becquerels on Monday, the day before the leak was found.

The utility says it does not know yet if the contaminated rainwater has seeped into the Pacific Ocean. It says the water leaked from seams in the barrier.

## Trying to keep stress levels down

## **Nuclear Watch : Stress on The Front Lines of Fukushima Cleanup**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclearwatch/20150312.html>

Four years ago, crews at Fukushima Daiichi in Japan were racing to keep the nuclear plant from spiraling out of control following the earthquake and tsunami. Today, that sense of urgency has dissipated. But the situation remains serious as workers juggle a host of problems as they decommission the facility. Given the risks involved, health concerns and other worries weigh heavily on their minds.

Fifty-one-year-old Mitsuhiro Maeda has been working for more than 20 years as an electrical contractor at the Fukushima Daiichi plant.

Before the accident, he supervised 30 workers and took pride in his contribution to the plant. "I felt we were helping Japan," he recalls. "We were generating electricity, and supporting the country."

Maeda rushed to the plant when he heard about the accident. He worked on restoring external power, which was crucial in cooling the reactors and averting an even bigger disaster. "Someone had to restore power at the Daiichi plant. I just acted because it was my duty," he says.

Working in the aftermath of the disaster, he was exposed to the maximum permissible amount of radiation. Health and safety restrictions prevent him from returning to Daiichi until next year.

Every day about 7,000 workers help decommission the reactors. In heavy protective clothing, they carry out such tasks as collecting and storing contaminated water. However, the decommissioning work is expected to take up to 40 years to complete. Keeping stress levels down and morale up is proving difficult. Maeda says a change of mood has definitely come over his staff. He also says it's getting harder to find new skilled workers. His company now has only one-third the number of experienced workers it had before the accident. "If it carries on like this, we'll go out of business," he says.

Four years after the disaster, the decontamination of land around the plant continues. But it is hard to predict when places like Maeda's hometown of Namie will be habitable again. He says many residents are losing hope of returning home.

Maeda is helping decommission the reactor out of a sense of duty to his hometown, he says he sometimes loses his faith in the future and is starting to doubt whether it's a good idea to continue his business. "We need to figure out how to pass on this responsibility to the next generation. Otherwise I can't see a clear future for the power plant," he says.

Reducing the risk of radiation and improving the working environment is important, but these efforts are not enough to secure workers over the long-term. Those on the front lines, like Maeda, also need to have motivation and hope.

March 13, 2015

## **Water contamination caused by radioactive soil?**

### **TEPCO suspects radioactive soil at nuclear plant source of rainwater contamination**

<http://mainichi.jp/english/english/newsselect/news/20150313p2a00m0na013000c.html>

A contaminated rainwater leak reported at the crippled Fukushima No. 1 Nuclear Power Plant earlier this week **might have been caused by radioactive soil that had been left untreated since 2012**, plant operator Tokyo Electric Power Co. (TEPCO) said.

TEPCO reported on March 10 that approximately 747 metric tons of contaminated rainwater has leaked from barriers (30-50 centimeters in height) built around water storage tanks that hold radioactively contaminated water generated at the nuclear plant. Following the rainwater leakage, some 11,000 becquerels of beta emitting radioactive materials, such as strontium-90, were detected per liter of underground water around the water tank area, suggesting the possibility of contamination in underground water.

According to the utility, high doses of radiation -- up to 35 millisieverts of beta rays per hour -- were measured at an area outside the barriers on March 11. **The soil in the area had absorbed some 100 tons of highly contaminated water when it leaked in 2012.** A TEPCO representative says the utility may have failed to collect all the contaminated soil in the area.

TEPCO is beefing up the monitoring system at the shattered nuclear plant to find out the extent of the rainwater leak. A utility official commented, "There is no leakage from the storage tanks, and the underground water will not flow into the ocean."

March 16, 2015

## TEPCO promises to reduce exposure

### TEPCO: Annual radiation dose can be cut

[http://www3.nhk.or.jp/nhkworld/english/news/20150316\\_26.html](http://www3.nhk.or.jp/nhkworld/english/news/20150316_26.html)

The operator of the Fukushima Daiichi nuclear power plant says it will be able to reduce the annual radiation exposure at the plant compound to below the limit set by Japan's nuclear regulators.

**Tokyo Electric Power Company says it will be able to cut the figure to less than one millisievert by the end of this month.** This will be in line with an order issued by the Nuclear Regulation Authority.

The company says a close study of a future plan to deal with tainted water shows that it will be able to **reduce radioactive materials in about 80 percent of the water within this month.**

About 600,000 tons of highly radioactive water from reactor buildings has been stored in tanks within the plant compound.

Experts say workers would be exposed to about 3.5 millisieverts of radiation from the tainted water in the tanks if they stayed on the compound for a year.

TEPCO has also set a new goal of treating most of the tainted water at least once by end of May. The



company had initially set an end-of-March deadline for treating the water.

At the moment, about 7,000 people work at Fukushima Daiichi every day as they prepare to scrap the reactors and deal with radioactive water.

**Their work environment is expected to improve if radiation exposure from the tainted water drops. But some radioactive substances will remain in the water even after being treated.**

## **TEPCO delays making ice walls**

[http://www3.nhk.or.jp/nhkworld/english/news/20150317\\_02.html](http://www3.nhk.or.jp/nhkworld/english/news/20150317_02.html)

Tokyo Electric Power Company has postponed a project designed to keep groundwater out of the Fukushima Daiichi nuclear plant, where it is trying to reduce the buildup of contaminated water at the site.

The company was planning to freeze soil around the crippled reactor buildings in order to create an underground wall of ice a kilometer and a half long.

The work was slated to start this month, but was postponed by one month following the accidental deaths of workers in January.

Work has scheduled to begin to freeze soil in one section, between the plant and a hill.

But TEPCO says it has not yet asked the nuclear regulator for permission to freeze another section between the plant and the sea, and it is unclear when the full frozen wall will be completed.

The buildup of radioactive water is another problem the utility is facing. TEPCO said it would process 600,000 tons of tainted water by the end of May. Now it says that 20,000 tons, including much amount of seawater, will not be finished by that time.

March 17, 2015

## **TEPCO will miss deadline of water decontamination**

### **Tepco to miss May deadline to treat 20,000 tons of Fukushima radioactive water**

<http://www.japantimes.co.jp/news/2015/03/17/national/tepco-to-miss-may-deadline-to-treat-20000-tons-of-fukushima-radioactive-water/#.VQg1fuF1Cos>

Jiji

NARAHARA, FUKUSHIMA PREF. – Tokyo Electric Power Co. said some 20,000 tons of radioactive water at the Fukushima No. 1 nuclear plant will be left untreated as of May, missing its cleanup target.

**Tepco cited the presence of relatively high levels of seawater-derived substances, including magnesium, and therefore it will take several more months to treat that portion of the contaminated water. The affected water represents 3 percent of the 600,000 tons of tainted water stored at the plant.**

The rest of the contaminated water is expected to be treated by that month using either the Advanced Liquid Processing System, or ALPS, which can drastically reduce levels of 62 radioactive substances, or another system capable of removing strontium-90, a radioactive isotope that is particularly harmful for human health.

Tepco presented the estimates at a meeting Monday with the government held in Naraha, Fukushima Prefecture.

The plant operator initially targeted completion of the treatment of all radioactive water by the end of this month, but it pushed back the deadline to May due to a lower than anticipated running rate of the ALPS system.

Tepco will show later how long the water cleanup work will be prolonged, a senior company official told reporters after the meeting.

Also at the meeting, Tepco said it will likely be able to start freezing soil around the four shattered reactor buildings in April. The utility hopes to form an underground ice wall to block the inflow of groundwater into the facilities' basements and thus stem the volume of radioactive water that it needs to take care of. The soil freezing had been initially planned to start this month, but preliminary work was suspended for about a month amid safety checks following the death in January of a plant worker in an accident.

## More precise radiation measurements from the air

### Measuring radiation from airship

[http://www3.nhk.or.jp/nhkworld/english/news/20150317\\_37.html](http://www3.nhk.or.jp/nhkworld/english/news/20150317_37.html)

A research team at Fukushima University has developed a system to measure radiation levels on mountains using an airship.

The group showed the system to media on Tuesday.

**The 14-meter-long unmanned airship has 2 devices on its bottom that measure radiation levels and types of radioactive substances on the ground.**

The craft took off from the university and slowly circled a mountain in the suburbs of Fukushima City to take measurements.

The group says the system is expected to obtain data more accurately than airplanes because airships can fly lower and more slowly.

The state uses airplanes to measure radiation from the air.

The system is expected to show where radioactive substances traveled from and accumulated after the accident at the Fukushima Daiichi nuclear power plant in March 2011. The group hopes it will help develop efficient methods for decontaminating mountains.

Team leader Professor Akira Watanabe says providing scientific data is the first step in ensuring a sense of safety, so his team will work to carry out precise measurements.

On Tuesday, strong wind blew the airship off its initially planned route, reportedly causing it to fall in a mountain forest. The team faces the challenge of achieving stable flight in windy and other poor weather conditions.

March 19, 2015

## Confirmed by muons: No more fuel in No1 core

### Images show no fuel inside No.1 reactor core

[http://www3.nhk.or.jp/nhkworld/english/news/20150319\\_34.html](http://www3.nhk.or.jp/nhkworld/english/news/20150319_34.html)

Researchers say X-ray-like photos of a crippled reactor at the Fukushima Daiichi plant have confirmed that no nuclear fuel remains in the reactor core.

The finding supports the result of a simulation suggesting most of the molten fuel penetrated the core's base.

Nuclear fuel in 3 of the plant's 6 reactors melted down in the March 2011 nuclear accident at the plant. But extremely high radiation levels have prevented experts from locating and determining the state of the molten fuel.

Experts from the High Energy Accelerator Research Organization and other institutions have succeeded in taking X-ray-like photos of the plant's No.1 reactor.

Since February, they have been using a type of elementary particle called the muon to get a peek inside the reactor, instead of using X-ray technology. The particles are created when cosmic rays collide with the Earth's atmosphere.

The experts found nuclear fuel inside a storage pool located beside the No.1 reactor. But they did not find fuel inside the core of the reactor where the meltdown took place.

The finding confirms the result from an earlier computer simulation that suggested most of the fuel in the reactor core likely melted and fell through the bottom into the containment vessel housing the core.

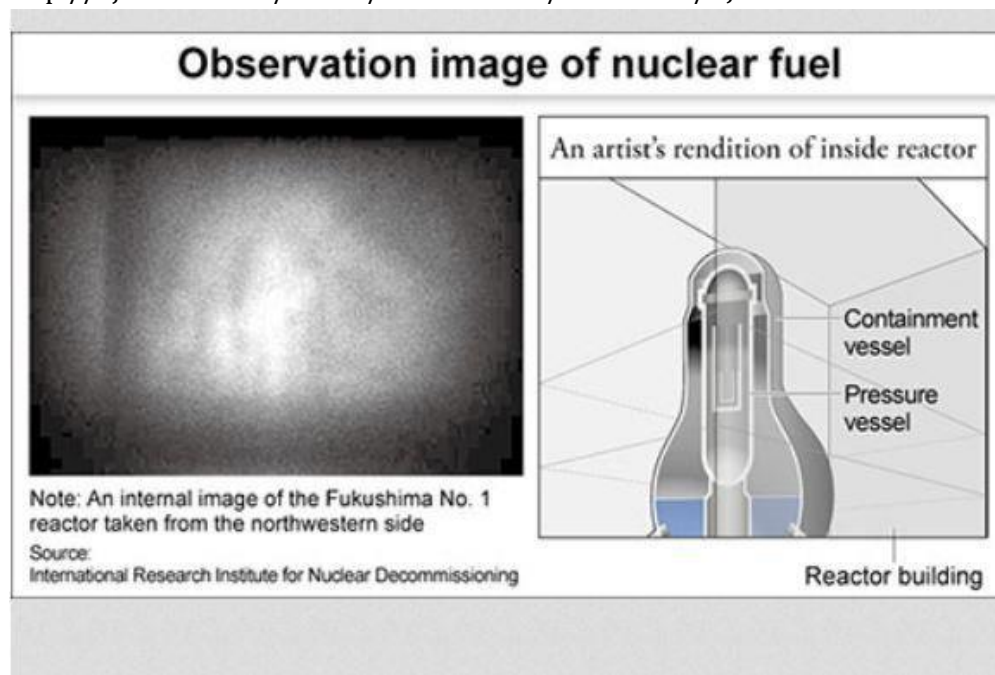
Experts say the finding that most of the fuel had leaked out of the reactor core underlines the difficulties faced in scrapping the reactor.

March 20, 2015

## TEPCO confirms all fuel melted in No.1

### TEPCO believes nearly all nuclear fuel melted in Fukushima reactor

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201503200050>



By TSUYOSHI NAGANO/ Staff Writer

Tokyo Electric Power Co. said almost all the nuclear fuel in the No. 1 reactor at the Fukushima plant likely melted in the aftermath of the 2011 Great East Japan Earthquake and tsunami.

The plant operator said March 19 that internal observations of the reactor building using cosmic rays reinforce earlier suspicions that all the fuel had melted and dropped to the bottom of the containment vessel.

Direct observations have been impossible because high radiation levels are preventing workers from approaching the damage inside the No. 1 reactor building.

TEPCO and the International Research Institute for Nuclear Decommissioning (IRID) have been working since February to study the interior of the reactor building at the Fukushima No. 1 nuclear plant. The study uses special equipment to examine muons--subatomic particles generated when cosmic radial rays collide with the atmosphere--that have passed through the reactor building to produce images similar to an X-ray.

Although muons can pass through concrete and iron, they are blocked by high-density materials, such as uranium, thereby creating a "shadow" of nuclear fuel.

The muon observation method has been used to study the inside of a volcano and the interior of ancient Egyptian pyramids.

The images of inside the No. 1 reactor did not show any nuclear fuel shadows around the reactor core, indicating that all fuel melted and fell to the bottom of the containment vessel after the earthquake four years ago.

The latest findings corroborate the results of an earlier computer prediction. However, muon observation is unable to detect objects smaller than 1 meter or see through the lower parts of the containment vessel. TEPCO said it will continue observation efforts to make clear what happened inside the reactor.

### **TEPCO releases 'see-through' image of Fukushima reactor**

<http://mainichi.jp/english/english/newsselect/news/20150320p2a00m0na013000c.html>

Tokyo Electric Power Co. (TEPCO) released a "see-through" image of the No. 1 reactor at the Fukushima No. 1 Nuclear Power Plant on March 19, suggesting that most of the nuclear fuel was no longer in the reactor.

The image was taken with muons, which are created when cosmic rays hit the Earth's atmosphere. Muons pass through substances like concrete but are absorbed by highly dense material like nuclear fuel.

The image was taken from Feb. 12 through March 10. The inside of the reactor's pressure vessel, which holds the nuclear fuel, showed as white, meaning that most of the fuel was gone. The muons should have shown the presence of fuel rods around one meter or longer.

The image supports the calculations by TEPCO and others that most of the fuel melted out of the reactor. It marks the first time the interiors of the Fukushima plant's reactors have been directly photographed. In the future, TEPCO plans to insert a camera-equipped robot into the lower part of the containment vessel to look for the melted fuel.

### **TEPCO confirms nearly all fuel melted in Fukushima No. 1 unit**

<http://mainichi.jp/english/english/newsselect/news/20150320p2g00m0dm028000c.html>

TOKYO (Kyodo) -- Tokyo Electric Power Co. said Thursday it has confirmed that nearly all fuel in the No. 1 reactor at its Fukushima Daiichi nuclear power plant has melted and fallen into the containment vessel, through analysis using elementary particles called muons.

The result marks the first confirmation of a meltdown of the reactor in the wake of the March 2011 massive earthquake and tsunami.

The utility plans to use the analysis result to devise methods for removing the melted fuel, the most difficult hurdle in decommissioning the plant.

Muons are elementary particles that form from the cosmic radiation reaching the Earth from space.

While muons penetrate most matter, they change direction in the face of uranium in nuclear fuel.

The analysis has been made since February with two measuring equipment units utilizing the nature of muons.

## **Tepco confirms nearly all fuel melted, sank into vessel, in Fukushima No. 1 unit**

<http://www.japantimes.co.jp/news/2015/03/20/national/tepcoco-confirms-nearly-fuel-melted-sank-vessel-fukushima-1-unit/#.VQtLEuF1Cot>

Tokyo Electric Power Co. said Thursday it has confirmed that nearly all fuel in reactor 1 at its Fukushima No. 1 nuclear power plant has melted and fallen into the containment vessel, through analysis using elementary particles called muons.

The result marks the first confirmation of a meltdown of the reactor in the wake of the March 2011 massive earthquake and tsunami.

The utility plans to use the analysis result to devise methods for removing the melted fuel, the most difficult hurdle in decommissioning the plant.

Muons are elementary particles that form from the cosmic radiation reaching the Earth from space.

While muons penetrate most matter, they change direction in the face of uranium in nuclear fuel.

The analysis has been made since February with two measuring equipment units utilizing the nature of muons.

## **Meltdown at No.1 confirmed**

erratum (March 21, 2015) from Gordon Edwards:

In a very recent e-mail about the Muon Scan at Fukushima showing the Complete Meltdown of Unit 1, I incorrectly stated that "***workers have only now finished building the largest mobile structure every constructed -- an enormous containment shell that will slide on concrete rails to fit tightly over the damaged Chernobyl reactor***". In fact the construction is not yet finished, but it was expected to be finished and fitted over the Chernobyl reactor in the summer of 2015. Apparently, according to World Energy News, that target date has now been pushed forward to the end of 2017. Sorry for the error. The enormous and highly sophisticated steel structure is called the "New Safe Confinement". It stands 110m high, and it is 250m wide and 150m long, weighing in at 30,000 tonnes. It is currently being assembled 600m away from the damaged reactor. This allows the workers to work for 40 hours a week without exceeding the radiation exposure limits for atomic workers. Once it is finished the entire massive structure will be "slid" along concrete tracks to fit over the old crumbling sarcophagus. It is called a "Confinement" structure rather than a "Containment" structure because it is not designed to hold in hot pressurized gases as reactor containments are required to do, but simply to confine radioactive solids and

dusts and vapours that may be stirred up during an inadvertent collapse of the existing sarcophagus or of the damaged reactor building itself, or by the radioactive demolition work that will be taking place inside the New Safe Confinement structure. See <http://tinyurl.com/owz9bwo>

**Background:** **March 20, 2015**

***It has long been known that three of the reactor cores at the Fukushima Dai-ichi nuclear station suffered meltdowns. In Units 1, 2 and 3, the nuclear fuel inside the reactor core, -- made mostly of uranium and plutonium oxides, and the fuel cladding, made of zirconium metal -- over-heated and melted at a temperature of 5000 degrees F (2800 degrees C).***

***The resulting mass of molten core material is called "corium". The question in many people's minds has been, how far did this molten material go? Did it collect and resolidify at the bottom of the reactor vessel? Or did it melt right through the reactor vessel and resolidify at the bottom of the containment vessel? Or did it melt even further, perhaps right through the floor of the reactor building into the ground below -- as the core of the Chernobyl reactor did in 1986?***

***Muon tomography is a technique developed in 2003 for obtaining a three-dimensional image of the internal distribution of very heavy elements (like uranium and plutonium) inside several thick-walled and otherwise impenetrable containers. This technique is well-suited to get a picture of where the fuel in a melted-down nuclear reactor might have gone after a major meltdown accident like the Fukushima disaster.***

***Muon tomography is a slow process requiring months of effort, harnessing extremely the energetic muons that are produced when cosmic radiation from outer space collides with air molecules in the Earth's atmosphere, and directing those muons through the core of the reactor, painstakingly building up a picture, in sections, of where the fuel is. Muons are much more penetrating than x-rays, and they are particularly good at picking out the heaviest elements while ignoring the lighter elements found (for example) in the walls of the containment structures.***

***Well the results are in for Unit 1, and the answer is -- there is no fuel in the core at all. The reactor vessel is devoid of fuel. It has all melted or dripped through the bottom of the reactor vessel, and it is still unknown where it has all gone to. We are talking about 150 tonnes of very heavy, intensely radioactive material, that has melted like candle wax and simply dripped away.... Time will tell whether the same is true for Units 2 and 3.***

***At Chernobyl, where the core of the reactor melted right down into the ground almost 30 years ago, workers have only now finished building the largest mobile structure ever constructed -- an enormous containment shell that will slide on concrete rails to fit tightly over the damaged Chernobyl reactor so that now, three decades after the accident, workers in Ukraine can begin the long and difficult job of dismantling the reactor building and recovering and packaging the many tonnes of highly radioactive corium from its underground cavity.***

**Gordon Edwards.**

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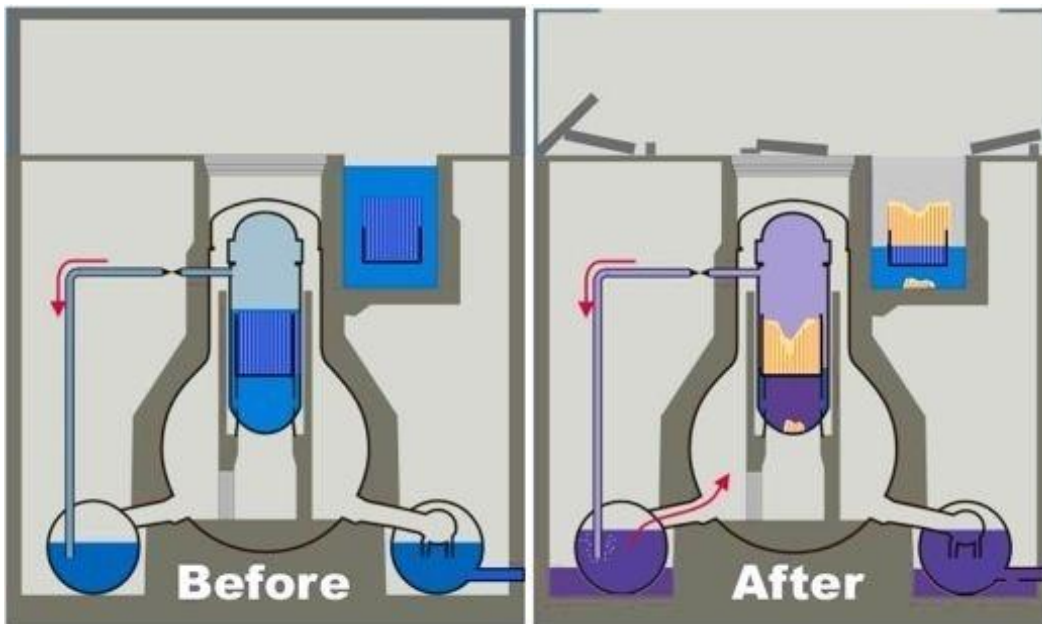
## Muon scans confirm complete reactor meltdown at Fukushima Reactor #1

By Joel Hruska, *Extreme Tech*, March 20, 2015

<http://tinyurl.com/l6l3pxa>

The Tokyo Electric Power Company (TEPCO) has announced that its muon tomography scanning efforts at Fukushima have borne fruit, and confirmed that nuclear plant's Reactor #1 suffered a complete meltdown following the earthquake and tsunami that struck Japan on March 11, 2011.

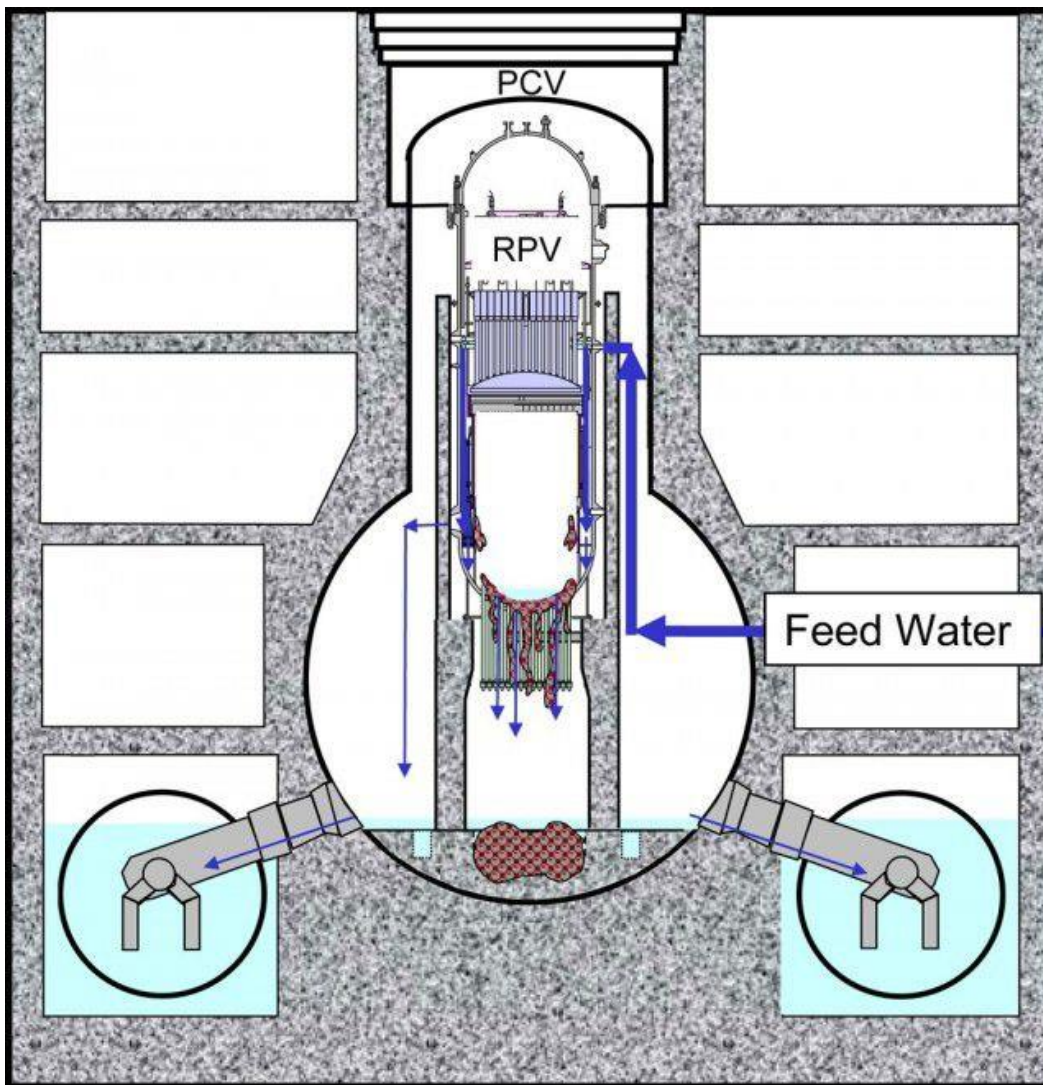
Thus far, the muon tomography scans haven't revealed anything that scientists and cleanup crews working at Fukushima didn't expect. But that doesn't make the work any less important. The only way to safely clean the site and dispose of the highly radioactive slag that's now believed to fill the bottom of the Pressure Containment Vessel, or PCV, is to first map out what melted within the core and where the flow went afterwards.



*Fukushima's Unit 1 reactor before and after*

Muon tomography was used to scan the damaged reactor because muons can penetrate materials that absorb other imaging wavelengths, like X-rays, in their tracks. Muons have also been used to image buildings and structures like the Great Pyramid in a search for secret chambers, and to examine volcano magma chambers for evidence of imminent eruptions. Superman's X-ray vision is actually more like muon vision, except for that whole can't-see-through-lead restriction.





*The expected position of Reactor #1's corium*

What today's findings confirm is that nuclear fuel rods inside the reactor underwent complete meltdown. The image below shows a before-and-after shot of what a reactor looks like in normal operation and then after partial meltdown has begun. Note that the water level inside the Reactor Pressure Vessel (RPV) has dropped and the rods are melting as a result. This began to happen in Reactor #1 within hours of the tsunami. Subsequent analysis over the past few years has confirmed that there seemed to be very little nuclear fuel remaining inside the RPV. Maybe.

*Did Fukushima suffer a melt-through at Reactor #1?*

After first denying that a melt-through had occurred, TEPCO later changed its tune and said that it most likely had, at least at Reactor #1. This means that molten corium flowed completely through the RPV and into the PCV before being stopped by the several meters of concrete within the base. This wasn't an entirely settled question, however, since radiation measurements and water testing have not found the isotope levels that would be expected if the majority of the corium were in direct contact with the concrete layer beneath the PCV. One alternate theory is that the seawater that was pumped into Reactor #1 after the disaster may have cooled the corium before it finished burning through the reactor pressure vessel.

Scans like the above appear to support TEPCO's position that melt-through occurred, but the organization's trustworthiness and understanding of the conditions at Fukushima Daiichi have been called into question multiple times since the accident. Conditions at the facility have been repeatedly misrepresented (or were simply inaccurate), and the company ignored multiple safety reports and warnings that the plant was vulnerable to a tsunami in the first place.

What happened to the fuel rods is more than an academic question. Reactor #1 contained an estimated 125 tons of uranium dioxide, zirconium, steel, boron carbide, and inconel, and finding out where the corium flowed is critical. TEPCO has announced that unlike Chernobyl, which is slowly being sealed inside a layer of concrete, they intend to scrap [*dismantle*] reactor Daiichi 1, 2, 3, and 4. This makes it particularly critical to understand where the corium *is* in order to facilitate its eventual removal. The scrapping process [*final decommissioning*] is a long one — it'll take an estimated 30-40 years to finish, and the company won't start removing [*molten*] reactor fuel until ten years after the accident.

## Muon scan can lead to varying conclusions

### Muon scan gives detailed, but incomplete, look at meltdown of No. 1 reactor

<http://www.japantimes.co.jp/news/2015/03/20/national/tepcoco-confirms-nearly-fuel-melted-sank-vessel-fukushima-1-unit/#.VQ1Ds-F1Cos>

AFP-JIJI

Confirmation this week that all the fuel inside one of the Fukushima No. 1 plant's broken reactors has long since melted leaves its operator with the tricky task of eventually scooping it all out, experts say.

Tokyo Electric Power Co. said Thursday it had performed a sophisticated scan of the plant's No. 1 reactor core, giving the most detailed picture so far of what is going on in the high-radiation environment.

Nuclear experts said Friday that the test showed the unit's fuel rods had melted beyond recognition.

"The results reaffirmed our previous understanding that a considerable amount of fuel had melted inside the nuclear pressure vessels," said Hiroshi Miyano, a visiting professor at Hosei University in Tokyo.

**"But there has been no evidence that the fuel has melted through the nuclear containment buildings and reached the outer environment,"** Miyano said.

However, the scan — based on tomography imaging that made use of elementary particles called muons — did not look at the bottom part of the reactor, where the molten fuel would have pooled. So some experts suggested that it was not possible to tell whether the fuel had indeed been contained.

The fuel rods are installed the reactor's pressure vessel, which is in turn enclosed by the primary containment vessel. These rods generate the heat used to drive steam turbines and produce electricity but must be submerged at all times to avoid melting.

"Eventually, Tepco is aiming to scoop out the melted fuel little by little, rather than burying it in concrete" as was done at Chernobyl in the former Soviet Union, Miyano said.

Muons, which continually shower the earth from space, penetrate solid objects to a greater depth than x-rays. The rate at which they pass through a material indicates its density and helps scientists to identify it. Since muons move more slowly through relatively dense plutonium and uranium fuel than through the reactor vessel itself, mapping their trajectory can reveal exactly where the fuel is — or isn't.

The data from this test should help Tepco's effort to decommission the plant, which lost all power in March 2011 after the Pacific coast of Tohoku was swamped by huge tsunami. The blackout triggered a triple core meltdown.

The decommissioning process at Fukushima is expected to take three or four decades.

Experts say the latest results and the operator's assessment of them were in line with earlier expectations.

**"We presume that despite the meltdown, the fuel is still in the containment vessel,"** said Tomohisa Ito, a spokesman for the International Research Institute for Nuclear Decommissioning, a special research unit involved in dismantling the troubled plant.

"But we still need to directly check the situation one day using remote-controlled robots," he said.

Last month the International Atomic Energy Agency said Japan had made "significant progress" in its cleanup efforts but warned the situation "remains very complex" due to the growing amounts of contaminated water being generated by the process.

While the quake and tsunami that triggered the man-made nuclear crisis killed almost 19,000 people, mostly by drowning, no one is officially recorded as having died as a direct result of the meltdowns at Fukushima, though indirect deaths related to the disaster continue to climb.

However, tens of thousands of people remain displaced because of radioactive contamination around the plant, and **scientists warn that some settlements may have to be abandoned forever.**

March 21, 2015

## Information about reactor no.2 (Nagoya University)

### Cosmic beams reveal melted core inside Fukushima No. 2 reactor

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201503210033>

Researchers harnessing cosmic rays have discovered that all of the nuclear fuel inside the No. 2 reactor at the Fukushima No. 1 nuclear power plant melted in the aftermath of the 2011 earthquake and tsunami.

**The Nagoya University team** "looked into" the interior of the reactor using special equipment to examine subatomic particles known as muons passing through, producing images similar to an X-ray.

The researchers also used the method to study the core of the No. 5 reactor, which did not enter a critical state after the facility was overcome by the tsunami generated by the Great East Japan Earthquake.

As the images showed fewer signs of substances inside the No. 2 reactor compared with the No. 5 reactor, the team concluded that the fuel inside the former had fully melted.

March 23, 2015

## TEPCO must analyse causes of failures

March 23, 2015

### TEPCO urged to probe troubled projects at plant

[http://www3.nhk.or.jp/nhkworld/english/news/20150323\\_37.html](http://www3.nhk.or.jp/nhkworld/english/news/20150323_37.html)

Japan's Board of Audit says the operator of the damaged Fukushima Daiichi nuclear plant needs to seek compensation from companies that engaged in failed projects to reduce the buildup of contaminated water at the plant.

The Board of Audit has pointed out for the first time issues related to Tokyo Electric Power Company's spending on dealing with the contaminated water.

The Board mentioned one of TEPCO's projects. The utility once tried to freeze contaminated water in underground tunnels to stop the inflow of highly radioactive water from reactor buildings. But the plan failed, and TEPCO officials adopted a method of pouring cement into the flooded tunnels.

They say they had conducted experiments beforehand on the plan to freeze contaminated water.

But **the Board says that if the final outcome was different from the results of the experiments, the utility should fully analyze the cause and use it for future experiments.**

The Board points out other problems as well. These include shutting down a French water treatment system due to malfunctions only 3 months after the start of its operation. The system, which cost more than 250 million dollars, was introduced 3 months after the March 2011 accident.

In 2013, TEPCO was forced to stop using underground water tanks due to leaks just 2 months after their construction. The utility is also being forced to replace its contaminated water tanks with seamless ones due to leaks.

The Board of Audit says the issue of contaminated water may take a long time to resolve. It says TEPCO should analyze the causes of the problems to prevent similar incidents from happening.

**The Board also urges the utility to take measures to seek compensation from the operators of the troubled projects.**

March 24, 2015

## A big waste of (taxpayer) money!

### Board of Audit: Billions of yen wasted in Fukushima No. 1 cleanup

<http://www.japantimes.co.jp/news/2015/03/24/national/board-of-audit-billions-of-yen-wasted-in-fukushima-no-1-cleanup/#.VRKC8uF1Cos>

by Mari Yamaguchi  
AP

Government auditors say **Tepeco has wasted more than a third of the ¥190 billion in taxpayer money allocated for cleaning up Fukushima No. 1.**

A Board of Audit report describes various expensive machines and untested measures that ended in failure. It also says the cleanup work has been dominated by one group of utility, construction and electronics giants despite repeated calls for more transparency and greater access for international bidders.

Tokyo Electric Power Co. spokesman Teruaki Kobayashi said all of the equipment contributed to stabilizing the plant, even though some operated only briefly.

Some of the failures cited in the report:

**French import:** Among the costliest failures was a ¥32 billion machine made by French nuclear giant Areva SA to remove radioactive cesium from water leaking from the three wrecked reactors.

The trouble-plagued machine lasted just three months and treated only 77,000 tons of water, a tiny fraction of the volume leaking every day. It has since been replaced with Japanese and American machines.

**Salt removal:** Sea water was used early in the crisis to cool the reactors after the normal cooling systems failed.

Machines costing ¥18.4 billion from several companies, including Hitachi GE Nuclear Energy, Toshiba Corp. and Areva were supposed to remove the salt from the contaminated water at the plant.

One of the machines functioned only five days, and the longest lasted just six weeks.

**Shoddy tanks:** Tepco hurriedly built dozens of storage tanks for the contaminated water at a cost of ¥16 billion.

The shoddy tanks, using rubber seals and assembled by unskilled workers, began leaking and some water seeped into the ground and then into the ocean. The tanks are now being replaced with more durable welded ones.

**Giant underground pools:** A total of ¥2.1 billion was spent on seven huge underground pools built by Maeda Corp. to store the contaminated water. They leaked within weeks, and the water had to be transferred to steel tanks.

**Unfrozen trench:** A ¥100 million project to contain highly contaminated water in a maintenance tunnel by freezing it failed because the water never completely froze.

Tepco subsidiary Tokyo Power Technology even threw in chunks of ice, but eventually had to pour in cement to seal the trench.

See also:

### **¥189 billion in public money spent on Fukushima cleanup so far**

<http://www.japantimes.co.jp/news/2015/03/23/national/%C2%A5189-billion-in-public-money-spent-on-fukushima-cleanup-so-far/#.VRALa-F1Cos>  
and

### **TEPCO urged to probe troubled projects at plant**

[http://www3.nhk.or.jp/nhkworld/english/news/20150323\\_37.html](http://www3.nhk.or.jp/nhkworld/english/news/20150323_37.html)

March 27, 2015

## **Gates of No.3 storage pool out of position**

### **Fuel pool gates found shifted at Fukushima plant**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the disabled Fukushima Daiichi nuclear plant says 2 iron gates that keep cooling water inside a spent fuel pool were found to be out of position.

Tokyo Electric Power Company officials say **this could affect the removal of debris.**

The utility has been using an underwater camera to examine the condition of about 560 units of spent nuclear fuel inside the No.3 reactor storage pool.

TEPCO officials said on Thursday that both of the iron gates in the pool had shifted from their original positions.

They say **the inner gate was likely damaged by a large machine that fell into the pool.**

The operator says it **will examine if removal of the machine from the pool may trigger water leaks.**

The utility plans to remove the machine in April and will start removing nuclear fuel by the end of September.

## No.3 storage pool

### Fukushima rod handler blocking spent-fuel pool of unit 3: Tepco

<http://www.japantimes.co.jp/news/2015/03/27/national/debris-poses-risk-spent-fuel-pool-gate-fukushima-1s-reactor-3-tepco/#.VRUsVuF1Cot>

Kyodo

Tokyo Electric Power Co. has disclosed that a 35-ton piece of machinery debris might be resting on the inner gate of a spent-fuel pool in reactor 3 of the Fukushima No. 1 power plant and that the gate is slightly out of position.

Tepco said Thursday that a fuel-handling machine dislodged by the March 2011 quake, tsunami and triple core meltdown is touching one of two gates that stand between the pool and the reactor containment vessel.

The utility confirmed by underwater camera that **both of the 8-meter-high, 1.6-meter-wide gates are slightly out of position but said the pool remains properly sealed due to water pressure and does not appear to be leaking.**

A plan to remove the debris is being hammered out. If the gates are damaged, it might trigger a water leak from the pool, which contains 566 spent fuel assemblies, the utility said.

Tepco was planning to finish debris removal at the No. 3 reactor pool by the end of June and start removing the old fuel rods by the end of September. Tepco said it is not clear whether the latest setback will change that.

## Setback of No.3 spent fuel removal

### Setback at Fukushima No. 1 plant threatens reactor 3 rod removal

<http://www.japantimes.co.jp/news/2015/03/27/national/debris-poses-risk-spent-fuel-pool-gate-fukushima-1s-reactor-3-tepco/#.VRcg0uF1Cos>

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## New device to help locate melted fuel

### New device to see through damaged reactor unveiled

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Mar. 27, 2015 - Updated 12:35 UTC+1

A team of scientists has unveiled a new device that will help them get a clearer look inside reactors at the Fukushima Daiichi nuclear power plant by using elementary particles called muons.

The team, made up of **officials from Toshiba and the US National Los Alamos Laboratory**, showed the device to the media on Friday.

Studies are underway at the damaged plant to locate the melted fuel at 3 reactors using muons.

The particles pass through various substances, but when they meet dense materials such as uranium, they change course or are absorbed.

The new device uses muon detectors, each measuring 8 by 8 meters. The detectors will observe how the courses of the particles change before and after they pass through the reactors, and use that to visualize the substances inside.

**Two devices will be installed for the No. 2 reactor, one on each side of it, later in the year.**

The team says the resolution offered by the device is expected to be more than 3 times that of the equipment that has been used by a Japanese institution to scan the No.1 reactor.

The institution said earlier this month that its scan, which uses only one small detector, found almost no nuclear fuel inside the No.1 reactor core. That suggests that the fuel fell into the containment vessel.



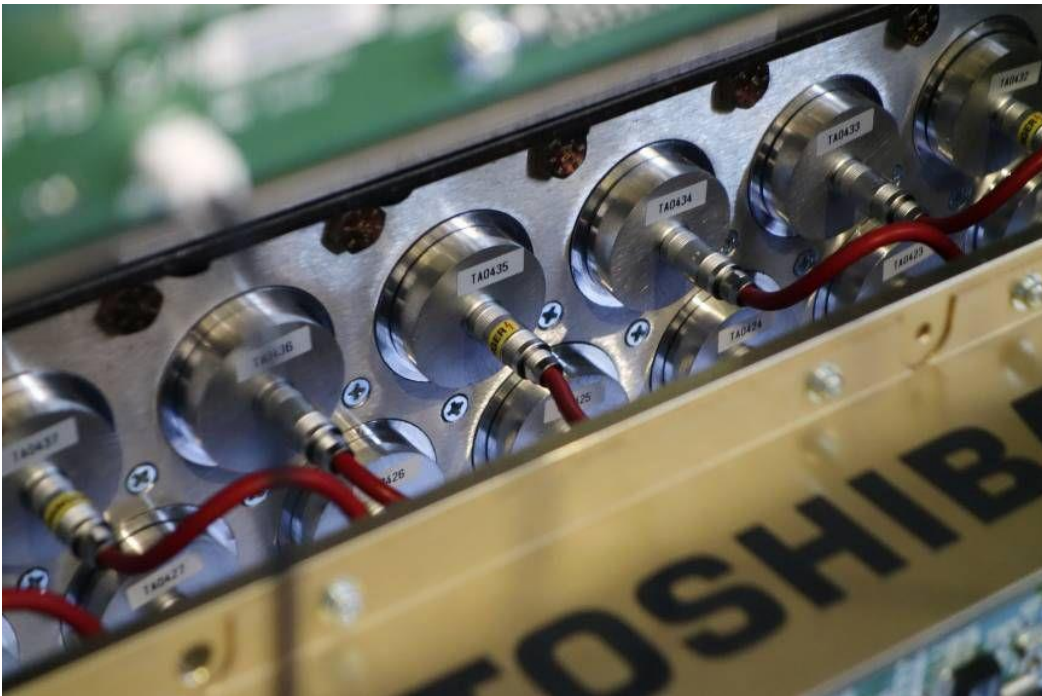
Toshiba official Haruo Miyadera says **the new device will help scientists discover details on the location and amount of the melted fuel**, and come up with ways to take it out.

March 28, 2015

## A "sobering reminder" of what lies ahead of decommissioning

### Technology that gives peek inside wrecked Fukushima reactors faces challenges

<http://www.japantimes.co.jp/news/2015/03/28/national/technology-that-gives-peek-inside-wrecked-fukushima-reactors-faces-challenges/#.VRcf3-F1Cos>



Muon drift tubes are seen on a piece of equipment shown to journalists by Toshiba officials at its research center in Yokohama on Friday. Using subatomic particles called muons, Toshiba says the drift tubes detect the muons and send data to electronic boards, which map images of the melted fuel in the Fukushima reactors.

by Yuri Kageyama

AP

YOKOHAMA – The cutting-edge technology was billed as a way to decipher where, exactly, the morass of nuclear fuel might sit at the bottom of reactors in the Fukushima nuclear power plant that went into multiple meltdowns four years ago.

But what went wrong, even in a simple demonstration for reporters Friday for the ¥500 million project, was **a sobering reminder of the enormous challenges that lie ahead for the decommissioning of the Fukushima No. 1 facility.**

Muons are cosmic ray subatomic particles so tiny they go through almost anything except for so-called heavy elements like uranium and plutonium used for nuclear fuel. They can help present a picture of what's inside an object, similar to the way doctors use X-rays, and have been used to study the Egyptian pyramids, the insides of volcanoes and ship cargo at ports.

The ideal scenario goes like this: Two giant walls more than two stories high will be set up right next to each reactor to shoot out muons so that data from how they scatter after hitting what's inside, picked up by sensors, can be analyzed. Such image-mapping is possible because muons will bend at different angles, depending on the material they hit.

But a programming glitch could not be fixed in time for Friday's demonstration at Toshiba's research center, near Tokyo, to show any image, even a mock-up, from the muons.

All reporters got to see was the huge piece of equipment, metal with lots of wirings and blinking little lights, in a giant garage-like building, and on its side, not straight up as it will be when put to use at the plant.

**Experts have long said that what's crucial for decommissioning is getting an image of the nuclear fuel** after the March 2011 tsunami crippled backup generators at Fukushima No. 1, setting off the worst nuclear catastrophe since Chernobyl, Ukraine, in 1986.

No one knows where the molten fuel debris lies, and in what shape or state. Tokyo Electric Power Co., which operates the facility, has said it likely sank to the bottom of the plant. But the fuel could possibly have escaped even beyond the containment facility to the outside environment.

Tadashi Yotsuyanagi, an official in charge of the muon project at Toshiba Corp., acknowledged radiation will be an obstacle for people doing the construction work to set up the walls. High exposure to radiation is unhealthy — and sometimes fatal.

**But once the image is relayed to a distant computer, studying that will not require people to be near radiation**, a plus of using muon technology for studying nuclear plants, according to Adrian Hillier, an expert on muons at the STFC Rutherford Appleton Laboratory in Britain.

Toshiba plans to start setting up the "muon trackers" at No. 1 sometime after October, but before next March.

The Japanese electronics giant, which owns Westinghouse Electric Co. of the U.S., is one of the main companies behind Japan's nuclear industry, including Fukushima. Toshiba has been working on the muon technology from right after the disaster, with the help of the Los Alamos National Laboratory in the U.S.

**But Yotsuyanagi acknowledged the technology will not be able to get the complete image toward the bottom of the reactor. He also said heavy radiation in the area would throw the sensors off, although that can be figured into the calculations of the scattered muons.**

David Ireland, a professor who heads the Nuclear Physics Group at the University of Glasgow, said muons may be the only way to probe inside atomic reactors.

"There are not really any other noninvasive options that will allow inspection," he said in an email.

March 31, 2015

## IAEA experts to check plant in April

### IAEA will probe Fukushima Daiichi water leak

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Experts from the UN nuclear agency will visit the damaged Fukushima nuclear power plant to examine the handling of contaminated water leaks by the plant's operator.

The International Atomic Energy Agency said on Monday the mission will visit Japan from April 17th to the 21st at the request of the Japanese government.

Officials of the Tokyo Electric Power Company will brief the experts on the leaks.

Workers were aware since last April that radiation levels in a drainage channel at the Number 2 reactor building rose every time it rained. TEPCO has been criticized for its failure not to disclose the matter earlier.

The IAEA experts are also expected to discuss how relevant information should be disclosed to the public when any trouble hits the plant.

Tainted rainwater was found to have leaked out of a barrier surrounding tanks holding contaminated water at the plant earlier this month.

The IAEA sent experts to Japan last month to check TEPCO's efforts to decommission the Fukushima Daiichi plant that was severely damaged by the disaster in March 2011. The team was due to come up with an official report by Tuesday, but the agency decided to send another mission instead following recent revelations of trouble at the plant.

**If you say so...**

## Ex-U.S. nuclear chief says tritium water at Fukushima No. 1 can be dumped safely

<http://www.japantimes.co.jp/news/2015/03/31/national/former-u-s-nuclear-chief-says-tritium-water-at-fukushima-no-1-can-safely-be-dumped-in-sea/#.VRuWUOHwmos>

by Kazuaki Nagata, Staff Writer

A former chief U.S. nuclear regulator asserted Tuesday that the massive volumes of tritium-tainted water stored at the Fukushima No. 1 nuclear plant can be “safely” dumped into the sea after it is diluted to reduce the levels of radioactive tritium below the legal limit.

“Most people don’t know what tritium is, so what they will think about is that it’s bad, something that’s really dangerous. But tritium is an element that we know a lot about,” Dale Klein, chairman of Tokyo Electric Power Co.’s Nuclear Reform Monitoring Committee, told a news conference in Tokyo.

“It can be released safely into the ocean. We know worldwide what the safe limit for tritium release is,” said Klein, who once headed the U.S. Nuclear Regulatory Commission.

Tepco has been treating water stored at the plant with a system known as ALPS (Advanced Liquid Processing System), which removes all radioactive materials except for tritium.

The processing has left the utility with vast amounts of water contaminated with heavy doses of tritium. About 350,000 tons of the water is currently stored in hundreds of large tanks, each of which poses a potential leak risk.

**Tepco has said the level of tritium in the water is between 1 million and 5 million becquerels per liter. The legal limit for release to the sea is 60,000 becquerels.**

**Tritium has a half life of 12.3 years, so it would take decades to die down to permitted levels if left undiluted.** The element is about one-thousandth as radioactive as the isotopes cesium-134 and cesium-137, according to Tepco.

Tepco said it has not decided yet what to do with the tritium-tainted water, as a government panel is currently trying to figure out what options are available.

Klein said he understands the option to release the water into the Pacific “is intensely emotional” among local fishermen, but he is confident that they will eventually agree with his view.

He noted that fishermen in the past agreed to an equally controversial decision to discharge clean groundwater pumped up at the site before it seeps into the reactor buildings and becomes contaminated. Meanwhile, Tokyo Electric Power Co. said Monday it will release all available radiation data associated with the Fukushima No. 1 plant after facing criticism for failing to promptly announce leaks of radioactive rainwater into the sea.

**Tepco said it had a policy of disclosing radiation information for contaminated water stored at the plant facilities if there is a risk of that water reaching the sea. This policy did not cover rainwater in drainage ditches, however radioactive it might be.**

The utility has been criticized for not promptly releasing information about radioactive rainwater when it had data confirming leaks had taken place.

Information from Jiji added

April 3, 2015

## Only dew after all

### TEPCO attributes 'leak' to dew

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the disabled Fukushima Daiichi nuclear power plant says a pool of liquid found on a wastewater container on Thursday is dew or rainwater, and did not leak from the container.

Tokyo Electric Power Company, or TEPCO, says 25 liters of liquid pooled on the container's lid, and that some leaked from a vent when workers who found the liquid touched the container.

TEPCO says **the liquid contained strontium and other beta ray-emitting substances at a rate of 3-million becquerels per liter, and radioactive cesium at 8,700 becquerels per liter. It says the wastewater, in comparison, has concentrations reaching tens of billions of becquerels.**

The utility says the large discrepancy shows that the liquid is **dew or rainwater that absorbed radioactive substances from the surrounding environment.**

It also says a liter of liquid was found on top of another container at the site.

The containers are in a concrete structure. TEPCO says all of the pooled water remains in the building.

### Radioactive water may have leaked at Daiichi plant

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Workers at the crippled Fukushima Daiichi nuclear plant have found a small amount of liquid that may have leaked from a container of highly radioactive wastewater.

The plant's operator, Tokyo Electric Power Company, says the workers detected the liquid on the lid of the container at around 1 PM on Thursday.

TEPCO says when the workers touched the container, a small volume of liquid leaked from a hole on the upper part. TEPCO surmised it is wastewater. The hole is to vent its gas.

The resin container measures 1.5 meters in diameter and 1.8 meters in height. The wastewater comes from a system to treat contaminated water. It includes substances such as magnesium and a high density of radioactive materials.

The utility says the liquid has not leaked out of a structure housing the container. The facility is made from concrete.

TEPCO says it will analyze the liquid's contents and determine why it has pooled on the lid. They add that depending on the results, they will also examine more than 670 containers in the same facility.

April 7, 2015

## Robot survey in No.1 reactor container

### TEPCO to conduct robot survey inside Fukushima No. 1 reactor container

<http://mainichi.jp/english/english/newsselect/news/20150407p2g00m0dm031000c.html>

TOKYO (Kyodo) -- The operator of the crippled Fukushima Daiichi nuclear plant said Monday it will conduct a remote-controlled robot survey inside the No. 1 reactor's containment vessel, **a step toward grasping the condition of melted fuel debris.**

It will be the first time that Tokyo Electric Power Co. uses a robot to check the interior of a reactor's primary containment vessel. The company hopes to obtain data on radiation levels and temperature as well as images inside the vessel.

Fuel inside the Nos. 1 to 3 units is believed to have melted through the reactor pressure vessels and has been accumulating in the outer containers. But the details remain unknown more than four years after the 2011 nuclear crisis due to extremely high levels of radiation.

**It is currently not feasible to conduct the survey in the lower part of the containment vessel where fuel debris is believed to be accumulating, as the robot cannot be deployed in highly radioactive water generated in the process of cooling the fuel,** a TEPCO official said.

In October 2012, radiation levels inside the containment vessel, which workers measured by lowering a dosimeter, measured up to 11 sieverts per hour.

April 8, 2015

## Evaporate contaminated water?

### TEPCO may evaporate contaminated Fukushima water

<http://rt.com/news/248041-fukushima-waters-evaporate-tepc/>

**Tainted water from Fukushima nuclear plant storage may be evaporated or stored underground instead of following earlier plans to release it into the ocean.**

Tokyo Electric Power Co (TEPCO), which is responsible for cleaning up the crippled power plant, planned to release the tritium-laced water into the ocean. However, it suffered a setback following protests by local fishermen who are already struggling with their livelihood following the 2011 earthquake and tsunami that led to the meltdown of three reactors.

Water is used to keep the wrecked reactors cool enough to prevent further radioactive releases, but there is no available technology to remove the tritium.

Chief decommissioning officer Naohiro Masuda, told Reuters he did not know when a final decision about evaporation would be made.

This comes as low-level radiation produced by the tsunami-stricken Fukushima nuclear power plant in Japan has been detected off the coast of Canada.

TEPCO is in a race against time to contain the wrecked nuclear facility. Management of the situation has likewise been marked by mishaps and scandalous revelations that have put a serious dent in the company's reputation.

The plant's operator announced a week ago its plans to disclose all data on radiation levels recorded at the site in response to mounting criticism over its lack of transparency.

In late February, TEPCO admitted to concealing a radioactive leak for 10 months, citing an ongoing investigation.

Earlier this year the company also admitted it won't be able to process the radioactive water stored at Fukushima plant by March, as the operator had promised before. TEPCO'S president said the delay is due to technical problems.

**Following the 1979 Three Mile Island nuclear disaster in the US, the cleanup crew used the evaporation method with success, but the amounts of water were much smaller.**

Three of the Fukushima plant's reactors suffered nuclear meltdown following an earthquake and tsunami on March 11, 2011 - becoming the world's worst nuclear disaster since Chernobyl in 1986.

The water used to keep the reactors cool is tainted with radioactive material and has since been leaking and mixing with groundwater that is seeping through the facility.

April 9, 2015

## Flooding or not flooding?

### Plans to remove melted nuclear fuel

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

New methods may be used to remove melted fuel from the crippled reactors at the Fukushima Daiichi nuclear plant.

The government-backed entity overseeing the plant's decommission says engineers are **exploring ways to remove the fuel debris without flooding the containment vessels with water.**

In the new methods, the melted fuel could be removed from the top of the reactor - or through a hole made on the side of the containment structure.

The Nuclear Damage Compensation and Decommissioning Facilitation Corporation disclosed its strategic plan for decommissioning technologies on Thursday.

Removal of melted fuel is considered one of the toughest challenges in the decommissioning process, which is expected to take up to 40 years.

The plan says **the new methods will be considered in addition to the conventional use of water to shield workers from high levels of radiation.**

It says **the flooding method faces significant challenges, including plugging leaks in the containment vessel, and ensuring its quake resistance during the process.**

The plan also warns that **in the new methods, high levels of radiation could affect not just workers but robots and other machines.**

**And steps must be taken to prevent radioactive materials from spreading in the air.**

The Japanese government and the plant's operator, Tokyo Electric Power Company, expect to choose a specific method by March 2017 after further study into the state of the melted fuel.

The plant suffered meltdowns at 3 of its reactors as a result of the 2011 earthquake and tsunami.

April 10, 2015

## **Robot checking No.1 containment vessel**

### **Robot inspects inside of Fukushima No. 1 reactor container**

<http://mainichi.jp/english/english/newsselect/news/20150410p2g00m0dm062000c.html>

TOKYO (Kyodo) -- The operator of the crippled Fukushima Daiichi nuclear power plant on Friday began a remote-controlled robot survey inside the No. 1 reactor's containment vessel, a step toward grasping the condition of melted fuel debris in detail and extracting it.

It is the first time Tokyo Electric Power Co. has deployed a robot to check the interior of a reactor's primary containment vessel since the March 2011 three-reactor meltdown triggered by a huge earthquake and tsunami.

TEPCO plans to eventually inspect the lower part of the containment vessel where a chunk of fuel debris is believed to be accumulating. That, however, is currently not feasible as the robot cannot be deployed in highly radioactive water generated in the process of cooling the fuel. A water-proof version of the robot is expected to be developed by the end of next March.



During Friday's survey, TEPCO hopes to obtain data on radiation levels and temperature and footage of the upper part of the vessel. Another survey will follow Monday next week.

Developed by Hitachi-GE Nuclear Energy Ltd. and the International Research Institute for Nuclear Decommissioning, the robot is equipped with cameras, a thermometer and dosimeter. Under high levels of radiation harmful to electronics, it can function properly only for around 10 hours, the institute said.

On Friday morning, workers inserted the shape-shifting robot through a narrow pipe, operating it from a location with relatively low levels of radiation within the reactor building. The robot can expand to a U shape to crawl inside the container, according to TEPCO.

Fuel inside the Nos. 1 to 3 units is believed to have melted through the reactor pressure vessels and has been accumulating in the outer containers. But the details remain unknown more than four years after the nuclear crisis due to extremely high levels of radiation.

In October 2012, radiation levels inside the containment vessel, which workers measured by lowering a dosimeter, measured up to 11 sieverts per hour.

Last month, the utility said it has confirmed nearly all fuel in the No. 1 reactor has melted and fallen into the containment vessel, through analysis utilizing cosmic rays called muons.

See also:

### **Robot enters primary containment vessel of reactor 1 in Fukushima**

<http://www.japantimes.co.jp/news/2015/04/10/national/remote-controlled-robot-probe-inside-reactor-1-containment-vessel/#.VSfYmpPwmos>

Kyodo

A robot on Friday crept into the deadly primary containment vessel of reactor 1 of the Fukushima No. 1 power plant to surveil its damaged interior, Tokyo Electric Power Co. said.[... ]

### **How robots are used at Fukushima Daiichi**

[http://www3.nhk.or.jp/nhkworld/english/news/20150410\\_12.html](http://www3.nhk.or.jp/nhkworld/english/news/20150410_12.html)

The operator of the damaged Fukushima Daiichi nuclear plant has no choice but to rely on robots to determine the state of the 3 reactors that suffered meltdowns. The high radiation levels could prove fatal for humans in a short period of time.

In March of last year, Tokyo Electric Power Company deployed a robot on the top floor of the building that houses the No.2 reactor and drilled for samples from the concrete floor. The operation was aimed at assessing the level of contamination in the building.

Robots are being developed to decontaminate the reactor buildings. One of them sprays particles of dry ice onto the floors and walls to remove their surfaces.

Robots are also used to study the condition of the reactors' containment vessels.

In November of 2013, a robotic probe confirmed for the first time that radioactive water was leaking from the containment vessel of the No.1 reactor.

But there are limits to what robots can do. A number of narrow spaces and uneven surfaces inside the reactor buildings are littered with debris.

This makes it difficult for robots to move around freely, and they often become stuck and irretrievable.

Another major obstacle is the intense radiation. Images of the inside of the containment vessel of the No.2 reactor shot by an endoscopic camera are completely fogged due to the radiation.

When approaching the nuclear fuel, even robots can malfunction or fail to capture clear images.

In the latest probe, efforts are being made to avoid such glitches by minimizing the use of computer circuits and other means. Still, engineers say, the probe can operate for only 2 days.

The government and Tokyo Electric are planning to examine the inside of the containment vessel of the No.2 reactor as well. But the intense radiation from the melted fuel makes it difficult even for robots to approach.

### **Robot to survey damaged Fukushima reactor**

[http://www3.nhk.or.jp/nhkworld/english/news/20150410\\_06.html](http://www3.nhk.or.jp/nhkworld/english/news/20150410_06.html)

The operator of the crippled Fukushima Daiichi nuclear power station will start looking inside one of the damaged reactors on Friday, with the help of a robot.

Three of the plant's reactors suffered meltdowns due to the March, 2011, earthquake and tsunami.

Since then, extremely high levels of radiation have prevented surveys on the location of molten fuel and internal damage to the reactors and their containment vessels. The vessels enclose reactor cores.

The plant's operator, Tokyo Electric Power Company, plans to put a 60-centimeter-long, snake-shaped robot into the No.1 reactor containment vessel.

The utility will operate the robot by remote control and have it negotiate obstacles.

Radiation and temperature levels will be measured and an installed camera will allow workers to study internal damage.

TEPCO also plans to run the robotic assessment on Monday.

Up until now the company has used computer simulations and scans with subatomic-particles to predict what the No.1 reactor containment vessel is like inside.

The results indicate almost all its nuclear fuel has melted and fallen to the bottom of the vessel in the basement of the reactor building.

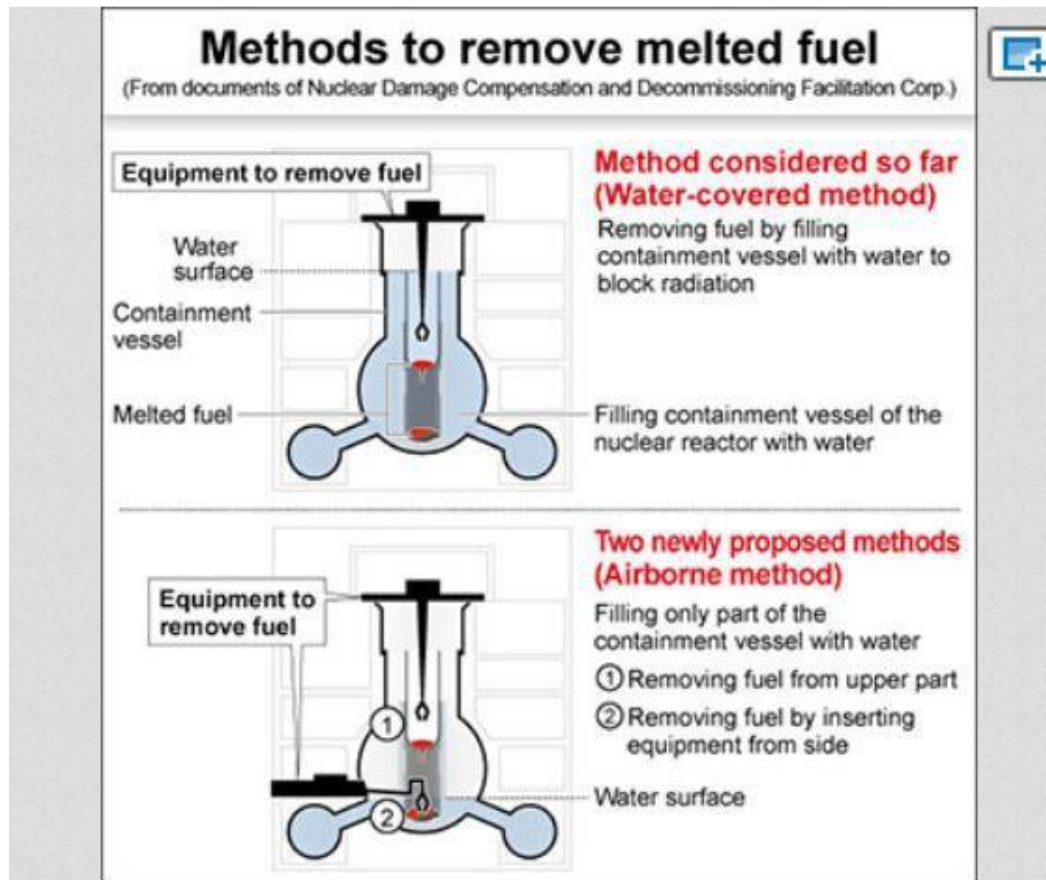
TEPCO officials say they hope to understand the internal damage to the vessel and gain clues on how best to remove the nuclear fuel.

They will make the most of data collected to help decommission the reactors.

## **Three possible methods to remove fuel**

### **3 methods proposed to remove melted nuclear fuel at Fukushima plant**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201504100053>



The Asahi Shimbun

A semi-governmental organization has come up with three possible methods to tackle the most difficult and dangerous task at the stricken Fukushima No. 1 nuclear plant: removing the melted nuclear fuel from the reactors.

All three methods proposed by Nuclear Damage Compensation and Decommissioning Facilitation Corp. (NDF) on April 9 carry the risk of radiation leaks and exposure to workers.

The difficulty in implementing these methods is also compounded by the fact that high radiation levels have prevented workers from determining the precise location and shape of the melted fuel.

The NDF, which is providing technological advice on removing the melted fuel from the No. 1, No. 2 and No. 3 reactors of the Fukushima plant, will incorporate the three methods in a road map scheduled to be revised by the government and the plant's operator, Tokyo Electric Power Co., in spring.

The preferred method, and the only one considered so far, would involve pumping in water to fill the reactor containment vessels to the upper part. The melted nuclear fuel would then be removed from above, and the water would keep radiation exposure of the workers at low levels, according to the plan.

But this "water-covered method" will not work if the containment vessels are corroded or cracked. In addition, if the containment vessels are filled with water, their quake-resistance capabilities would weaken.

“The water-covered method is desirable from the viewpoint of safety,” said Hajimu Yamana, the NDF vice president who is in charge of the division supporting decommissioning work. “But it is not certain whether we can completely prevent water leakages from the containment vessels.”

For that reason, the NDF also proposed two “airborne methods,” under which water would fill only the bottom part of the containment vessels and the melted fuel would be removed through the air.

In one of these airborne methods, the melted fuel would be taken out from the upper part of the containment vessels. In the other method, the fuel would be removed from a hole drilled into the side of the containment vessel.

**The big challenge in the two airborne methods is preventing radioactive materials from being scattered in the air and contaminating the workers.**

“Respecting the experts’ opinions, we want to tackle the revision (of the road map),” said Yosuke Takagi, senior vice minister of economy, trade and industry.

The NDF is also tasked with disposing of radioactive waste and assisting in compensation payments to residents affected by the nuclear accident caused by the March 2011 Great East Japan Earthquake and tsunami.

The NDF explained the three possible methods to residents at a meeting in Koriyama, Fukushima Prefecture.

see: <http://www.fukushima-is-still-news.com/2015/04/flooding-or-not-flooding.html>

## **Nuclear Watch: Robot to survey reactor**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclearwatch/20150410.html>

The managers of Japan's crippled Fukushima nuclear plant are trying to gain a better understanding of the challenges they're facing. They've spent four years sketching out a detailed picture of the damage to the reactors there. In order to get around the dangers the facility presents to humans, they've been using robots instead. And for the first time on Friday they sent one inside the containment vessel of reactor number one.

Three of the plant's reactors suffered meltdowns after the March, 2011 earthquake and tsunami. But due to the high levels of radiation, workers have not been able to gauge the true extent of the damage or locate the melted fuel.

Tokyo Electric Power Company engineers are directing their latest robot by remote control. The snake-like device can maneuver around obstacles inside the containment vessel.

But TEPCO officials say that after the robot had traveled more than 10 meters into the plant, or about two-thirds of the planned distance, they were no longer able to move it. They say they were able to receive the images and radiation data the machine had gathered before it stopped.

Until now, TEPCO has used computer simulations to try to understand what's going on inside the reactors. The results indicate that the nuclear fuel has melted and fallen to the bottom of the vessel.

Engineers hope the data collected by the robot will help them gain clues on how best to remove the fuel.

This robot went deeper inside the plant this morning than any used since the accident. Previous robots have managed to record vital information. They've given the operator a better idea of what's going on inside. But the work is difficult, even for a machine. NHK WORLD's Chiaki Ishikawa explains.

In March of last year, TEPCO engineers deployed a robot inside the building that houses the No.2 reactor. It used a drill to take samples from the contaminated concrete floor. The goal was to study the contamination levels inside the building.

A number of robots have already been used inside the plant, carrying out inspections and decontamination work. One of them sprayed dry ice onto the floors and walls, and this was then scraped off, along with the decontamination.

Robots have also been used to study the condition of the containment vessels that enclose the reactors. In November of 2013, officials confirmed for the first time that a robot had found contaminated water leaking from the containment vessel of the number 1 reactor.

But there are limits to what robots can do. The interiors of the reactor buildings are littered with debris. This makes it difficult for robots to move around freely. They often become stuck and irretrievable. Another major obstacle is the intense levels of radiation. Images from the inside of the containment vessel of the No.2 reactor shot using an endoscopic camera show white dots generated by radiation. When approaching nuclear fuel, even robots can malfunction or fail to capture clear images.

In another examination, engineers tried to avoid such glitches by minimizing the use of computer circuits. Still, the probe could only operate for two days.

Government and TEPCO officials will eventually examine the inside of the containment vessel of the No.2 reactor as well.

April 13, 2015

## Robot finally abandoned in containment vessel

### Tepco gives up on rescuing shape-shifting reactor robot

<http://www.japantimes.co.jp/news/2015/04/13/national/science-health/tepc-gives-ups-rescuing-shape-shifting-reactor-robot/#.VSvNx5PwILM>

JJI

FUKUSHIMA – Tokyo Electric Power Co. has given up on retrieving the shape-shifting robot it sent into the damaged primary containment vessel of reactor 1 of the crippled Fukushima No. 1 power station, the company said.

Tokyo Electric Power Co. has given up on retrieving the shape-shifting robot it sent into the damaged primary containment vessel of reactor 1 of the crippled Fukushima No. 1 power station, the company said. The robot, tasked with surveying the damage caused by the March 2011 meltdown, was expected to survive 10 hours in the high radiation environment but died in less than 3 hours.

Before it quit, the robot succeeded in taking video of the damaged PCV and collecting radiation and temperature data at 14 of the 18 planned survey points.

The robot, which is not waterproof, was sent into the vessel on Friday morning to check the actual conditions inside so it can draft a plan to extricate the molten nuclear fuel and other debris, which is believed to have puddled at its bottom.

The remote-controlled robot was initially scheduled to examine half of the area on the first floor of the PCV but stopped moving after completing two-thirds of the route. In that time, however, it managed to collect video and other data from the area leading to the basement, where the fuel debris is thought to be, Tepco said.

On Monday, a survey that was planned to be conducted by a similar remote-control robot on the other half of the vessel's first-floor area was postponed.

The Fukushima No. 1 nuclear power station was badly damaged in March 2011 by a triple core meltdown caused by a tsunami-triggered station blackout in the wake of the offshore Great East Japan Earthquake.

## **'Transformer' robot breakdown leaves TEPCO in the dark at Fukushima nuclear plant**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201504130029>

An unresponsive robot means it's back to the drawing board for officials at Tokyo Electric Power Co. in determining how to decommission reactors at their crippled Fukushima No. 1 nuclear power plant.

The sleek, shape-changing robot, which was expected to deliver a preliminary view of the inside of the No. 1 reactor, failed to complete its mission when it stalled just hours after entering its containment vessel on April 10.

TEPCO officials announced April 12 that they had abandoned plans to retrieve the stranded robot as well as postponing the entry of another robot that had initially been scheduled for April 13.

Work will now proceed to cut the cable connecting the first robot to the outside world.

TEPCO had sent in the robot on April 10 to photograph the interior of the reactor containment vessel and record temperatures and radiation levels.

But the failed mission was not deemed a complete waste of time as the robot was able to check on 14 of the planned 18 locations within the containment vessel that were on its initial agenda, said TEPCO officials.

There was no indication as to why the device stalled.

The robot was developed by the International Research Institute for Nuclear Decommissioning to chart areas inside the containment vessel where humans cannot enter because of high radiation levels.

Measuring 60 centimeters long in its normal state, the robot can change its shape depending on the space it is trying to enter and is operated via a connecting cable.

The robot is essential in leading the way for a full-blown investigation scheduled for the end of this fiscal year. It is part of the preparatory work required to eventually retrieve melted nuclear fuel, the toughest part of the decommissioning process.

## **TEPCO fails to retrieve survey robot from Fukushima reactor vessel**

<http://mainichi.jp/english/english/newsselect/news/20150413p2g00m0dm077000c.html>

TOKYO (Kyodo) -- The operator of the crippled Fukushima Daiichi nuclear plant said Monday it has failed to retrieve a survey robot sent into the No. 1 reactor's containment vessel after it stopped working last week during its first inspection of the vessel's interior since the nuclear crisis at the plant.

Tokyo Electric Power Co. cut the cables connected to the non-functional robot and decided to postpone another survey that it initially planned to conduct on Monday morning using a different robot.

It is the first time that TEPCO has deployed a robot to check the interior of a reactor's primary containment vessel since the March 2011 three-reactor meltdown triggered by a huge earthquake and tsunami. The survey was a step toward discovering the condition of melted fuel debris in detail. Fuel inside the Nos. 1 to 3 units is believed to have melted through the reactor pressure vessels and has been accumulating in the outer containers. But the exact conditions remain unknown more than four years after the nuclear crisis began due to extremely high levels of radiation. Nonetheless, the disabled robot, equipped with cameras, dosimeter and thermometer, was able to record data on radiation levels and temperatures in 14 locations out of the initially targeted 18 and footage inside the highly radioactive container. TEPCO plans to release the data soon. During the remote-controlled robot survey that began Friday morning, the robot was expected to go halfway around the container. However, it suddenly stopped functioning after crawling some 10 meters inside the vessel. The cause remains unknown, a TEPCO spokesman said.

### **TEPCO abandons robot in reactor**

[http://www3.nhk.or.jp/nhkworld/english/news/20150413\\_02.html](http://www3.nhk.or.jp/nhkworld/english/news/20150413_02.html)

The operator of the crippled Fukushima Daiichi nuclear plant has given up recovering a robotic probe that has remained stationary inside one of the reactors at the complex.

Tokyo Electric Power Company inserted the remote-controlled robot for the first time into the containment vessel of the No.1 reactor on Friday.

The 60-centimeter-long, snake-like robot was supposed to survey internal damage to the vessel. But it stalled after moving about 10 meters.

TEPCO and other engineers suggest the possibility that the robot or its remote-control cable has become caught on something.

The workers used the robot's camera to confirm the state of the reactor. They also operated the robot's maneuvering belt and manually pulled the cable.

But the robot has remained immobile and is not showing any sign of improvement. That's forced the company to give up recovering the device.

Company officials also postponed plans to conduct a similar survey on the same vessel using another robot on Monday. They say this is because the first robot's cable in the vessel's pipe is blocking the entry of the second probe.

TEPCO officials say they have yet to decide when to conduct the second survey as they have to first complete an investigation into the accident.



## Pictures from robot

### TEPCO releases reactor footage captured by robot



[http://www3.nhk.or.jp/nhkworld/english/news/20150413\\_33.html](http://www3.nhk.or.jp/nhkworld/english/news/20150413_33.html)

The operator of the damaged Fukushima Daiichi nuclear plant has released interior footage of a reactor containment vessel captured by a robot.

Tokyo Electric Power Company sent the remote-controlled robot into the highly contaminated area of the No.1 reactor last Friday to assess damage. But the robot became immobile after advancing about a dozen meters.

On Monday, TEPCO released part of the about 3-hour-long footage recorded by the robot.

The 2-minute 40-second-long clip shows mainly steam. It is thought that water at the bottom of the containment vessel is being evaporated by the heat of the melted nuclear fuel.

The temperature inside the vessel was about 20 degrees Celsius. But the robot recorded up to around 10 sieverts of radiation per hour, a level that could kill a person in about 40 minutes.

The footage shows small bits of debris around the robot, but no major damage to the nearby wall and structures.

TEPCO plans to analyze the footage to consider ways of removing the melted fuel and decommissioning the reactors.

The utility has cut the remote control cable for the robot after giving up on its recovery on Sunday, and postponed a second survey with another robot.

## Deadly radiation concentration in reactor

### Radiation measured at deadly 9.7 sieverts in Fukushima reactor

JJI

Tokyo Electric Power Co. said Monday that radiation in the primary containment vessel of the No. 1 reactor of the Fukushima No. 1 power station gets as high as 9.7 sieverts per hour — enough to kill a human within an hour.

The radiation levels at six locations in the western section of the first floor of the PCV ranged from 7.0 to 9.7 sieverts per hour, the beleaguered utility said in disclosing data collected by a remote-controlled robot on Friday.

By contrast, the temperatures at the six locations monitored were cool, ranging from 17.8 to 20.2 degrees. Tepco sent the robot into the primary containment vessel on Friday, expecting it to stay alive for 10 hours. But the robot failed within three hours after completing about two-thirds of its planned route. Tepco has given up on recovering the robot.

The survey involved eight Tepco employees and 36 other workers who were hired by contractors. The maximum radiation dose logged was 1.73 millisieverts.

Tepco official Teruaki Kobayashi said the survey found no major obstacles around an opening leading to the underground part of the vessel, which is good news for future surveys needed to extricate the molten nuclear fuel.

The No. 1 reactor is one of the three damaged by core meltdowns during the Fukushima nuclear crisis in March 2011.

April 14, 2015

### Images from containment vessel

## TEPCO footage reveals inside of wrecked Fukushima reactor containment vessel



An image of objects inside the No. 1 reactor of the Fukushima No. 1 Nuclear Power Plant sent from the robotic probe is seen. The piece in the middle is believed to be a hook for pipe insulation. (Image courtesy of the International Research Institute for Nuclear Decommissioning)

<http://mainichi.jp/english/english/newsselect/news/20150414p2a00m0na004000c.html>

Tokyo Electric Power Co. (TEPCO), the operator of the crippled Fukushima No. 1 nuclear plant, on April 13 released footage taken by a robotic probe sent inside a highly radioactive reactor vessel.

The images sent from the robot that has been sent inside the containment vessel of the No. 1 reactor at the Fukushima No. 1 Nuclear Power Plant included a number of objects scattered on a steel mesh floor on the ground level. This is the first footage taken inside a reactor containment vessel among those of the No. 1 to 3 reactors at the Fukushima plant that experienced meltdowns in the wake of the 2011 earthquake and tsunami.

The air radiation dosage inside the vessel recorded by the robot was up to around 10 sieverts per hour while temperatures measured at around 17.8-20.2 degrees Celsius. The images showed steam coming from radioactively contaminated water underground.

The utility is set to conduct a study on the basement level of the reactor vessel, to which nuclear fuel is believed to have melted down, by the end of March next year. A TEPCO representative said the company successfully collected data that could lead to the next step of the probe.

TEPCO sent the robot inside the reactor vessel on April 10, but it stopped working after traveling for less than 20 meters. The utility said the robot possibly has got stuck on a bump or some objects on the floor.

## Robots essential in decommissioning

## Stalled robot still useful in moving Fukushima decommissioning forward, TEPCO says

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201504140034>

By HIROMI KUMAI/ Staff Writer

All was not lost when a robotic probe broke down inside a highly radioactive containment vessel at the crippled Fukushima No. 1 nuclear power plant, the plant operator says.

Tokyo Electric Power Co. said the mission showed that robotics has a vital role to play in the decommissioning process.

**"It shows that monitoring devices (attached to the robot) can function amid high levels of radiation for two to three days,"** said a TEPCO official, referring to the tubular-shaped robot that stopped dead in its tracks just hours after entering the first floor of the No. 1 reactor's containment vessel on April 10.

Images taken by the robot, released on April 13 by the plant operator, reveal fist-sized stone-like objects and other debris scattered on the floor. The images also appeared to show a latch and other wreckage, but TEPCO officials said they had no idea where those objects were originally located.

The robot measured radiation levels at six points inside the containment vessel. They ranged from 7.0 to 9.7 sieverts per hour, while temperatures fluctuated between 17.8 and 20.2 degrees.

The sleek, shape-changing robot entered the containment vessel through piping on April 10. But after covering 10 or so meters--about two-thirds of its planned route--the device came to a standstill.

The operation marked the first time to introduce a robotic probe to shoot images in the containment vessels for the No. 1 through No. 3 reactors, where meltdowns occurred after the March 2011 earthquake and tsunami disaster.

The mission was viewed as **essential in paving the way for a full-blown investigation scheduled for the end of this fiscal year.** It is part of preparatory work required to eventually retrieve melted nuclear fuel, the toughest part of the decommissioning process.

While the robot failed to complete its intended mission, the images it took showed there is enough space and no obstacles in an area connecting the first floor and the basement--the planned next probe site--and that pipes on the survey route are more or less intact.

TEPCO gave up trying to retrieve the robot and cut the cable connecting the device to an outside power source on April 13. The plant operator speculated that the robot broke down after it collided with a step or other obstacles.

April 15, 2015

## TEPCO resumes survey with new robot

### 2nd robotic survey begins inside damaged reactor

[http://www3.nhk.or.jp/nhkworld/english/news/20150415\\_30.html](http://www3.nhk.or.jp/nhkworld/english/news/20150415_30.html)



The operator of the crippled Fukushima Daiichi nuclear plant has begun operating a new robotic probe in the containment vessel of one of the facility's reactors after a similar device failed.

Tokyo Electric Power Company sent the new 60-centimeter, snakelike robot into the vessel of the damaged No.1 reactor on Wednesday.

The first probe stopped working on Friday after advancing about 10 meters on a platform in the container. The utility gave up on recovering the device as one of its maneuvering belts apparently got stuck in a gap of the platform.

The probe collected valuable images in the vessel along with temperature and radiation data. The container was filled with steam from water heated by molten nuclear fuel. Humans cannot stay there due to extremely high radiation levels.

The operator concluded that the robot's camera and maneuvering belts functions well, but decided to be more cautious even if the new probe takes two or three days.

The 2nd robot is to take a route different from the previous one, to collect a wide range of information about the reactor.

### **TEPCO resumes robot survey inside Fukushima reactor vessel**

<http://mainichi.jp/english/english/newsselect/news/20150415p2g00m0dm076000c.html>

TOKYO (Kyodo) -- The operator of the crippled Fukushima Daiichi nuclear power plant resumed surveying the inside of the No. 1 reactor's containment vessel using a remote-controlled robot Wednesday, aiming to obtain more data about the condition of melted fuel.

Tokyo Electric Power Co. began the probe last Friday, in its first attempt since the 2011 three-reactor meltdown to check the interior of a damaged reactor's primary containment vessel using a robot. But the shape-shifting robot stopped moving after only a few hours and the utility gave up on retrieving it. On Wednesday morning, TEPCO sent another robot equipped with cameras, a dosimeter and a thermometer into the vessel. The robot is expected to go halfway around the container to gather data on radiation levels and temperatures while taking footage of locations that were not covered during last week's survey.

TEPCO said the robot used on Friday is likely to have become stuck to the metal-mesh floor. Nonetheless, the stranded robot was able to record some data, measuring radiation levels of up to around 10 sieverts per hour -- a fatal level for humans.

The company also said it has learned from Friday's probe that the robot can function for a few days under high levels of radiation harmful to electronics -- much longer than the 10 hours or so initially anticipated. Fuel inside the Nos. 1 to 3 units is believed to have melted through the reactor pressure vessels and has been accumulating in the outer containers.

However, its precise condition remains unknown more than four years after the nuclear crisis triggered by a huge earthquake and tsunami in March 2011.

The utility plans eventually to inspect the underground area of the containment vessel where fuel debris is believed to be accumulating.

### **Tepco resumes survey of crippled Fukushima reactor vessel with new robot**

<http://www.japantimes.co.jp/news/2015/04/15/national/tepc-resumes-survey-crippled-fukushima-reactor-vessel-new-robot/#.VS6BBpPwlLM>

Kyodo

The operator of the crippled Fukushima No. 1 nuclear power plant resumed a video survey inside a reactor containment vessel on Wednesday, inserting a second robot after an earlier effort left a similar robot stranded inside.

Tokyo Electric Power Co. began the probe last Friday, in its first attempt since the 2011 meltdown to check the interior of the No. 1 reactor's primary containment vessel and to ascertain the position of the melted-down fuel. The shape-shifting robot produced valuable images and radiation readings but stopped moving after only a few hours and the utility gave up on retrieving it. [...]

April 17, 2015

**More footage from TEPCO**

## TEPCO reveals more footage inside wrecked Fukushima reactor vessel

<http://mainichi.jp/english/english/newsselect/news/20150417p2a00m0na010000c.html>

Tokyo Electric Power Co. (TEPCO), the operator of the stricken Fukushima No. 1 nuclear power plant, on April 16 released additional footage taken inside a highly radioactive nuclear reactor containment vessel. The images recorded on April 15 were sent from a robotic probe the utility had sent inside the containment vessel of the No. 1 reactor at the Fukushima No. 1 Nuclear Power Plant. It was the second robot to enter the highly radioactive unit as the first one sent in on April 10 had stopped moving a few hours after the probe operation began.

The footage captured by the second robot showed no major damage in an air-conditioning unit on the first floor of the reactor vessel. Meanwhile, parts of lead curtains used to reduce the radiation impact on pipes and other equipment were seen fallen on the steel mesh floor.

**The second robot traveled in different areas on the ground level from the first probe. The latest probe found fewer objects scattered on the floor than the first robot.**

The air radiation dosage inside the vessel was up to 8.3 sieverts per hour, excluding the time when the figure instantaneously skyrocketed due to the noise from the dosimeter, while temperatures measured at around 20 degrees Celsius.

TEPCO continued the probe with the robot on April 16 and the results of the investigation will be released on April 17 or later.

**While the first robot cannot be retrieved from the vessel, the utility is set to recover the second robot sometime after April 17.**

## Second 'transformer' robot completes mission inside crippled nuclear reactor

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201504170060>

The second shape-shifting robotic probe sent into the Fukushima No. 1 nuclear power plant has successfully surveyed the inside of a reactor after the failure of the first unit, the plant operator announced on April 16.

The robot was sent into the containment vessel inside the No. 1 reactor building on April 15 and scanned along an approximately 15-meter-long path, Tokyo Electric Power Co. said.

The machine was sent in to complete the mission of the first unit, which stalled April 10 just hours after it was sent inside the reactor.

The second robot measured radiation levels in three locations inside the containment vessel, which varied from a deadly 6.7 to 8.3 sieverts per hour.

The figures were similar to the measurements taken by the first robot, which read between 7.0 and 9.7 sieverts per hour in six locations.

All of those measurements indicate sufficient levels of radiation to kill a human in about one hour.

The identical robot units were developed by the International Research Institute for Nuclear Decommissioning to chart areas inside reactor containment vessels where humans cannot enter because of high radiation levels. Three reactors at the plant experienced meltdowns following the March 2011 Great East Japan Earthquake and tsunami.

Each robot is 60 centimeters long in its normal state, but can change shape depending on the space it is trying to enter. The probes are operated via connecting cables.

The utility plans to analyze the footage and radioactivity readings taken by the robots in hopes of utilizing the data when eventually removing the melted nuclear fuel from inside the building.

The second robot is scheduled to be retrieved on April 17.

## Glimpses inside containment vessel

### Water inside containment vessel filmed by robot

[http://www3.nhk.or.jp/nhkworld/english/news/20150417\\_42.html](http://www3.nhk.or.jp/nhkworld/english/news/20150417_42.html)

A second robotic probe into a reactor containment vessel at the damaged Fukushima Daiichi plant has captured a clear image of tainted water at its bottom.

Operator Tokyo Electric Power Company released the footage on Friday.

It sent the remote-controlled robot into the vessel at the No.1 reactor 2 days ago to assess its interior damage and radiation levels.

The 1 minute and 20 second footage shows water reflecting the light from the robot. The operator says the water is about 2.8 meters deep, judging from the position of the reflection. The figure is similar to data obtained by other means.

The footage also shows a platform in the vessel covered with a large amount of rust. Equipment surfaces have deteriorated severely.

The utility says the surface was painted before the nuclear accident. The paint might have come off due to severe heat from the meltdown.

The utility dispatched the first robot last Friday but after going in about a dozen meters it couldn't move. The firm plans to use the second robot still inside the vessel to again film the area where the first robot conducted an incomplete survey.

see also:

April 15, 2015

### Nuclear Watch: Robot Gives Glimpse

<http://www3.nhk.or.jp/nhkworld/english/news/features/201504152112.html>

April 19, 2015



## TEPCO footage from 2nd robot (2)

### TEPCO releases video from second robot probe at Fukushima reactor

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201504190026>



Rust or peeling paint on a steel floor was visible in video footage taken by the second robot probe sent into one of the reactors at the crippled Fukushima No. 1 nuclear plant.

Tokyo Electric Power Co., operator of the plant, released the footage on April 17, two days after the robot entered the containment vessel of the No. 1 reactor.

The robot's camera captured the water surface at the bottom of the containment vessel. Light from the robot can be seen reflecting off the water surface estimated at between 30 and 110 centimeters below the steel gird floor.

The footage did not show damage to equipment or fallen objects.

The first robot became immobilized hours after it was sent into the containment vessel on April 10. Efforts to retrieve that robot were abandoned, but video from it was released on April 13.

High radiation levels have prevented workers from going near the containment vessel.

April 20, 2015

### TEPCO issues video of robot stranded inside reactor

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the Fukushima Daiichi nuclear power plant has issued a video of a robot stranded inside one of the damaged reactors.

The video released by Tokyo Electric Power Company on Monday shows the remote-controlled robot tilting to the right inside the containment vessel of the No.1 reactor.

The robot was sent inside the vessel on April 10th but stopped working after advancing just 10 meters. The utility has since given up on recovering the device.

TEPCO sent a second robot to retrieve the first robot. But the probe's camera malfunctioned due to radiation exposure.

The utility decided to abandon both robot probes.

TEPCO says video footage shows no major damage to a part leading to the bottom of the containment vessel. Melted nuclear fuel fell on the vessel in the 2011 accident.

The operator says it will analyze the footage and other data to remove the fuel.

April 21, 2015

## How much toxic water has leaked into sea?

### **Fukushima plant pumps halted, toxic water leaking into ocean**

<http://mainichi.jp/english/english/newsselect/news/20150421p2g00m0dm067000c.html>

TOKYO (Kyodo) -- Tokyo Electric Power Co. said Tuesday it has found all of the eight water transfer pumps halted at its stricken Fukushima Daiichi nuclear power station, leaving radiation-contaminated water to leak into the Pacific Ocean.

The utility is now checking why the pumps for a drainage path have stopped and how much water has leaked into the ocean.

TEPCO began to pump up contaminated water from the path only last Friday, after finding in late February that radioactive water was continuing to leak from the path into the ocean, following the March 2011 earthquake-tsunami disaster that devastated the plant.

The pumps, designed to move contaminated water from the path to another one that leads to a bay facing the station surrounded by fences, were confirmed to be working Monday afternoon but found stopped at 8:45 a.m. Tuesday.

The utility unveiled earlier this year that it had found water samples from the drainage last May containing more radioactive materials than the legally allowable limit.

## TEPCO abandons second robot

### Images show structures intact near Fukushima reactor; robots abandoned

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201504210045>

By HIROMI KUMAI/ Staff Writer

A second robotic probe was abandoned after completing its survey mission inside a reactor containment vessel at the crippled Fukushima No. 1 nuclear plant, Tokyo Electric Power Co. said.

TEPCO, operator of the plant, said April 20 that it has wrapped up the study of the highly radioactive environment at the No. 1 reactor and given up efforts to retrieve the robot.

"We have gathered sufficient information on the inside of the containment vessel," a TEPCO official said. The utility started the survey of the containment vessel by sending in a tubular-shaped robot to shoot images and monitor radiation levels and temperatures on April 10. The robotic probe, however, became inoperable.

The second robot entered the containment vessel on April 15.

TEPCO said images taken by the devices showed that scattered cables and other debris are unlikely to hamper the next stage of the decommissioning process there.

The plant operator said the photos revealed no obstacles in an area connecting the first floor and the basement, and that the surrounding facilities are more or less intact.

TEPCO on April 20 released additional images taken by the robots, including piping, conduits, ladders and pumps to circulate water inside the reactor.

The images snapped by the second robot confirmed TEPCO's assumption that the first robot became stuck in the iron-mesh first floor of the container vessel.

A monitoring camera installed in the containment vessel to control the second robot later malfunctioned because of high radiation levels, forcing TEPCO to give up its plan to retrieve the robot.

"Attempts to forcibly retrieve the robots could pose the larger risk (of further damaging it)," a TEPCO official said.

**After analyzing radiation levels, temperatures and other data obtained by the robotic probes, TEPCO plans to start a robotic survey of the basement of the containment vessel, where coolant water is circulating.**

This phase is scheduled to start by the end of March next year and is intended to gather more detailed information for preparations to remove the melted nuclear fuel, the toughest part of the decommissioning process

### New photo confirms robot probe stuck inside Fukushima No. 1 reactor vessel

<http://mainichi.jp/english/english/newsselect/news/20150421p2a00m0na006000c.html>

A new photo of a disabled observation robot inside the disaster-stricken Fukushima No. 1 nuclear plant's No. 1 reactor containment vessel was released on April 20 by plant operator Tokyo Electric Power Co. (TEPCO).

TEPCO believes that the new image -- shot by a second robot sent into the containment vessel -- confirms that the first device was immobilized after its tread snagged on the vessel's steel mesh floor.

The second robot was scheduled to be removed from the highly radioactive containment vessel, but TEPCO decided to leave the probe inside over fears that the probe would get stuck on its way out. In the end, the utility cut the robot's power cable so it wouldn't get in the way of future inspections, abandoning the device.

Though TEPCO lost both probes, the robot inspections appeared to show nothing blocking the entrance to the containment vessel's basement level, where the No. 1 reactor's melted fuel is thought to have pooled.

The utility also confirmed that contaminated water is collecting in the basement.

TEPCO is planning to develop another robot capable of underwater missions, and is looking to inspect the containment vessel's basement level by the end of fiscal 2015.

April 21, 2015(Mainichi Japan)

## How much toxic water has leaked into the sea? (2)

### Outage hits pumps at Fukushima plant; toxic water leaks into ocean

Kyodo

<http://www.japantimes.co.jp/news/2015/04/21/national/outage-hits-pumps-fukushima-plant-toxic-water-leaks-ocean/#.VTY0vJPwmt>

Tokyo Electric Power Co. on Tuesday reported that a power outage has shut down all eight water transfer pumps at the Fukushima No. 1 nuclear power station and that radioactive water is again leaking into the Pacific Ocean.

The pumps are being used to pump tainted water from a drainage channel to another channel leading to a fence-enclosed artificial bay facing the station. The beleaguered utility said it was checking into what happened and how much water had leaked.

The pumping had begun last Friday, in response to a finding in late February that highly radioactive water in the channel was reaching the ocean. They were confirmed to be working Monday afternoon but found stopped at 8:45 a.m. Tuesday.

The utility said earlier this year that water samples from the drainage channel last May contained concentrations of radioactive materials that surpassed the legal limit.

See also :

### Radioactive water leaking into sea

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the crippled Fukushima Daiichi nuclear power plant says radioactively contaminated rainwater is spilling outside the facility's port after pumps to prevent leakage stopped working.

In February, Tokyo Electric Power Company, or TEPCO, found that radioactive rainwater that had accumulated on the roof of the plant's No. 2 reactor building was leaking outside the port through a drainage channel.

TEPCO blocked the channel and installed 8 pumps in a tentative measure to reroute the channel so that contaminated water would not leak into the sea.

The firm started operating the pumps last Friday. But on Tuesday, a worker found that they had stopped and the water was going into the sea.

TEPCO officials say they don't know the amount or radioactive level of the water. But they say that as of April 9th, the level was extremely low.

They add that the pumps were working normally when workers checked them on Monday afternoon. They say they don't know what caused the problem or when they can restart the pumps.

The pumps can handle rainfall up to 14 millimeters per hour. It was not raining heavily when they presumably stopped.

## **Pumps back in operation**

### **Pumps restart; contaminated water leak stops**

[http://www3.nhk.or.jp/nhkworld/english/news/20150422\\_03.html](http://www3.nhk.or.jp/nhkworld/english/news/20150422_03.html)

The operator of the crippled Fukushima Daiichi nuclear power plant says radioactive rainwater has stopped leaking into the sea as pumps are back in operation.

Officials of Tokyo Electric Power Company say the generator for the 8 pumps was apparently out of order.

The pumps were used to draw the contaminated rainwater from a drainage channel to prevent leaks.

The utility used a backup generator to restart the pumps on Tuesday night.

The officials had reported the trouble earlier on Tuesday. They said a worker found the pumps had stopped, allowing the water to spill outside the facility's port.

The officials say the rainwater spilled into the sea for more than 11 hours, but they do not know the amount.

But they say the radioactive levels of the drainage water were low in samples taken shortly before the problem was discovered.

They say the utility is continuing an investigation to pinpoint the cause of the trouble.

**The pumps had been installed as a stopgap measure to reroute the channel after the utility found in February that contaminated rainwater was leaking into the sea.**

The firm said the rainwater that had accumulated on the roof of a reactor building was spilling through the drainage channel. This rooftop water contained comparatively high levels of radioactive substances.

April 25, 2015

## New Toshiba robot for No.2 containment vessel

### New robot tested for probing damaged reactor

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Engineers have tested a new robot designed to probe a damaged reactor at the Fukushima Daiichi nuclear plant.

Plant operator Tokyo Electric Power Company plans to use the device to view inside the containment vessel of the No. 2 reactor.

The robot is **shaped like a scorpion and is equipped with front and rear cameras**. Once inside the containment vessel, it is designed to raise its rear camera and capture images of its surroundings.

Engineers tested the robot on Friday at a factory in Yokohama City. The machine was inserted into a simulated section of the No. 2 reactor through a pipe 10 centimeters in diameter. It moved slowly on a rail-like structure to the center of a location under the reactor.

Tokyo Electric Power Company plans to implement the device at the No. 2 reactor **as early as this summer**.

**TEPCO officials say radiation levels inside the No. 2 containment vessel reach 70 sieverts, which is higher than in the No. 1 unit.**

They say they will implement the probe carefully by measuring radiation levels as they go. They say **the new device can withstand radiation exposure of up to 1,000 sieverts**.

Kazuo Sudo of the robot's maker Toshiba says the challenge is difficult as the situation inside the reactor is not known. He said engineers fear narrow parts of the rail and obstacles may hamper the robot's movement.

Sudo said that if the probe can find the location and condition of the molten fuel, it should help engineers figure out how to remove it.

A version of the robot sent into the No. 1 reactor was not able to see the condition of melted nuclear fuel, as it was unable to reach far enough under the reactor.

April 28, 2015

## Ice wall

### TEPCO to begin creating ice wall

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Japan's nuclear regulators have approved a plan by the operator of the damaged Fukushima Daiichi nuclear plant to build an underground wall of ice to stem the buildup of contaminated water in reactor buildings.

Tokyo Electric Power Company plans to freeze soil around the No.1 to No.4 reactor buildings to create an ice wall 1.5 kilometers long. The wall is intended to keep groundwater from seeping into the reactor buildings.

The utility began work on the project last June. Workers drove pipes into the ground for containing liquid that will be frozen.

On Tuesday, the Nuclear Regulation Authority approved TEPCO's plan to start trials on Thursday to freeze the liquid at 18 locations.

If the ice forms as planned, TEPCO will start freezing the liquid at other locations, pending government approval, to eventually create a wall of ice.

But it's unclear how long it will take to complete the ice wall due to its unprecedented scale.

In addition, construction has been hampered by a delay in removing radioactive wastewater from underground utility tunnels around the reactor buildings.

April 30, 2015

## Icewall challenges

### Ice wall project faces challenges

[http://www3.nhk.or.jp/nhkworld/english/news/20150430\\_14.html](http://www3.nhk.or.jp/nhkworld/english/news/20150430_14.html)

Underground ice-wall technology to block groundwater has been used for subway and tunnel construction.

But building a 1.5 kilometer ice wall of uniform thickness is unprecedented.

TEPCO will drive about 1,700 pipes into the ground, 30 meters deep, around the reactor buildings. The pipes will be filled with liquid frozen to minus 30 degrees Celsius.

Pipe installation is nearly complete on the inland side of the reactor buildings, where the trials will be held.

But work on the seaside has been hampered by the delay in removing radioactive wastewater from underground utility tunnels.

At present, 300 tons of groundwater flows into the reactor building basement each day, increasing the pool of contaminated wastewater.

The government and TEPCO say the ice wall and other measures could cut the inflow to one-tenth.

But if the level of groundwater falls below that of contaminated wastewater in the reactor buildings, the wastewater could leak out and spread the contamination.

TEPCO plans to control the level of groundwater by adding water through wells that will be dug around the reactor buildings.

A system to pump up groundwater for purification and release into the ocean remains on hold due to local opposition.

### TEPCO to begin freezing soil on trial basis

[http://www3.nhk.or.jp/nhkworld/english/news/20150430\\_12.html](http://www3.nhk.or.jp/nhkworld/english/news/20150430_12.html)

The operator of the damaged Fukushima Daiichi nuclear power plant will build an underground wall of ice to stem a buildup of contaminated water in reactor buildings.

Tokyo Electric Power Company plans to freeze soil around the No.1 to No.4 reactor buildings to create the 1.5-kilometer-long ice wall. The structure is intended to keep groundwater from seeping into the reactor buildings.

The utility began work on the project last June.

Workers drove pipes into the ground for containing the liquid to be frozen.



On Tuesday, Japan's Nuclear Regulation Authority approved TEPCO's plan to start trials to freeze the liquid at 18 locations.

The government and TEPCO decided to begin the work at noon on Thursday.

If the ice forms as planned, TEPCO will start freezing the liquid at other locations, pending government approval, to eventually create the wall.

The project is unprecedented. It's unclear how long it will take to complete the structure due to a delay in removing radioactive wastewater from underground utility tunnels around the reactor buildings.

May 1, 2015

## Suspected leak of highly radioactive water from (bolted) tank

### Possible leak probed at Fukushima Daiichi plant

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the disabled Fukushima Daiichi nuclear plant is investigating a **suspected leak of highly radioactive water from a holding tank at the facility.**

Tokyo Electric Power Company says inspectors found a pool of water at the base of the tank on Friday morning. The pool's surface measures about 20 by 20 centimeters square.

Company officials say workers placed sandbags around the water and there's no sign the pool is getting bigger. They say none of the water has seeped past barriers surrounding the tanks.

The officials say they measured a high **70-millisievert-per-hour rate of beta ray emission from the surface of the water.**

Water that was pumped out of the reactor buildings is stored in many tanks at the plant. The water was treated to remove cesium but remains highly toxic. Officials believe the water in the pool came from one of the tanks.

**The tank is an old type that has leaked before. Its steel plates are simply bolted together, not welded.**

Tokyo Electric plans to remove the remaining water in the tank for treatment. And officials will try to find out how the leak occurred.

## Starting tests on frozen soil



Pipes installed south of the No. 4 reactor building to create an underground frozen soil wall at the Fukushima No. 1 nuclear power plant (Pool)

### TEPCO starts tests of frozen soil wall at Fukushima nuclear plant

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201505010039>

By HIROMI KUMAI/ Staff Writer

Tokyo Electric Power Co. started freezing soil at the Fukushima No. 1 nuclear plant in trial operations for an underground wall aimed at preventing groundwater from flowing into the damaged reactors and becoming radioactive.

The work was conducted at 18 points around the No. 1 through No. 4 reactor buildings on April 30 for the first time since the project started last June.

TEPCO plans to eventually create a 1,500 meter-long frozen soil wall around the reactors by circulating liquid of minus 30 degrees inside pipes 30 meters deep at 1-meter intervals. Under the project, the wall will divert the clean groundwater away from the plant and into the ocean, thereby stemming the daily accumulation of radioactive water at the plant.

The company says it will start creating the complete frozen soil wall after the tests are completed at the 18 points, where surrounding piping and other factors will likely make it difficult to freeze the soil.

But it is unclear when TEPCO will be able to begin the full operations.

In the trial run, TEPCO will use 58 underground pipes to freeze soil over a 60-meter distance on the mountain side of the nuclear facility. The company will monitor changes in temperature and groundwater levels near the test sites.

The trial operations, which are expected to take weeks to complete, are intended to determine if the method can create frozen walls even in locations with nearby structures and large volumes of groundwater.

TEPCO originally planned to start the freezing process of the entire 1,500-meter frozen wall by the end of March. But delays in preparatory work near the ocean, as well as a suspension of operations associated with safety checks following a worker's death in January, pushed back the scheduled date.

In addition, the Nuclear Regulation Authority has required the utility to carefully examine the effectiveness of the project, so TEPCO decided to conduct the test operations before fully introducing the underground wall.

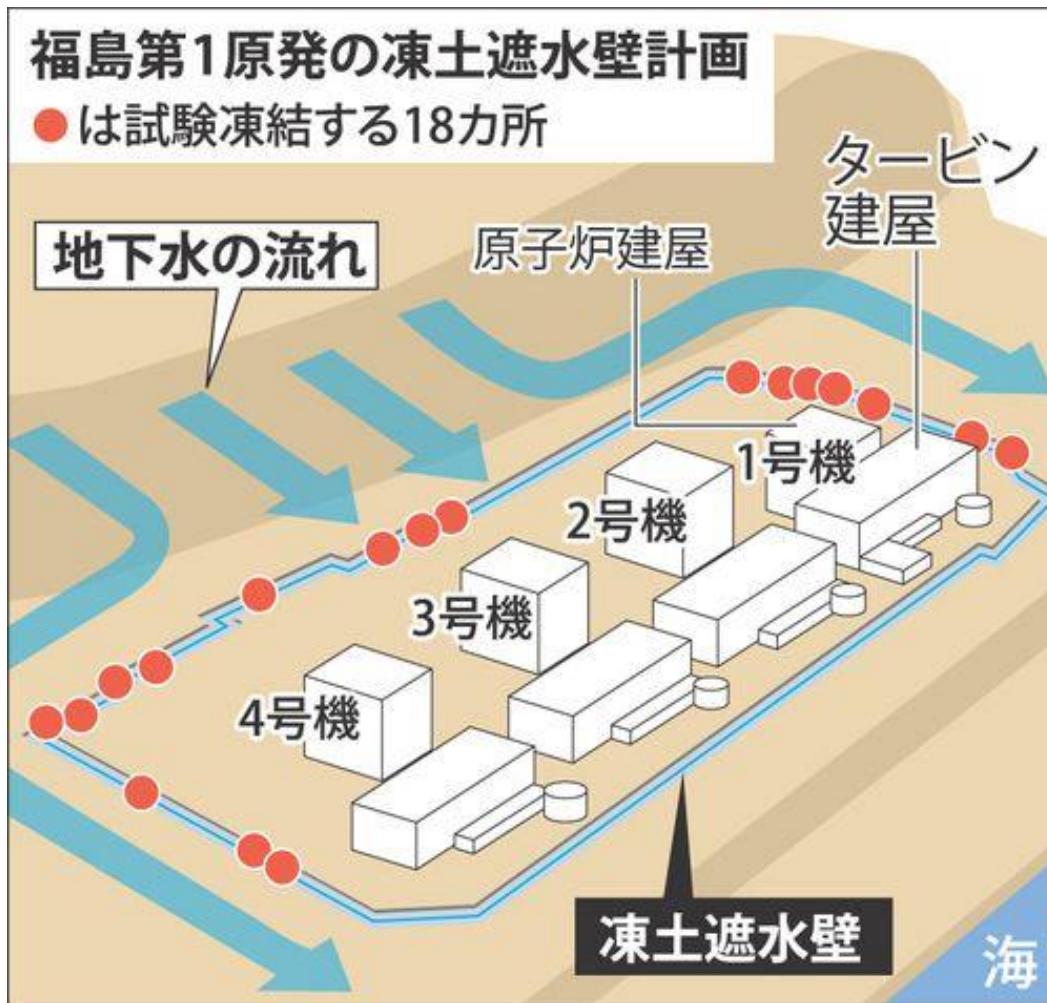
### **TEPCO begins test operation on ice soil wall at crippled Fukushima nuclear plant**

<http://mainichi.jp/english/english/newsselect/news/20150501p2a00m0na005000c.htm>

Tokyo Electric Power Co. (TEPCO), the operator of the stricken Fukushima nuclear station, began a test operation on the frozen soil wall installed around reactor buildings on April 30 to restrict groundwater flowing into the buildings.

The utility plans to ultimately surround No. 1 to No. 4 reactor buildings at Fukushima No. 1 Nuclear Power Plant with a 1.5-kilometer-long ice wall. Along with other countermeasures such as pumping groundwater out of the area, TEPCO expects to cut the daily amount of groundwater flowing into the reactor buildings from approximately 400 metric tons to less than 100 tons.

In the test operation, the utility poured cooling liquid into 58 pipes installed in 18 locations on the mountainside where the freezing time is believed to take longer due to buried objects in the area, and evaluated temperatures in surrounding areas and changes in the level of groundwater. There are 1,551 pipes surrounding the reactor buildings, including the 58.



In this diagram of the layout of Fukushima No. 1 Nuclear Power Plant, the blue arrows show how groundwater flows, the red dots show the 18 locations where test operations are being carried out and the ice wall is shown by a blue line surrounding the four reactor buildings.

TEPCO plans to release the test results sometime after mid-May.

It has emerged that when the frozen soil wall holds back water from flowing into reactor buildings, the groundwater level in areas inside the wall drops below the level of radioactively contaminated water in the reactor buildings, leading to concerns over the contaminated water leaking through damaged parts of the reactor buildings.

In the meantime, questions over water-level management are still under debate between the government, TEPCO and the Nuclear Regulation Authority, and the timing to start the full-scale freezing operation is still up in the air.

May 2, 2015

## Toxic water leaks from tank

## Radioactive water leaks from storage tank at Fukushima

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201505020022>

A tiny amount of radioactive water has leaked from a storage tank at the crippled Fukushima No. 1 nuclear power plant.

Tokyo Electric Power Co., the operator of the plant, said May 1 that about 40 milliliters of water was found under a storage tank holding radiation-contaminated water. The water is believed to have leaked from the tank.

Sandbags were placed around the tank to prevent water from spreading to other areas.

A TEPCO official said a worker came across the wet patch measuring 20 centimeters square at 9:30 a.m. on May 1.

Seventy millisieverts per hour of beta ray-emitting radioactivity were detected on the surface where the water had leaked.

May 5, 2015

## Over 10% of tanks have leaked

### Radioactive water found leaking from wastewater tanks at Fukushima plant

<http://mainichi.jp/english/english/newsselect/news/20150505p2a00m0na011000c.html>

A sampling inspection of tanks containing radioactive waste produced during the processing of contaminated water at the Fukushima No. 1 Nuclear Power Plant has found that over 10 percent of them have leaked.

**The tanks contain sludge and wastewater produced when removing radioactive contaminants from water with the Advanced Liquid Processing System (ALPS).** The plant's operator, Tokyo Electric Power Co. (TEPCO) sampled 105 of 1,354 tanks at the plant, and found that contaminated water had leaked or seeped out of 15 tanks, or about 14 percent of those that were inspected. Each tank measures about 1.5 meters in diameter and 1.9 meters in height and can hold roughly 3 tons of waste.

A TEPCO worker found water had accumulated on the ground under the tanks and on their lids during an inspection in early April. It emerged that wastewater had leaked from holes to let out gas near the tops of the tanks. TEPCO suspects that hydrogen and other gases built up in the wastewater, thereby increasing its volume and forcing it out through the gas holes.

The highest concentration of radioactive cesium in the leaked wastewater was around 9,000 becquerels per liter. **The radioactivity of materials emitting beta rays, meanwhile, was particularly high, at around 3.9 million becquerels per liter.**

The tanks are shielded within a concrete structure at the Fukushima No. 1 nuclear plant, and TEPCO official Isao Shirai maintains that there have been no leaks outside the plant site. The tanks were drop tested in advance, but no tests using actual wastewater were carried out. **TEPCO says the leaks were "unexpected."**

An official from the Secretariat of the Nuclear Regulation Authority commented, "**The leaked water is the most concentrated contaminated water at the nuclear power plant.** Quick countermeasures are needed." Officials will ask TEPCO to thoroughly manage the radiation exposure of workers involving in leak checking and other relevant work.

**TEPCO plans to take measures to prevent further leaks, including reducing the amount of wastewater in the tanks by about 10 centimeters. At the same time, as long as ALPS continues operating, it will keep producing sludge and wastewater. As the number of tanks increases, TEPCO will have to secure space for them. It also faces the task of dealing with the waste once the tanks have reached the end of their durable life (about 20 years).**

May 15, 2015

## **Dismantling cover of No.1 reactor**

### **TEPCO starts removing cover for Fukushima reactor**

[http://www3.nhk.or.jp/nhkworld/english/news/20150515\\_08.html](http://www3.nhk.or.jp/nhkworld/english/news/20150515_08.html)

The operator of the Fukushima Daiichi nuclear plant began work on Friday morning to dismantle the cover of the No.1 reactor building.

The cover was installed after the March 2011 nuclear accident to prevent radioactive dust from dispersing. The reactor experienced a hydrogen explosion at the time of accident.

Tokyo Electric Power Company plans to remove the cover in order to clear away radioactive debris on the upper part of the building and remove spent nuclear fuel still stored inside. It is part of an effort to decommission the reactor.

**For about one week, workers will spray chemicals over the debris inside the cover by using a remote-controlled crane to prevent radioactive dust from spreading.**

They will proceed with the work to remove the cover over the period of about one year. Company officials say they will enhance monitoring of radiation levels during the procedure.

TEPCO says a preliminary test last year showed no scattering of radioactive materials when dismantling the cover.

**The utility initially planned to start dismantling the cover on the No.1 reactor building in July of last year. But the work was delayed after the removal of debris from the No. 3 reactor in 2013 caused radioactive dust to spread, sparking fear among local residents. The death of workers at the plant also affected the plan.**

## **TEPCO starts prep work to take cover off damaged Fukushima reactor**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201505150060>

By MASANOBU HIGASHIYAMA/ Staff Writer

Tokyo Electric Power Co. began preparations on May 15 to remove the cover around a damaged reactor building at the crippled Fukushima No. 1 nuclear power plant, the first step in a lengthy process to extracting nuclear fuel inside it.

The work is part of a preparatory process that could take several years for the eventual removal of nuclear fuel from the spent fuel pool in the No. 1 reactor building.

On the first day of the work, TEPCO, the plant operator, sprayed a chemical agent in the reactor building to prevent radioactive dust in the building from being released into the air when the cover is removed.

On May 15, a large crane lifted a spraying machine to insert a thin, long nozzle into the building through holes created on the top cover to spray a glue-like chemical to contain dust and other materials generated by a hydrogen explosion triggered by the March 2011 Great East Japan Earthquake and tsunami.

The agent will be sprayed through the nozzle at 48 points. After it completes the spraying, TEPCO plans to begin retracting the roof cover on May 25 at the earliest to remove debris from the upper part of the building.

When the utility was removing debris from the No. 3 reactor building in the summer of 2013, a large amount of radioactive substances was released into the environment, fostering the public's distrust in the process.

Subsequently, TEPCO has cautiously been proceeding with preparations for removing the cover around the No. 1 reactor building, such as testing anti-scattering agents in advance last October.

**Because it is currently rice planting season around the Fukushima plant, TEPCO has pledged to suspend its work and inform surrounding local governments within 30 minutes when amounts of released dust and radiation exceed certain levels.**

## **Video footage of inside No1 Reactor**

### **Video shot by robot inside damaged reactor**

[http://www3.nhk.or.jp/nhkworld/english/news/20150515\\_40.html](http://www3.nhk.or.jp/nhkworld/english/news/20150515_40.html)

The operator of the Fukushima Daiichi nuclear power plant on Friday released hundreds of hours of video footage showing the inside of the containment vessel of one reactor.

The footage was shot in April by 2 remote-controlled robots sent inside the No. 1 reactor's vessel where radiation levels are very high.

Footage first captured shows fallen rubble in front of the robot.

The probe's camera also captured what might be lead sheets that fell when meltdown occurred. Rubble can be seen piling up around them. All this testifies to the severity of the accident.

Meanwhile, no major damage was found in areas near the route leading to the bottom of the containment vessel.

Tokyo Electric Power Company plans to carry out further searches by sending robots to the lower levels of the vessel to look for nuclear fuel that melted down.

It also plans to send them into the containment vessel of the No. 2 reactor as early as August.

A survey using robots at the No. 3 reactor is expected to start as early as autumn this year.

The operator's effort using robots to look into the reactor vessels will go into full swing in preparation for removing nuclear fuel. That should be the most difficult part of the work in the reactors' decommissioning.

## 5.1 quake hits Fukushima

### **Magnitude 5.1 quake shakes Fukushima**

<http://mainichi.jp/english/english/newsselect/news/20150515p2g00m0dm065000c.html>

TOKYO (Kyodo) -- An earthquake with an estimated magnitude of 5.1 jolted Fukushima Prefecture and other areas in northeastern Japan early Friday afternoon, the Japan Meteorological Agency said. No tsunami warning was issued.

The quake occurred around 12:30 p.m. off the coast of Fukushima at a depth of about 50 kilometers. It registered 4 on the Japanese seismic intensity scale of 7 in coastal areas facing the Pacific.

Tokyo Electric Power Co. said its Fukushima Daiichi and Fukushima Daini nuclear power plants were unaffected by the quake.

May 22, 2015

## Accumulated hydrogen in the tanks likely caused leaks

### **Radioactive wastewater leak linked to hydrogen**

[http://www3.nhk.or.jp/nhkworld/english/news/20150522\\_27.html](http://www3.nhk.or.jp/nhkworld/english/news/20150522_27.html)



The operator of the Fukushima Daiichi nuclear plant says recent leaks of highly radioactive wastewater from their containers were likely due to **accumulated hydrogen gas in the tanks**.

Tokyo Electric Power Company reported this to the Nuclear Regulation Authority on Friday. TEPCO has found since April that the wastewater, produced during the process of treating radioactive water, had seeped out through the lids of a number of containers.

The utility says that 28 of the 265 inspected containers had leaked, and in 15 of them, bubbles formed when workers stirred the liquid inside, and water levels went down.

**The utility believes the bubbles mainly consist of hydrogen, generated by strong radiation inside the containers. TEPCO officials suspect the gas increased the volume of the wastewater, forcing some to overflow.**

They say none of the spilled water has affected the external environment. As stopgap measures, they plan to put liquid absorbents on the lids of the containers, and reduce the amount of water stored inside.

May 23, 2015

## **Tanks without vents: Risk of hydrogen explosion**

### **Risk of hydrogen explosion from leaking containers at Fukushima plant**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201505230059>



Fukushima Governor Masao Uchibori, right, is briefed on the ALPS system that removes radioactive substances from contaminated water at the Fukushima No. 1 nuclear power plant in November. (Pool)

By HIROMI KUMAI/ Staff Writer

Inspections of containers holding contaminated water at the Fukushima No. 1 nuclear power plant found that at least 10 percent have leaks, which could trigger a hydrogen explosion.

Tokyo Electric Power Co., the plant's operator, reported its findings at a meeting with a study group from the Nuclear Regulation Authority on May 22. It said no radioactive water was found to have escaped outside the concrete structures that encase the containers.

According to TEPCO, there were about 1,300 such containers at the plant as of May 20.

They store waste water from the ALPS (advanced liquid processing system) equipment that removes radioactive substances from contaminated water.

The containers, which are made of polyethylene, are 1.8 meters high and have diameters of 1.5 meters.

The first leak was discovered in a lid on April 2.

TEPCO began inspecting others to see if they had similar problems. Of the 278 it had examined by May 20, it found 26 had some sort of leak or were bleeding from their lids.

The operator said the leaks and bleeding were likely caused by hydrogen and other types of gases that resulted from the water's exposure to high levels of radiation.

Such gases appear to have accumulated in sediment at the bottom of the containers, expanding the volume of the liquid.

An NRA official said the accumulating hydrogen poses a potential danger.

“If the concentration level is high, a spark caused by static electricity could cause a container to explode,” the official said.

Although all the lids of the containers were supposed to be fitted with pressure-release valves to allow gasses to escape, TEPCO’s survey found that one did not have the mechanism.

Further review of the delivery records for the containers showed there may be as many as 333 that are also defective, a TEPCO official said.

## Container for Fukushima waste found without gas venting holes

<http://mainichi.jp/english/english/newsselect/news/20150523p2a00m0na015000c.html>

Tokyo Electric Power Co. (TEPCO) revealed on May 22 that one of its containers for waste liquid remaining after the processing of contaminated water at the Fukushima No. 1 Nuclear Power Plant did not have the necessary holes in its lid for venting out gas.

A total of 305 containers are being used without having been checked for venting holes. TEPCO says it will quickly inspect all of the containers.

The containers hold sludge and other waste liquids containing radioactive materials that remain after contaminated water is put through the Advanced Liquid Processing System (ALPS). The waste produces gasses like hydrogen, so as a safety measure the Nuclear Regulation Authority had asked TEPCO to create the holes.

In early April, containers were found to be leaking radioactive waste liquids through the venting holes.

Later in the month, a company in a cooperative relationship with TEPCO was inspecting the containers when it discovered the container without the venting holes. Out of the approximately 1,400 containers, 334 -- including ones that are not being used yet -- have not yet been checked for venting holes.

TEPCO has speculated that the work to create the holes was skipped over at a factory in the United States.

May 25, 2015

## No place for complacency, says IAEA

### **IAEA report on Fukushima slams lack of tsunami preparedness despite awareness of threat**

<http://www.japantimes.co.jp/news/2015/05/25/national/iaea-report-fukushima-debacle-slams-lack-tsunami-preparedness-despite-awareness-threat/#.VWLT0bwmic>

Kyodo

VIENNA – The International Atomic Energy Agency criticized Tokyo Electric Power Co. and Japanese regulatory authorities for their failure to prevent the 2011 Fukushima No. 1 nuclear plant disaster despite knowing the risk of large tsunami hitting the facility, according to a copy of an IAEA report.

The U.N. nuclear watchdog said in the final report on the nuclear disaster triggered by a huge earthquake and tsunami in March 2011, obtained Sunday, that “the Fukushima Daiichi NPP (nuclear power plant) had some weaknesses which were not fully evaluated by a probabilistic safety assessment, as recommended by the IAEA safety standards.”

The paper, compiled by around 180 experts from 42 countries, is set to be submitted to the IAEA’s annual meeting in September after its board examines the 240-page summary in June.

The report addressing the causes and consequences of the Fukushima disaster as well as lessons learned is expected **to serve as a reference for nuclear safety measures worldwide.**

**The IAEA said a new approach applied between 2007 and 2009 postulated a magnitude-8.3 quake off the coast of Fukushima that could lead to tsunami of around 15 meters hitting the No. 1 plant and inundating the main buildings.**

**Despite the analysis, Tepco, the old Nuclear and Industrial Safety Agency, which oversaw Japan’s nuclear industry at that time, and other organizations did not act, deciding instead that “further studies and investigations were needed.”**

“Tepco did not take interim compensatory measures in response to these increased estimates of tsunami height, nor did NISA require Tepco to act promptly on these results,” the report says.

Prior to the accident, there was not sufficient consideration of low probability, high consequence external events which remained undetected. This was in part because of the basic assumption in Japan, reinforced over many decades, that the robustness of the technical design of the nuclear plants would provide sufficient protection against postulated risks,” it says.

As a result, **Tepco did not implement a sufficient safety assessment as recommended by the IAEA and lacked protection for the emergency diesel generators, battery rooms and other vital systems against tsunami-caused flooding,** the paper adds.

“The operators were not fully prepared for the multiunit loss of power and the loss of cooling caused by the tsunami. Although Tepco had developed severe accident management guidelines, they did not cover such an unlikely combination of events,” the report says, also pointing to the lack of appropriate training for workers at the plant.

**The IAEA called on countries that use, or plan to use, nuclear power to make continuous efforts to improve safety based on new findings and to be prepared to cope with natural disasters more severe than those predicted when nuclear power plants were designed.**

“There can be no grounds for complacency about nuclear safety in any country. **Some of the factors that contributed to the Fukushima Daiichi accident were not unique to Japan,**” the report warns.

May 26, 2015

## TEPCO finished with toxic water?

## TEPCO to finish processing highly contaminated water by month's end

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201505260041>



Equipment to remove radioactive substances from contaminated water stored at the Fukushima No. 1 nuclear power plant (Pool)

By MASANOBU HIGASHIYAMA/ Staff Writer

IWAKI, Fukushima Prefecture--Tokyo Electric Power Co. said it will finish processing highly radioactive water stored in tanks at the Fukushima No. 1 nuclear power plant by the end of the month.

**The plant operator said the volume of water containing tens of millions to hundreds of millions of becquerels of radioactive substances per liter had been reduced to 8,872 tons by May 21.**

At one point, more than 360,000 tons of highly contaminated water was stored in tanks on the premises of the crippled facility.

In March, TEPCO said it would not finish processing all the highly radioactive water by the end of May. But it now says it will be able to complete treatment of 20,000 tons of salty radioactive water generated when reactor cores were cooled with seawater, a factor TEPCO cited as the key reason for the delay in processing work.

Finishing the work will lower the risk of radioactive substances on the plant site from leaking. But **the treated water still contains some radioactive materials, and TEPCO has yet to decide how to handle the processed water.**

May 27, 2015

## Task completed, at least in part

### TEPCO 'completes processing' highly radioactive water at Fukushima plant

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201505270071>

By MASANOBU HIGASHIYAMA/ Staff Writer

Tokyo Electric Power Co. said it “completed” the onerous task of processing about 620,000 tons of highly radioactive water stored at the Fukushima No. 1 nuclear power plant on May 27.

The work ended at 9:15 a.m., and it greatly reduces the risk of large amounts of radioactive substances leaking into the environment surrounding the crippled plant, TEPCO officials said.

The water, kept in storage tanks at the plant, had contained tens of millions to hundreds of millions of becquerels of radioactive substances per liter.

However, TEPCO has yet to decide how to handle the rising volume of processed water that still contains low levels of radioactive substances. Currently, about 440,000 tons of such water, containing several hundreds of becquerels of radioactive substances per liter, are on the plant site.

The site also has about 180,000 tons of contaminated water with some radioactive substances, such as strontium, removed. This water needs further processing to eliminate other radioactive substances.

The triple meltdown at the plant following the March 2011 Great East Japan Earthquake and tsunami has required tons of water to cool the nuclear fuel and keep the situation under control. That in turn led to a huge volume of highly contaminated water held in row upon row of storage tanks at the plant.

Another problem for TEPCO has been the 300 tons a day of groundwater flowing into the nuclear reactor buildings and becoming contaminated with radioactive substances. The utility is planning a “frozen soil wall” to divert the groundwater into the ocean before it reaches the buildings.

### TEPCO completes some wastewater decontamination

[http://www3.nhk.or.jp/nhkworld/english/news/20150527\\_31.html](http://www3.nhk.or.jp/nhkworld/english/news/20150527_31.html)

The operator of the damaged Fukushima Daiichi nuclear plant says removal of 2 main radioactive substances is complete from most of the highly contaminated wastewater stored at the facility.

Tokyo Electric Power Company had presented a plan to the government to finish processing roughly 600,000 tons of radioactive wastewater by the end of March.

Officials with the utility cited problems with equipment for failing to meet that target. Instead, they aimed to complete at least one round of processing by the end of this month.

They announced on Wednesday that **workers had removed cesium and strontium from about 620,000 tons of the wastewater stored in tanks.**

**They said about 10,000 tons of stored water could not be removed from the tanks and remained unprocessed.**

They said workers were able to remove about 60 other types of radioactive substances from 440,000 tons of the wastewater. That leaves about 180,000 tons still to be processed for those substances.

TEPCO officials said the processed water is still contaminated and will remain in storage tanks.

Workers on Wednesday also began dismantling some of the storage tanks. The tanks are made with steel plates bolted together rather than welded and are prone to leaks.

TEPCO has about 370 of these tanks and is considering how many to replace with seamless types.

### **TEPCO says all highly toxic water in tanks filtered**

<http://mainichi.jp/english/english/newsselect/news/20150527p2g00m0dm071000c.html>

TOKYO (Kyodo) -- The operator of the crippled Fukushima Daiichi nuclear plant said Wednesday it has finished filtering a total of 620,000 tons of extremely toxic water being stored in tanks on the premises of the complex to lower its radiation level.

Tokyo Electric Power Co. says the risk of radiation leakages from the water tanks is now much lower.

However, around 400 tons of radioactive water is still being generated everyday as groundwater is seeping into the plant and mixing with tainted water more than four years since the nuclear accident.

According to TEPCO, some 440,000 tons of the water has been treated through a key water processing system said to be capable of removing 62 different types of radioactive material with the exception of tritium. The remaining 180,000 tons has been processed through another facility capable of removing strontium, but still contains other types of radioactive substances and needs further treatment.

The highly radioactive water has been generated during the process of cooling the plant's reactors that suffered meltdowns in the March 2011 nuclear crisis triggered by the magnitude 9.0 earthquake and tsunami.

When Prime Minister Shinzo Abe visited the Fukushima plant in September 2013, TEPCO President Naomi Hirose pledged that the company would filter all the water kept in tanks by March 31, 2015 to drastically reduce the amount of radioactive materials it contains.

But the process has been delayed due to a series of problems with its key water treatment facilities.

### **Tepco says all radioactive water in Fukushima No. 1 tanks filtered**

<http://www.japantimes.co.jp/news/2015/05/27/national/tepco-says-radioactive-water-fukushima-1-tanks-filtered/#.VWWVFUbwmot>

Kyodo

The operator of the crippled Fukushima No. 1 nuclear plant said Wednesday it had finished filtering 620,000 tons of extremely toxic water stored in tanks on the premises of the complex to lower its radiation level.[...]

## Ceramic blocks to store radioactive water?

### Potter creates ceramic cure to help stop radioactive water leaks at Fukushima

[http://ajw.asahi.com/article/behind\\_news/social\\_affairs/AJ201505270060](http://ajw.asahi.com/article/behind_news/social_affairs/AJ201505270060)

By KEIZO FUKATSU/ Staff Writer

YOKKAICHI, Mie Prefecture--A manufacturer of traditional ceramics has created special blocks that can absorb water, a development that could enable radioactive water at the Fukushima No. 1 nuclear power plant to be stored safely.

"Contaminated water would not leak if it is stored inside the blocks," said Taiji Mizutani, who heads Mizutani Shoten. "We will commercialize the product after verification experiments and hope evacuees from Fukushima will be able to return to their homes as early as possible."

Mizutani came up with the idea of developing water-absorbing blocks with unglazed ceramics when he was working as a volunteer in the Tohoku region, which was devastated by the March 2011 Great East Japan Earthquake and tsunami.

The 37-year-old expressed concern about frequent reports of highly radioactive water leaking from storage tanks at the stricken plant.

Since the disaster, Mizutani has visited affected areas more than 10 times and interacted with people who were evacuated from their homes near the nuclear plant.

"I always wanted to help them return to their hometowns," Mizutani said.

He first realized ceramics may be useful for storing radioactive water when he found biscuit ware absorbs glaze more easily. Then, Mizutani began testing the water-absorbing quality of ceramics.

He mixed chaffs of grain with soil mainly comprised of clay. Because rice hulls burn away when the soil is fired, hollows remain where the chaffs existed. Mizutani also kept the firing temperature at around 700 degrees to remove water from the clay and create tiny linear cracks.

According to Mizutani, the hollows and cracks help the ware absorb water. It took Mizutani almost a year to develop the highly absorbent material.

While ordinary unglazed ceramic ware absorbs 40 percent of its weight in water, Mizutani's "spongelike" block absorbed a volume equivalent to its own weight in just two minutes in one experiment, Mizutani said.

He has received patents for the special block as well as his original water-storage system, in which contaminated water is stored after being absorbed by the ceramic blocks laid on a huge pool made of high-density concrete.

He intends to reach out to Tokyo Electric Power Co., the operator of the Fukushima plant, so the product can be used in the decommissioning process at the crippled facility.

May 29, 2015

### Radioactive water leaks at Fukushima Daiichi

[http://www3.nhk.or.jp/nhkworld/english/news/20150529\\_41.html](http://www3.nhk.or.jp/nhkworld/english/news/20150529_41.html)



The operator of the crippled Fukushima Daiichi nuclear plant says workers have found a leak of comparatively highly radioactive water at the plant's site. It says the water flowed into the plant's port.

Tokyo Electric Power Company says the contaminated water was leaking from a hose connecting a wastewater tank and a building at the plant.

The hose had a crack about 1 centimeter long. The contaminated water was produced in a process to clean up rainwater tainted by radioactive materials at the plant.

Utility officials said the leaked water flowed into a nearby drainage channel and into the port.

They said they detected about 1,200 becquerels per liter of beta ray-emitting substances from water taken from the channel on Thursday. That figure was 40 times the level the previous day.

They said the figure rose to a maximum of 1,400 becquerels on Friday. The officials believe the leakage continued over the two days.

The company says **concerns were raised about the hoses' durability**. It has been replacing them.

Authorities in Fukushima Prefecture have urged the company to conduct an investigation to identify the cause of the leak. They say the company should take thorough measures to prevent a recurrence.

May 30, 2015

## Record-high radioactivity in port

### Record levels of radioactivity in plant's port

[http://www3.nhk.or.jp/nhkworld/english/news/20150530\\_09.html](http://www3.nhk.or.jp/nhkworld/english/news/20150530_09.html)

The operator of the damaged Fukushima Daiichi nuclear plant says it has found record-high levels of radioactive water in the facility's port. It says the high levels are due to a leak of wastewater.

Tokyo Electric Power Company officials said on Friday that **contaminated water leaked from a crack in a hose connecting a wastewater tank to a building at the plant**.

**They later detected about 22,000 becquerels of beta ray-emitting substances per liter of water in a nearby drainage ditch. The ditch is in the upper part of a drainage channel.**

The utility also found the density of radioactive materials in the channel was around 6,600 becquerels per liter. That's more than 200 times higher than the figure recorded on Wednesday.

TEPCO officials took samples of seawater from 4 locations in the port, where the leaked water reached via the drainage channel. They detected **between 190 and 320 becquerels of radioactive substances per liter.** **The figure is the highest ever recorded in the port.**

Utility officials say the leak stopped after they halted the flow of water, and that it has not affected waters in the Pacific Ocean outside the port.

TEPCO workers are trying to collect water from the drainage channel to prevent it from reaching the ocean.

June 2, 2015

## Durability in doubt but hose not replaced

### Hose leaking radioactive water not replaced

[http://www3.nhk.or.jp/nhkworld/english/news/20150602\\_13.html](http://www3.nhk.or.jp/nhkworld/english/news/20150602_13.html)

Officials at the Fukushima Daiichi nuclear plant say a hose that leaked radioactive water was left untended **even though its durability was in doubt.**

The leak of highly radioactive wastewater was detected on Friday. Tokyo Electric Power Company, or TEPCO, estimates that **7 to 15 tons of water leaked from a crack in the hose, some into the plant's port.**

Water sampled from 4 locations inside the port turned up the highest levels of radioactive substances since monitoring began 2 years ago.

Company officials say the crack in the hose was caused by stress from excessive bending that went beyond the permissible level set by its maker.

TEPCO had been replacing the same type of hose at other parts of the plant due to doubts about its durability.

But the one that leaked was left untouched since it was placed at a site where workers were busy building a wall of frozen soil around the nuclear complex to keep groundwater from seeping into the reactor buildings.

No clear rules for patrols were in place at the site. **A worker passing by happened to notice the leak.**

TEPCO plans to speed up work to replace the hoses with stronger ones. It also plans to draw up a new manual to ensure proper monitoring when the hoses are used.

### **Hose caused radioactivity leak**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclearwatch/20150602.html>



Officials at the Fukushima Daiichi nuclear plant have supplied more details about a leak of highly radioactive water that was discovered last week. They say a hose that caused the leak was left unchecked even though there were concerns about its durability.

Tokyo Electric Power Company (TEPCO) workers discovered the problem on Friday. They estimate that as much as 15 tons of water seeped into a drainage channel and then leaked into the port that is managed by the plant.

When workers tested water samples from the port, they found the highest level of radioactivity since monitoring began 2 years ago.

Company officials say the crack in the hose was caused by stress from excessive bending. Concerns about durability had led them to replace similar equipment in other parts of the plant.

TEPCO will now accelerate replacement work. Officials are also compiling a manual to ensure proper checks are carried out when the hoses are in use.

June 3, 2015

### **TEPCO lies again on wastewater handling**

## **NRA not informed of tainted water transfer**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the damaged Fukushima Daiichi nuclear plant is facing censure for transferring wastewater that was possibly more radioactive than it originally stated. The company failed to notify Japan's nuclear regulator of the change.

In May, officials found that water sampled at 4 sites at the plant's port briefly exceeded levels of radioactivity seen previously in the 2 years since monitoring began.

It's believed the contaminated water came from a cracked and leaking hose inside the plant. The water from the hose flowed into a channel that led to the port.

Initially, Tokyo Electric Power Company said the hose contained wastewater that was a byproduct of treating contaminated rainwater.

But on Wednesday it was revealed at a meeting of the Nuclear Regulation Authority that **the utility had begun adding other highly radioactive wastewater to the water since mid-May.**

**TEPCO says that as a result the wastewater in the hose was likely more radioactive than it initially declared.**

**Some of the water in the hose was groundwater mixed with extremely highly contaminated water that had pooled in the plant's basement.**

The hose cracked from being bent beyond the operational limit set by the maker. The utility had also failed to replace the hose despite questions about its durability.

NRA Chairman Shunichi Tanaka condemned the utility for its utter failure to control the wastewater. He ordered the company to continue monitoring and reporting on its handling of wastewater.

June 4, 2015

## **Two more temporary stockyards in Fukushima**

### **2 Fukushima waste storage sites to be built**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Japan's environment ministry will soon start building two more temporary stockyards to **store radioactive waste from decontamination work** in Fukushima Prefecture. A nuclear accident took place there in 2011.

The stockyards are facilities to temporarily store contaminated soil and other waste before it goes to a main storage facility that has yet to be built.

The ministry already has two such stockyards in the region of Futaba and Okuma towns. The two towns host the damaged nuclear plant. The stockyards can store 20,000 cubic meters of waste.

With the two new stockyards to be built in the same region, the ministry has now nearly secured enough land to carry out its plan to transfer **more than 40,000 cubic meters of waste** gathered from 43 municipalities in the prefecture in a year.

Work to transfer radioactive waste to the existing stockyards began in March. But the ministry has only transferred 3,000 cubic meters of waste. That's less than a tenth of the planned annual total amount.

As for the entire site of the main storage facility planned for the same area, the Environment Ministry faces the challenge of negotiating with more than 2,300 landowners. Only a few have so far agreed to sell their land.

The planned main storage facility is for intermediate storage until a site is secured for final disposal. Legislation obliges the government to ensure the waste stored in the main storage facility is moved to a final disposal site outside Fukushima Prefecture within 30 years.

## TEPCO lies again on wastewater handling (2)

### **NRA rebukes TEPCO for failure to contain radioactive Fukushima water**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201506040105>



Rows of tanks holding contaminated water at the Fukushima No. 1 nuclear power plant (Asahi Shimbun file photo)

Japan's nuclear watchdog had harsh words for Tokyo Electric Power Co. over its failure to implement a comprehensive strategy to plug leaks of contaminated water at its crippled Fukushima No. 1 nuclear power plant.

"(TEPCO) has failed to manage (contaminated water) properly," said Shunichi Tanaka, chairman of the Nuclear Regulation Authority, at a regularly scheduled meeting on June 3. "It lacks a strategic approach in addressing the contaminated water issue."

Tanaka's remarks followed the recent revelation that an estimated 7 to 15 tons of highly radioactive water leaked from a hose that was used to transfer contaminated water from storage tanks to a treatment facility. The leak was discovered on May 29.

**The incident was just the latest in a spate of similar mishaps that have plagued the plant.**

TEPCO announced on June 1 that the escaped water contained 1.1 million becquerels of beta ray-emitting radioactive materials per liter. The radioactive water apparently made its way to the sea through a ditch, according to the company.

The leak likely occurred because the condition of the hose had deteriorated. In the part where the water escaped, the hose was bent at a far sharper angle than is allowed under regulations, the company said. TEPCO said it did not replace the hose with a more durable one even though it was aware of the potential danger that could result from aging. **It had not checked the hose since installing it in October 2013.**

Tanaka rebuked the utility for failing to replace it, saying, "(TEPCO) should be held deeply responsible." An official with the NRA who investigated the incident also revealed at the meeting that **TEPCO had failed to notify the authorities before the leak that the tanks holding water that was scheduled for treatment included highly contaminated water.**

The heavy contamination resulted from tons of groundwater making contact with melted nuclear fuel in the reactor buildings.

June 5, 2015

## Fallout still Japan's major problem

### Report: Nuclear fallout top environmental problem

[http://www3.nhk.or.jp/nhkworld/english/news/20150606\\_04.html](http://www3.nhk.or.jp/nhkworld/english/news/20150606_04.html)

A Japanese government report says the release of massive amounts of radioactive materials is still the country's top environmental problem 4 years after the nuclear accident in Fukushima Prefecture.

This year's white paper on the environment says high levels of radiation are still detected in some areas. It says affected areas face a number of problems, such as depopulation and ungrounded rumors.

The report calls for the introduction of renewable energy in such areas. It proposes using part of earnings from green energy generation to help residents to return to their communities.

June 20, 2015

## Highly radioactive water comes out of pipe

### TEPCO investigating water leak at Fukushima plant

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Officials in charge of the Fukushima Daiichi nuclear power plant say around 20 liters of highly radioactive water leaked from equipment used to treat tainted rainwater. But they say the incident poses no danger to the outside environment.

Tokyo Electric Power Company officials say the leak came to light when an alarm went off around 9 AM on Saturday. Workers found water was coming out of a joint in a pipe.

TEPCO says all of the water fell into a receptacle below the equipment.

The utility says the water contained about 24,000 becquerels per liter of beta-ray emitting substances, a

very high amount.

TEPCO officials say a valve that should have been open was closed, and they believe this raised pressure in the pipes and caused the leak.

The utility is investigating to see if there was any error on the part of workers.

June 23, 2015

## Hoses again

### TEPCO finds problems with hoses at Daiichi plant

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the disabled Fukushima Daiichi nuclear plant says **most of the facility's other hoses like the one that developed a leak last month need repair or replacement.**

The leak from a cracked hose in late May sent highly contaminated water into the plant's port, sending radioactivity in the seawater there to the highest level since observations began 2 years ago.

Plant operator Tokyo Electric Power Company believes the crack in the hose was caused by **stress from excessive bending.** It has checked 159 hoses of the same type at the site, and found that 139 -- or nearly 90 percent -- are also being used in an incorrect manner.

Some are similarly bent beyond the permissible level set by the maker, or have not been coated with material to protect them from damage.

TEPCO says all the hoses that need improvement carry relatively low-level radioactive water, including rainwater tainted at the site. **The utility plans to speed up work to replace the hoses with a more durable type. It will also shorten the length of hoses used to carry contaminated water to reduce the risk of leakage.**

June 30, 2015

## Very high radiation near No.2



## High radiation detected near No.2 reactor pipe

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the Fukushima Daiichi nuclear plant has detected very high levels of radiation **near a reactor pipe where workers plan to soon launch a robotic probe inside a containment vessel.**

Tokyo Electric Power Company took measurements at the No.2 reactor Friday last week. The unit suffered a meltdown in the March 2011 disaster.

The utility says radiation levels near the pipe leading to the inside of the reactor's containment vessel reached a maximum of more than 1,000 millisieverts per hour.

The utility is planning to inject a robot through the pipe to inspect the melted fuel debris in August. It says **workers would have to go near the site to prepare.**

Separately, the company has found traces of a **blackish material that appears to have melted from the steel cover of the pipe.**

Officials say they do not know whether the blackish material has anything to do with high radiation levels. They say they will examine whether it will hamper the robotic probe.

Tokyo Electric says it will decontaminate the area, and that at this point, the schedule for the probe will carry on as scheduled.

## Contaminated water removed from tunnels

### TEPCO: Radioactive water removed from tunnels

[http://www3.nhk.or.jp/nhkworld/english/news/20150630\\_29.html](http://www3.nhk.or.jp/nhkworld/english/news/20150630_29.html)

The operator of the crippled Fukushima Daiichi nuclear plant says it has finished removing highly radioactive water from underground tunnels connected to one of the facility's reactor buildings.

Tokyo Electric Power Company, or TEPCO, said on Tuesday that **workers removed about 4,500 tons of the water from the tunnels linked to the No. 2 reactor building.**

**Underground space of the building is filled with highly contaminated water that had contact with melted nuclear fuel, raising concerns that the water could flow out to the nearby sea through the tunnels.**

Since November, workers had been filling in the tunnels with cement to remove the water.

TEPCO officials say they hope to finish similar work at underground tunnels connected to the plant's No. 3 reactor in July.

The company estimates that **more than 10,000 tons of such water has flowed into underground tunnels of both reactors.**

In April last year, TEPCO tried to create ice walls just outside the reactor buildings to keep tainted water out of the tunnels. But the plan did not work, and the utility decided to fill them with cement.

TEPCO and the government say they attach the highest priority to removing contaminated water from the tunnels, to avoid polluting the sea.

July 1, 2015

## Scorpion robot for Fukushima

### Shape-changing robot built to photo melted fuel at Fukushima reactor

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201507010051>

By HIROMI KUMAI/ Staff Writer

YOKOHAMA--Toshiba Corp. unveiled a shape-shifting robot that could finally reveal the actual condition of melted nuclear fuel at the crippled Fukushima No. 1 power plant.

The robot will likely be deployed in August in the No. 2 reactor containment vessel for the first survey underneath a reactor core at the plant, Toshiba officials said at a June 30 demonstration for reporters at its Keihin works here.

Equipped with two cameras and light-emitting diodes, the robot will be tasked with taking pictures of the melted fuel.

More than four years after the March 2011 Great East Japan Earthquake and tsunami caused the triple meltdown at the Fukushima plant, high radiation levels are still preventing workers from approaching the reactor containment vessels to accurately assess the damage within.

"We hope the robot will gather as much information as possible with the two cameras," a company official said.

According to Toshiba officials, the probe was developed at the request of the International Research Institute for Nuclear Decommissioning, an organization consisting of electric power companies and nuclear reactor manufacturers.

To pass through narrow spaces, the probe transforms into a 54-centimeter-long tubular shape that measures 9 cm in width and 9 cm in height.

The back part of the robot, which contains one of the cameras, can be rotated to take pictures from different angles.

The device can also right itself if it overturns, Toshiba said.

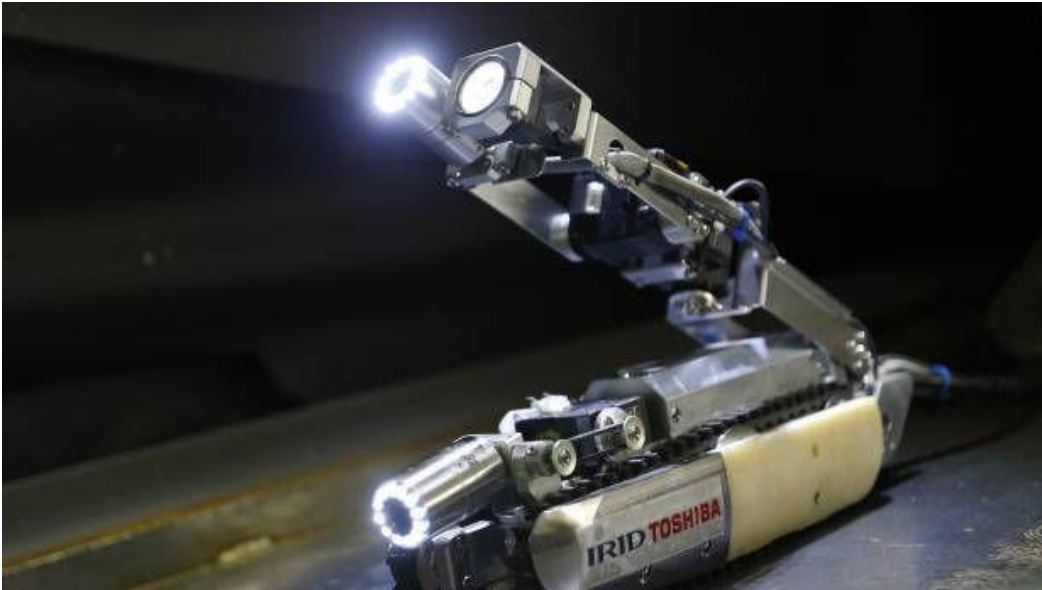
The probe will enter the central part of the containment vessel through a rail link and operate on the iron-mesh floor beneath the reactor core.

The robot can identify objects up to 3 meters away, even in poor visibility caused by steam or other factors, according to Toshiba.

Robotic probes developed by another company were used to survey the No. 1 reactor containment vessel at the plant in April, but those devices did not enter areas directly underneath the reactor core.

One got stuck between obstacles on the floor, rendering it inoperable.

A monitoring camera installed in the containment vessel to control the second robot later malfunctioned because of high radiation levels, forcing plant operator Tokyo Electric Power Co. to give up its plan to retrieve the robot.



A robot developed by Toshiba Corp. is demonstrated at its laboratory in Yokohama Tuesday. As Japan struggles in the early stages of a decades-long cleanup of the Fukushima nuclear crisis, Toshiba developed the robot, which raises its tail like a scorpion and collects data, to hopefully locate some of the melted fuel in the stricken reactor 2. | AP

## **Toshiba rolls out ‘scorpion’ robot to look inside crippled reactor at Fukushima No. 1**

<http://www.japantimes.co.jp/news/2015/07/01/business/tech/toshiba-rolls-scorpion-robot-look-inside-stricken-fukushima-reactor-2/#.VZOcnUbwmic>

**by** Mari Yamaguchi

AP

YOKOHAMA – A new robot that raises its tail like a scorpion is scheduled to survey melted nuclear fuel inside one of the three wrecked reactors at Tepco’s Fukushima No. 1 plant.

Toshiba Corp., codeveloper of the device, which was demonstrated on Tuesday, said the robot will venture into reactor 2’s primary containment vessel in August after its operators undergo a month of training.

ADVERTISING

Officials hope the robot can see the fuel in the pressure vessel in the middle of the reactor. The location of the fuel has yet to be pinpointed because of the dangerously high radiation levels nearby.

The unprecedented work of decommissioning the Fukushima No. 1 plant, which was crippled in the 2011 earthquake and tsunami, is expected to take decades.

The scorpion robot is the second to enter a primary containment vessel, after a “snake” robot was sent into the worst-hit reactor 1 in April. The robot stalled inside the reactor and was unable to spot melted-fuel debris there.

This time, the scorpion crawler, which is 54 cm (21 inches) long when it is stretched out, will enter through a duct designed as a passageway for fuel rods.

During the demonstration at a Toshiba lab near Tokyo, the robot slid down a railing and stretched out like a bar, with a head-mounted LED showing its way. After crawling over a slight gap and landing on a metal platform, the robot lifted its tail and looked up the bottom of the control rod drive, a structure above the platform simulating where some melted nuclear fuel might be left.

The scorpion also demonstrated it can roll back upright if it hits an obstacle and rolls over. The ability comes from a tail joint in the middle that bends.

One operator controls the robot with a joystick, and another monitors the video feed from the robot and other data. At the Fukushima plant, the robot will be operated remotely from the command center in a separate building.

The work is expected to take a full day. The robot is designed to tolerate radiation, which should allow it to stay inside reactor 2 for more than 10 hours.

July 9, 2015

## Russian firm to remove tritium

### Russia Prepares Technology Details For Tritium Removal At Fukushima

<http://www.nucnet.org/all-the-news/2015/07/09/russia-prepares-technology-details-for-tritium-removal-at-fukushima>

9 Jul (NucNet): RosRAO of Russia says it has prepared working documents that detail the technology it plans to propose for a demonstration project to separate tritium from contaminated water at Tokyo Electric Power Company’s Fukushima-Daiichi nuclear power station.

The company, **a subsidiary of state nuclear corporation Rosatom**, said the draft documentation details the design, construction, piping, ventilation and electrical systems for a facility that would verify the performance of tritium separation technology.

In September 2014, Tepco chose three companies to produce proposals for the facility. The three companies are **RosRAO, GE Hitachi Nuclear Energy Canada, and US-based Kurion**.

RosRAO said negotiations have begun for Russia to build a demonstration plant, but did not give any details.

A project tender document published by the Japan Ministry of Foreign Affairs said the government will pay up to one billion Japanese yen (about \$9.5m, €7.3m) per project to build a facility that demonstrates the removal of tritium from radioactive water.

The document said the project is designed to verify the separation performance of tritium separation technology, to assess construction costs and operating costs for installing the system at Fukushima-Daiichi, and for treating water remaining after treatment with existing multi-nuclide removal equipment.

Efforts to remove 62 kinds of nuclides are ongoing at Fukushima-Daiichi, the document said, but it is not possible to remove tritium with existing physicochemical methods. Removing tritium requires an efficient hydrogen isotope separation method such as distillation, electrolysis or a combination of these processes.

**The verification tests will be carried out offsite and the companies will be responsible for transporting the treated water to their test sites and then back to Fukushima-Daiichi.**

**The technology must be shown to be capable of achieving a separation factor higher than 100 and of being able to process up to 400 cubic metres of water a day with a tritium concentration between 0.6 and 4.2 million becquerel per litre (Bq/ℓ). The deadline for the demonstration is 31 March 2016.**

Contaminated water at Fukushima-Daiichi is being treated with EnergySolutions' Advanced Liquid Processing System (Alps), which removes 61 radionuclides, but not tritium.

Tritium is a radioactive isotope of the element hydrogen and has a radioactive half-life of 12.3 years. According to the US Environmental Protection Agency, exposure to tritium increases the risk of developing cancer.

However, because **tritium emits very low energy radiation and leaves the body relatively quickly, for a given amount of activity ingested, tritium is one of the least dangerous radionuclides.** According to radiation protection guidelines, a concentration of up to 7,000 Bq/ℓ would be considered acceptable for drinking water.

July 16, 2015

## Radioactivity leak

### Radioactive water from Fukushima plant escapes

[http://www3.nhk.or.jp/nhkworld/english/news/20150717\\_01.html](http://www3.nhk.or.jp/nhkworld/english/news/20150717_01.html)

The operator of the crippled Fukushima Daiichi nuclear plant has found that radioactive water has overflowed from a drainage channel, spilling into the sea. This is due to heavy rain.

Workers at the complex discovered the leak at around 8:40 AM on Thursday.

The operator, Tokyo Electric Power Company, said rainwater samples taken from the channel about 2 hours later contained **830 becquerels per liter of radioactive cesium. That's above the government standard for water allowed to be released into the sea.**

**The water also had 1,100 becquerels of beta-ray emitting radioactive substances.**

An approaching typhoon has been bringing intermittent heavy rain around the plant. The utility suspects that the rain has washed away mud and soil that also contains radioactive materials.

It also presumes the amount of rainwater has exceeded the pump's capacity.

**The leak was continuing as of 5 PM. But the firm says it cannot stop the spill anytime soon** and has been monitoring the density of the radioactive substances.

Radioactive rainwater spilled into the sea from the same channel in February. The company built a barrier at channel's downstream to pump up water before it leaks into the sea.

July 22, 2015

## **Online archive of beginning of 3/11disaster**

### **Online archive of Fukushima disaster debuts**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

**A Tokyo-based non-profit organization has created an online archive of public documents that show how the Japanese government dealt with the 2011 Fukushima Daiichi nuclear accident.**

The Information Clearing House Japan announced the website's debut at a symposium in Tokyo last Friday.

The group obtained about 60,000 pages of documents by requesting them from the industry ministry and other agencies, as well as the Fukushima prefectural government.

The papers include the minutes of meetings held immediately after the accident between government officials and representatives of the plant's operator, Tokyo Electric Power Company.

Also included are documents related to the health of residents living near the plant. Many of those papers

had not been released before.

The director of the NPO, Yukiko Miki, said nuclear accidents take a long time to bring under control, so it is important to preserve the documents for future generations.

She says providing people who have different expertise and interests with easy access to information should help people demand a better response from the government.

The archive can be seen at <http://www.archives311.org>

July 27, 2015

## Preparing to clear debris in No.3 pool

### Fukushima Operator Prepares to Lift 20-Ton Debris From Fuel Pool

<http://blogs.wsj.com/japanrealtime/2015/07/27/fukushima-operator-prepares-to-lift-20-ton-debris-from-fuel-pool/>

The latest challenge at the Fukushima Daiichi nuclear power plant is to remove a 20-ton piece of debris from a pool holding over 500 spent fuel rods.

More than four years after the plant was hit by a massive earthquake and tsunami, Fukushima Daiichi's operator Tokyo Electric Power Co. Tepco9501.TO +4.71% said it would start work on the critical task this week using a specially designed crane.

"The debris will be pulled out using two cranes, but we had to create a specially designed hook with a unique shape for it to securely hold on to the object," a Tepco spokesman told Japan Real Time on Monday. The object is what remains of a fuel handling machine originally located above the surface of the water.

**The debris is preventing Tepco from removing the spent fuel rods to a safer location.** It is the largest object requiring removal inside the power plant's reactor No. 3, according to the company.

The removal will be conducted at the slowest possible speed to ensure safety. The pool's water level, as well as any signs of a jump in radiation levels, will be monitored closely with multiple cameras during the procedure. The debris must be lifted so that it won't swing or cause damage to the spent fuel pool's gates. While it is unlikely that any water from the pool will leak even if the object comes into contact with the gate, Tepco said it will be ready to add water in case of a drawdown. Reduced water levels or exposure to air could cause the radioactive fuel rods to heat up.

All other procedures at Fukushima Daiichi will be halted while the debris is being removed, according to the company.

July 28, 2015

## Ice wall: Power failure

### TEPCO confirms equipment failure for ice wall

[http://www3.nhk.or.jp/nhkworld/english/news/20150728\\_25.html](http://www3.nhk.or.jp/nhkworld/english/news/20150728_25.html)

The operator of the Fukushima Daiichi nuclear plant says the equipment to build an underground ice wall has stopped working due to **power failure**.

Tokyo Electric Power Company has been conducting trials to create a barrier of frozen soil around the reactor buildings that will keep groundwater from seeping into them.

An alarm was set off on Tuesday morning signaling trouble with a power panel at the plant. Workers then found white smoke rising from a power cable.

Officials at TEPCO also found that part of a system to send nitrogen into the containment vessels of 3 reactors had stopped working.

The equipment has been building the subsoil ice wall by pumping liquid coolant of minus 30 degrees Celsius into pipes installed in the ground around the reactor buildings.

The officials say they do not know when they can restart the equipment. But **they say the ice wall will not melt for several days, even without coolant running from the equipment.**

## Removing No.1 cover





The interior of the No. 1 reactor building of the Fukushima No. 1 nuclear power plant can be seen from above after a canopy panel was removed on July 28. (Eiji Hori)

## TEPCO removes canopy panel from Fukushima reactor building

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201507280071>

By HIROMI KUMAI/ Staff Writer

OKUMA, Fukushima Prefecture--Tokyo Electric Power Co. on July 28 started removing a canopy covering a damaged reactor building at the Fukushima No. 1 nuclear plant to prepare for the eventual extraction of spent nuclear fuel inside.

Around 7 a.m., workers using a giant crane lifted away the first of six canopy panels, each measuring 40 meters long and 7 meters wide, from the No. 1 reactor building.

The 30-minute removal of the panel left a large hole in the canopy through which steel beams on the damaged upper part of structure could be seen from above. **Workers closely monitored radiation levels in the surrounding areas during the removal process.**

The utility plans to remove the remaining five panels from next week.

The removal of the canopy will allow TEPCO to clear debris inside the building, possibly in the latter half of fiscal 2016. That process should **pave the way for the removal of nuclear fuel rods from the spent fuel pool in the building.**

Before removing the canopy panel, the utility sprayed the inside of the reactor building with liquid resin through holes drilled in the cover to prevent radioactive materials from being stirred up during the dismantling work.

TEPCO initially planned to start removing the canopy panels from the No. 1 reactor building in summer 2014, but the schedule was delayed because a large amount of radioactive substances was released into the environment when the utility removed debris from the No. 3 reactor building in August 2013. Even after the anti-scattering resin was sprayed into the No. 1 reactor building in May, removal of the canopy panel was **postponed by a problem inside the building**.

## **Work begins to dismantle cover at Fukushima plant**

<http://mainichi.jp/english/english/newsselect/news/20150728p2g00m0dm069000c.html>

TOKYO (Kyodo) -- The operator of the disaster-hit Fukushima Daiichi nuclear plant began Tuesday dismantling the cover shrouding the No. 1 reactor building, installed in the wake of the 2011 disaster to keep radioactive materials from dispersing.

Tokyo Electric Power Co. workers removed one of the six panels, each about 7 meters in width and about 42 meters in length, using a crane.

With the removal of the panel, the upper part of the reactor building, which was destroyed by a hydrogen explosion, became visible for the first time since last December, when part of the cover was temporarily removed.

The utility plans to complete the whole cover removal process in fiscal 2016, which begins next April, and clear debris and install equipment before beginning to take out the 392 spent fuel assemblies from the building's pool in fiscal 2020.

Takao Kikori, a senior nuclear safety official at the Fukushima prefectural government, called for care to be taken in conducting the dismantling work for the safety of local people.

The utility plans to remove the second panel in early August or later and complete the removal of all six panels by the end of this year. It also plans to later remove panels on the sides of the reactor building and install windbreaker sheets for debris clearing work.

The reactor building cover was installed in October 2011 as an emergency measure to keep radioactive dust from scattering. The utility initially planned to dismantle it in fiscal 2013 or 2014 but was forced to put off the work to take additional dust control and other measures.

## **Dismantling of reactor building cover begins**

[http://www3.nhk.or.jp/nhkworld/english/news/20150728\\_13.html](http://www3.nhk.or.jp/nhkworld/english/news/20150728_13.html)

The operator of the damaged nuclear power plant in Fukushima has begun work to remove the cover of the Number 1 reactor building, a step toward decommissioning the plant.

Workers are using a remote-controlled crane to remove one of the panels of the ceiling.

Tokyo Electric Power Company, or TEPCO, installed the cover after the 2011 accident to prevent the dispersal of radioactive materials. But the utility needs to remove it to allow the clearing of debris and removal of nuclear fuel in a spent fuel storage pool.

The operator plans to take several months to remove the 6 panels of the ceiling. It plans to then dismantle the cover while clearing debris.

The utility says it expects to complete the task around the winter of 2016.

The dismantling of the cover was originally due to start in July last year. But TEPCO delayed the operation after people living nearby expressed concerns over the possible spread of radioactive materials.

The utility postponed the work again in May this year as it found **a problem with a device that controls the air flow in the building.**

TEPCO has sprayed chemical agents on the debris in the building to prevent radioactive particles from being released into the air.

The operator says it will keep a closer watch on radiation levels and make information public during the work.

## TEPCO resumes works on ice wall

### Ice wall building resumes

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the damaged Fukushima Daiichi nuclear plant has resumed building an underground ice wall after a brief equipment failure.

Tokyo Electric Power Company has been conducting trials to create a barrier of frozen soil around the reactor buildings to keep groundwater from seeping into them.

On Tuesday morning, workers responding to an alarm found smoke rising from a power cable.

They confirmed that all the equipment to build the ice wall had stopped working due to a power failure.

The staff found no problems with the equipment and resumed work in the afternoon using another power system.

The power failure also partially stopped a system that sends nitrogen into the containment vessels of 3 reactors. That work has been resumed as well.

TEPCO says the power cable that was emitting smoke had short-circuited.

The utility is investigating what may have triggered the problem.

July 29, 2015

## Explanation

### **Damaged power cable briefly disables frozen soil shields at Fukushima No. 1**

[http://www.japantimes.co.jp/news/2015/07/29/national/accidental-power-cable-damage-briefly-disables-frozen-soil-shields-fukushima-no-1/#.VbiOQ\\_nwmot](http://www.japantimes.co.jp/news/2015/07/29/national/accidental-power-cable-damage-briefly-disables-frozen-soil-shields-fukushima-no-1/#.VbiOQ_nwmot)

JJI

FUKUSHIMA – Frozen soil shields aimed at curbing the buildup of radioactive water were temporarily disabled at Tokyo Electric Power Co.'s stricken Fukushima No. 1 nuclear power plant on Tuesday. The problem occurred after a power cable was damaged by mistake, Tepco said. Electricity leaked from the damaged cable, causing fail-safe systems to kick in for the shields and other devices, it said. The underground shields, designed to block groundwater from flowing into the basements of the stricken reactor buildings, were restarted later in the day. The power leak also halted a device circulating nitrogen in reactors 1, 2 and 3 to prevent hydrogen explosions. According to Tepco, a plant worker found white smoke around the power cable at around 8:35 a.m.

## Removal of debris to start in No.3

### **Removal of debris in spent fuel storage to start**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Workers at the Fukushima Daiichi nuclear power plant on Sunday will start the removal of a fuel exchanger inside the Number 3 reactor building. The 20-ton device fell into the fuel pool during the 2011 disaster.

The device has since been a major obstacle for workers at Tokyo Electric Power Company in the start of removal of extremely radioactive rubble left in the storage pool. 566 fuel rods remain inside the spent fuel pool.

Workers cannot directly take part in the process as the site is highly radioactive. The work will require 2 remote-controlled cranes that will lift and remove the device, which is some 14 meters long.

The work poses a challenge as spent fuel may suffer damage if the device falls back into the pool during removal.

Workers accidentally dropped a 400-kilogram device into the pool last August. Though none of the rods suffered damage, removal was postponed for 4 months.

**TEPCO has been preparing for the removal by developing equipment tailored to grip the device. Cushions have also been placed on top of the fuel rods.**

**TEPCO officials say all other work to decommission the plant will be suspended while the removal takes place as a hydrogen explosion in 2011 left the pool without a roof.**

July 30, 2015

## **Tunnels cleared of radioactive water**

### **Fukushima plant tunnels clear of radioactive water**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the crippled Fukushima Daiichi nuclear power plant says it has finished removing highly radioactive water from underground tunnels linked to the reactor buildings.

More than 10,000 tons of highly contaminated water flowed into the **tunnels outside the buildings for reactors No.2 and 3**. Experts feared that the water might seep into the sea.

The concern led the plant operator, Tokyo Electric Power Company, to try and block any more tainted water from entering the tunnels.

**The firm has been filling the tunnels with cement to pump out contaminated water since November.**

It finished draining the No.2 reactor building's tunnels late last month. The company says it also completed similar work on the tunnels connected to the No.3 reactor building on Thursday.

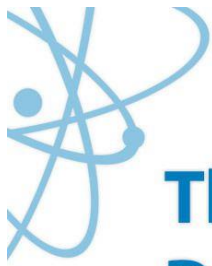
The firm will continue the work to fill the tunnels with cement until sometime late next month.

The utility initially attempted to freeze radioactive water in sections where the tunnels connect to the reactor buildings. But this did not work.

**The government and TEPCO had placed top priority on addressing the highly radioactive water in the tunnels due to a fear that it might badly pollute the sea near the plant.** The latest achievement will significantly reduce that risk.

July 31, 2015

## Final report on Fukushima disaster (1)



# The Fukushima Daiichi Accident

Report by the Director General  
and Technical Volumes



<https://www.iaea.org/newscenter/news/iaea-releases-director-general%E2%80%99s-report-fukushima-daiichi-accident>

### IAEA Releases Director General's Report on Fukushima Daiichi Accident

By Miklos Gaspar, IAEA Office of Public Information and Communication

The IAEA Director General's Report on the Fukushima Accident and the five technical volumes distil and assemble lessons learned from the accident and provide a knowledge base for the future.

The IAEA Director General's Report on the Fukushima Daiichi Accident, along with five technical volumes on this topic by international experts, have just been publicly released. This publication comes ahead of the Agency's General Conference in September.

The report assesses the causes and consequences of the 11 March 2011 accident at the Fukushima Daiichi Nuclear Power Plant in Japan, triggered by a tsunami that followed a massive earthquake. It was the worst emergency at a nuclear power plant since the Chernobyl disaster in 1986.

"The report considers human, organizational and technical factors and aims to provide an understanding of what happened, and why, so that the necessary lessons learned can be acted upon by governments, regulators and nuclear power plant operators throughout the world," IAEA Director General Yukiya Amano said in his Foreword to the Report. "There can be no grounds for complacency about nuclear safety in any country."

The report and the technical volumes distil and assemble lessons learned from the accident and provide a knowledge base for the future. They consider the accident itself, emergency preparedness and response, radiological consequences of the accident, post-accident recovery and the activities of the IAEA since the accident. Measures taken, both in Japan and internationally, are examined. "Although nuclear safety remains the responsibility of each individual country, nuclear accidents can transcend national borders," Mr Amano said in his foreword. "The Fukushima Daiichi accident underlined the vital importance of

effective international cooperation. The IAEA is where most of that cooperation takes place. Our Member States adopted the IAEA Action Plan on Nuclear Safety a few months after the accident and have been implementing its far reaching provisions to improve global nuclear safety.”

Mr Amano had announced in 2012 that the IAEA would prepare an authoritative, factual and balanced assessment of the accident, addressing both its causes and consequences. The report is the result of an extensive collaboration that involved some 180 experts from 42 IAEA Member States and several international bodies.

The report and the technical volumes are accessible here. A brochure summarizing the main findings is available here.

The Director General’s Report in Arabic, French, Russian and Spanish is available here. The Chinese translation will be available later this week. The unofficial Japanese translation of the Foreword and the Executive summary of the Director General’s Report are available here. The full translation will be published in September.

### *Related Resources*

- The Fukushima Daiichi Accident Report by the Director General and Technical Volumes
- In Focus: Fukushima Nuclear Accident
- In Focus: IAEA Action Plan on Nuclear Safety

## Difficult preparations for No.2 probe

### **Robot probe into No.2 reactor may be delayed**

[http://www3.nhk.or.jp/nhkworld/english/news/20150731\\_06.html](http://www3.nhk.or.jp/nhkworld/english/news/20150731_06.html)

The operator of the crippled Fukushima Daiichi nuclear plant says it may have to postpone plans to send a robot probe into the plant’s No.2 reactor due to **difficult preparations**.

Tokyo Electric Power Company was planning to send a robot into the containment vessel of the No.2 reactor in August. The purpose is to capture video images of molten nuclear fuel for the first time.

The utility assumes the fuel penetrated the reactor core and is inside the containment vessel.

**The plan involved using a pipe sticking out of the container as an entry point for the robot. But some concrete blocks are blocking the way and need to be removed.**

Workers found that **the remote-controlled machinery they wanted to use to remove the blocks cannot operate in some areas of the reactor building due to an eroded floor and other reasons.**

TEPCO says it is now considering using chemicals to clear the blocks or developing new machinery to remove the blocks.

Due to these reasons, the utility says the probe may be postponed from August until December or later, in the worst case.

## Trenches almost clear

### TEPCO removes radioactive water from No. 3 reactor trench at Fukushima plant

<http://mainichi.jp/english/english/newsselect/news/20150731p2a00m0na018000c.html>

Tokyo Electric Power Co. (TEPCO) announced on July 30 that it had completed the removal of radioactive water collected in the trench for the No. 3 reactor at the crippled Fukushima No. 1 Nuclear Power Plant. **With the removal of the No. 3 reactor's trench water, the work to clear the trenches of the No. 2 through No. 4 reactor trenches is almost over.** In addition to lowering the risk of highly contaminated water leaking into the ocean, **the removal of the radioactive water sets the stage for the creation of walls of frozen dirt around the No. 1 through No. 4 reactors to block any more underground water from flowing onto the premises of the reactors.**

According to TEPCO, after the disaster struck the plant, the amount of contaminated water in the trenches measured 4,500 tons in the No. 2 reactor trench, 5,800 tons in the No. 3 reactor trench and 660 tons in the No. 4 reactor trench, for a total of around 11,000 tons. **In the water from the No. 2 and No. 3 reactors, where meltdowns occurred, the water contained up to 100 million becquerels of radiation per liter.** The Nuclear Regulation Authority had been concerned that the water would escape into the ocean. The trench for the No. 4 reactor still has around 60 tons of water in it, but at up to 100,000 becquerels per liter, the radiation level is low compared to what was in the No. 2 and No. 3 reactor trenches. The water from the trenches had previously been planned to be removed by April 2014, but a plan to freeze the areas where the reactor buildings and the trenches connect and stop the flow of water into the trenches failed. The plan was changed to pouring in a special kind of concrete to fill up the trench while draining out the water, setting back the schedule considerably. The draining of the No. 2 reactor's trench was completed around the end of June this year.

August 2, 2015

## Removing 20-ton debris from No.3 pool

### In delicate operation, 20-ton object removed from Fukushima fuel pool

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201508020026>





Two cranes are used to remove a huge piece of debris from the nuclear fuel storage pool of the No. 3 reactor building at the Fukushima No. 1 nuclear power plant on Aug. 2. (Tatsuya Shimada)

By HIROMI KUMAI/ Staff Writer

Tokyo Electric Power Co. on Aug. 2 removed a 20-ton piece of debris from a nuclear fuel storage pool, a small but critical step in decommissioning the crippled Fukushima No. 1 nuclear power plant. It was the largest piece of debris left in the No. 3 reactor building's storage pool, which is holding 566 nuclear fuel assemblies.

The reactor building was heavily damaged by a hydrogen explosion shortly after the Great East Japan Earthquake and tsunami on March 11, 2011, triggered the nuclear crisis at the plant.

The object removed was part of fuel replacement equipment used to load and unload nuclear fuel at the No. 3 reactor. It has prevented TEPCO from removing the nuclear fuel assemblies in the pool to a safer location.

The piece of equipment originally weighed 35 tons, but TEPCO used an underwater cutting device to pare it down to 20 tons.

The utility began lifting the debris shortly before noon. Workers remotely controlled two large cranes, equipped with three specially designed hooks, to pull out the debris while closely monitoring the process with cameras.

The delicate operation required the utmost attention to detail to prevent the debris from touching the pool's walls. If it had dropped back into the pool, it could have damaged the nuclear fuel assemblies.

The debris was safely placed on the ground after 90 minutes, during which time TEPCO suspended all outdoor decommissioning work at the plant compound in case of an accident.

After removing the smaller debris from the pool, the utility plans to install special equipment on the upper structure of the reactor building to lift out the nuclear fuel assemblies.

TEPCO plans to start the fuel-removal operation in January 2018 at the earliest.

## **Key debris operation at Fukushima clears way for removal of still-simmering fuel rods**

<http://www.japantimes.co.jp/news/2015/08/02/national/key-debris-operation-fukushima-clears-way-removal-still-simmering-fuel-rods/#.Vb4hRPnwmos>

by Reiji Yoshida  
Staff Writer

Tokyo Electric Power Co. succeeded Sunday in safely removing a massive piece of debris weighing roughly 20 tons from the fuel pool of the Fukushima No. 1 nuclear power plant's damaged reactor 3 building, the utility said.

The operation was considered a major step toward removing the 566 fuel rod assemblies that have remained in the pool since the triple meltdown at the Fukushima plant in March 2011.

Tepeco is aiming to remove all of the still-hot fuel assemblies in the No. 3 pool by the end of March 2018.

The debris, originally a piece of equipment used to remove and insert fuel rod assemblies, fell into the pool after a hydrogen explosion ripped through the reactor building on March 14, 2011.

More than four years after the crisis, radiation still remains dangerously high in the area around the pool.

In Sunday's removal operation, which took just over an hour, workers used two huge remote-controlled cranes to lift the 14-meter-long piece of debris out of the pool.

The risk surrounding the removal effort — given the huge number of fuel assemblies in the pool — meant Tepeco halted all other outdoor decommissioning work.

No significant uptick in radiation levels was observed at the plant during the operation, the utility said.

The gigantic tsunami that hit the Fukushima plant on March 11, 2011, knocked out critical cooling functions and led to meltdowns of three of the six reactors, triggering hydrogen explosions that blew up the upper floors of the reactor 1, 3 and 4 buildings.

Tepeco has already moved fuel rod assemblies from the pool of the reactor 4 building — considered the most fragile among the damaged structures — to a safer building within the plant's compound.

## **566 still hot fuel assemblies in No.3 pool**

## **Key debris operation at Fukushima clears way for removal of still-simmering fuel rods**

<http://www.japantimes.co.jp/news/2015/08/02/national/key-debris-operation-fukushima-clears-way-removal-still-simmering-fuel-rods/#.Vb8i5fnwmot>

video URL : <https://youtu.be/9C3L64ZYxMo>

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## **Workers remove fuel exchanger at Fukushima Daiichi**

[http://www3.nhk.or.jp/nhkworld/english/news/20150802\\_15.html](http://www3.nhk.or.jp/nhkworld/english/news/20150802_15.html)

Workers at the Fukushima Daiichi nuclear power plant have successfully removed a 20-ton device from the Number 3 reactor building.

The fuel exchanger fell into the fuel pool on the top floor when the reactor building exploded during the 2011 disaster. The device was used to move nuclear fuel in and out of the pool.

The removal of the fuel exchanger started on Sunday morning and took 7 hours to complete.

As the site is highly radioactive, workers watched camera footage, and used 2 remote-controlled cranes to carry out the task.

The 566 fuel rod assemblies in the spent fuel pool of the Number 3 reactor building could have suffered damage if the device had fallen back in during the removal procedure.

The other decommissioning work at the plant was suspended during the removal to secure the safety of the workers.

The plant's operator, Tokyo Electric Power Company, says there were no major problems, and the amount of radioactive substances at Fukushima Daiichi has not changed.

The removal of spent fuel is the first major challenge for the decommissioning of the plant, which will take an estimated 40 years to complete. But the large amount of debris and the high levels of radiation have kept spent fuel from being removed from the Number 1, 2 and 3 reactor buildings.

The removal of the fuel exchanger is a major step forward, but the removal of spent fuel will not start until 2017, or 2 years behind schedule, as it will take a long time to remove the debris and decontaminate the area.

The current roadmap says the removal of spent fuel will start in 2021. However, TEPCO has not been able to determine the location of the spent fuel rods that melted and fell, and has yet to start developing technologies to remove them.

Many issues remain before the buildings are demolished and the decommissioning work is completed.

August 3, 2015

### **Key piece of debris removed from one of damaged Fukushima reactors**

<http://mainichi.jp/english/english/newsselect/news/20150803p2g00m0dm019000c.html>

TOKYO (Kyodo) -- A key piece of debris was successfully removed Sunday from a damaged reactor at the Fukushima Daiichi nuclear power plant, clearing the way for the removal of over 500 spent fuel rods sitting inside the unit's cooling pool more than four years after the 2011 crisis.

An official of plant operator Tokyo Electric Power Co. called the removal of fuel handling equipment from the pool "major progress" in the debris clearing process and a step forward to the reactor's eventual decommissioning.

The fuel handling device, used to put fuel rods in and out of the No. 3 reactor and located above its spent fuel pool, fell into the pit when a hydrogen explosion rocked the structure housing the reactor on March 14, 2011.

The 20-ton device was the largest piece of debris inside the pool. With 566 spent fuel rods still in the pool, its removal required workers to be extra-cautious amid concern that if mishandled, the device could fall into the pool again and damage the fuel.

Shortly before noon, workers began remotely operating two large cranes to lift the fuel handling equipment from the pool and removed it in less than 90 minutes, according to the utilities company.

The government and Tokyo Electric plan to begin removing the spent fuel from the pool by the end of March 2018.

The No. 3 reactor is one of three units at the Fukushima plant that experienced nuclear meltdowns after losing cooling functions in the wake of the March 11, 2011, earthquake-caused tsunami.

The disaster at the six-reactor complex caused massive amounts of radioactive materials to be released into the air and sea, contaminating large areas in northeastern Japan and forcing more than 100,000 people to evacuate their homes.

The decommissioning work, including the removal of melted fuel from inside the reactors that suffered meltdowns, is expected to take around 30 to 40 years.

August 4, 2015

## **NRA approves frozen barrier plan**

### **NRA approves soil freezing plan**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Japan's nuclear regulator has approved plans for underground frozen barriers at all locations at the damaged Fukushima Daiichi nuclear plant. The aim is to stem the buildup of contaminated water in reactor buildings.

On Friday, the Nuclear Regulation Authority approved a revised construction plan submitted by the Tokyo Electric Power Company to build a system that will freeze soil along the seaside. The utility hopes to start the work as soon as possible. It began work on the project on the inland side last June.

TEPCO plans to freeze soil around the No.1 to No.4 reactor buildings in order to create a barrier 1.5 kilometers long. It is intended to keep groundwater from seeping into the reactor buildings.

The nuclear regulator told TEPCO that a condition of its approval of the frozen barrier plans is that the utility must control the level of groundwater by adding water from wells that will be dug around the reactor buildings.

The utility faces opposition from residents as the plans require pumping up groundwater for purification and releasing it into the ocean.

TEPCO began trials to freeze soil around the reactor buildings on the inland side in April. But it says temperatures did not get low enough at some locations.

## **Damage in No.3 pool may delay fuel removal**

## Fuel rod casings found damaged by debris

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Workers at the crippled Fukushima Daiichi nuclear plant have been preparing to remove hundreds of fuel rod assemblies from a pool of the facility's No. 3 reactor building.

The workers have found damaged fuel rod containers after removing a device that had fallen on them during the 2011 disaster. They're now checking whether the damage will affect their plan to remove fuel from the pool.

A 20-ton device for moving fuel rods in and out of the pool on the building's top floor was removed on Sunday, more than 4 years after the nuclear accident. High radioactivity prevented workers from carrying out the removal smoothly.

The plant's operator, Tokyo Electric Power Company, checked the condition of 566 fuel rod assemblies in the pool.

Workers found that the metal casings of 4 assemblies had been distorted and have twisted handles. This is evident in images released by the operator. It says the fuel rods appear undamaged, as radiation levels in the pool have shown no irregularities.

The utility is checking for other damage and studying how to remove the distorted casings from the pool.

Removing fuel rod assemblies from spent fuel pools is an important part of decommissioning work at the plant. More than 1,500 assemblies are still in pools at 3 of the facility's reactor buildings.

August 5, 2015

## Probe for No.2 reactor too big to use

### Probe into Fukushima No.2 reactor hits snag

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Sources familiar with the decommissioning process at the Fukushima Daiichi nuclear plant say efforts to determine the state of molten fuel in the reactors have hit another snag.

They say 2 new devices developed at a cost of more than 4 million dollars to take X-ray-like photos inside the No.2 reactor are **too big to install**.

The Japanese government and the plant operator, Tokyo Electric Power Company, devised the machines so that they use elementary particles called muons to see through hard surfaces and map the spread of fuel inside.

They planned to start capturing images as early as this fall.

But they found the 8-by-8-meter devices will not fit the No.2 reactor building site unless they remove and decontaminate other equipment first. They believe that would hinder the decommissioning process. It would also cost twice as much money as they spent creating the devices.

Workers have been using muon detectors at the No.1 reactor since February. The devices meant for the No.2 reactor were designed to capture images with higher resolutions.

The government and TEPCO will divert the machines at the No.1 reactor to the No.2 reactor as early as year-end. They say if it is a success, they may abandon the plan to use the new devices.

TEPCO has also postponed plans to send a robot probe into the No.2 reactor in August to investigate the molten fuel due to problems with the preparations.

August 11, 2015

## Fukushima fishermen okay water discharge into sea



Fukushima No. 1 nuclear power plant in May (Asahi Shimbun file photo)

## **Fukushima fishermen give nod to TEPCO's plan to release treated water into sea**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201508110060>

By SUSUMU OKAMOTO/ Staff Writer

Fisherman operating in waters close to the stricken Fukushima No. 1 nuclear power plant formally approved a plan by plant operator Tokyo Electric Power Co. to discharge radioactive groundwater into the ocean after decontamination treatment.

The Fukushima Prefectural Federation of Fisheries Cooperative Associations gave the green light to TEPCO's "subdrain plan" at an extraordinary meeting on Aug. 11.

TEPCO is expected to start discharging treated water as early as next month.

It will pump contaminated groundwater accumulating in areas around reactors damaged by the March 2011 earthquake and tsunami disaster for processing and then release it into the sea.

The fishermen's federation submitted a written request to the central government and TEPCO setting certain conditions for giving its approval to the subdrain plan. It warned the utility against discharging highly radioactive water inside the reactor buildings even after decontamination treatment and called for strict monitoring of standards for the release of water. It also insisted on compensation in the event the local fishing industry suffers losses as a result of groundless rumors.

Many fishermen initially opposed the TEPCO plan as processed radioactive water had never been discharged into the ocean.

TEPCO's delay in disclosing the leakage of radioactive water into the sea each time it rained heavily also hampered its negotiations with local fishermen as it undermined their confidence in the company. The matter only came to light in February.

TEPCO then made an intensive effort to explain the subdrain plan would help reduce the flow of contaminated underground water into the ocean. This convinced the prefectural fishermen's federation that the work could drastically decrease radiation levels in nearby waters, prompting it sign off on the plan.

## **Fukushima fishermen to allow discharge into sea**

[http://www3.nhk.or.jp/nhkworld/english/news/20150811\\_24.html](http://www3.nhk.or.jp/nhkworld/english/news/20150811_24.html)

Fukushima's fisheries federation is planning to conditionally allow decontaminated underground water from the crippled nuclear power plant to be discharged into the sea.

In exchange, it has asked the government and the operator of the Fukushima Daiichi nuclear power plant to take measures to prevent negative harmful rumors.

The Fukushima Prefectural Federation of Fisheries Co-operative Associations reached this decision on Tuesday after a conditional agreement by a fishermen's group in Iwaki City.

The group handed a written request to officials from the central government and TEPCO.



It is asking that strict operational standards be observed for the discharge and that the process be subject to monitoring by a third party. It also asks that compensation be paid for harmful rumors.

Tokyo Electric Power Company is planning to pump up contaminated ground water from wells near the reactor buildings, decontaminate the water, and then release it into the ocean.

This measure will be taken to deal with the 300 tons of contaminated water that is being produced at the facility every day.

But TEPCO's plan has been suspended. In February, local distrust of the operator mounted after it was found to have failed to disclose leaks of contaminated rainwater into the ocean.

The federation's chairman Tetsu Nozaki said it was a very troubling decision, but measures to deal with the contaminated water are necessary. He said they will make a final decision after receiving a response.

TEPCO's Tsunemasa Niitsuma said they appreciate the understanding of the plan, and will try to respond quickly.

August 25, 2015

## Fishermen agree to dump radioactive water into sea



August 25, 2015

## Agreement reached on decontaminated water disposal

[http://www3.nhk.or.jp/nhkworld/english/news/20150825\\_33.html](http://www3.nhk.or.jp/nhkworld/english/news/20150825_33.html)

Fishers in Japan's northeastern prefecture of Fukushima have formally allowed the release of decontaminated groundwater from around buildings of nuclear reactors into the sea.

**The release is aimed at reducing production of heavily contaminated water in the basements of the buildings at the Fukushima Daiichi plant.**

**Groundwater flowing into the buildings is producing 300 tons of highly radioactive water daily,** resulting in a huge number of storage tanks at the plant.

Plant operator Tokyo Electric Power Company, or TEPCO, and the government have been asking the fishers to allow the release to keep the water from flowing into the buildings and becoming heavily tainted.

TEPCO plans to use 41 wells already dug around the buildings to pump up the water and lower the levels of radioactive substances to between one-one-thousandth and one-ten-thousandth of their original amounts before releasing it.

**The operator, the government and an independent institution plan to check so that only water below allowed levels is discharged.**

On Tuesday, the local federation of fisheries cooperatives approved the plan **on condition that the release rules are strictly followed and that compensation is paid for any damage due to harmful rumors.**

Federation chairman Tetsu Nozaki said the approval was decided unanimously, but that some members were dissatisfied. He added that the plan is needed for steadily decommissioning the plant, and that he wants TEPCO and the government to keep their word.

The firm's Fukushima headquarters chief Yoshiyuki Ishizaki said the plan is a big step forward in the decommissioning process as well as tackling the problem of contaminated water. He said fishermen told him that the plan could lead to rebuilding of Fukushima's fishing industry, and that he will keep their remarks in mind.

**TEPCO plans to start releasing the water soon.**

## Fishermen OK TEPCO's plan to dump Fukushima plant water into sea

<http://mainichi.jp/english/english/newsselect/news/20150825p2g00m0dm075000c.html>

FUKUSHIMA, Japan (Kyodo) -- Fishermen in Fukushima Prefecture approved on Tuesday a plan by Tokyo Electric Power Co. to pump up contaminated groundwater continuously flowing into the stricken Fukushima Daiichi nuclear station and dump it into the ocean after removing almost all radioactive materials from it.

The plan is one of TEPCO's key measures aimed at curbing the amount of toxic water buildup at the complex. Local fishermen had long opposed the plan amid concern over pollution of the ocean and marine products.

"I don't know if it's acceptable for all fishery operators, but stable work of decommissioning (of the Fukushima plant) is necessary for the revival of Fukushima's fishery industry," Tetsu Nozaki, chairman of the Fukushima Prefectural Federation of Fisheries Co-operative Associations, told reporters after a board meeting.

He also called on TEPCO to make sure it will only discharge water which does not contain radioactive materials exceeding the legally allowable limit.

The amount of toxic water is piling up every day, as untainted groundwater is seeping into the reactor buildings and mixing with radioactive water generated in the process of cooling the reactors that suffered meltdowns in the nuclear crisis triggered by a massive earthquake and tsunami in 2011.

By pumping up water through drainage wells and dumping it into the ocean after treatment, **TEPCO said it will be able to halve some 300 tons of contaminated water being generated each day.**

In exchange for approving the plan, the Fukushima fisherman's association demanded on Aug. 11 that the government and TEPCO continue paying compensation for the fishermen as long as the nuclear plant causes damage to their business, among other requirements.

On Tuesday, the National Federation of Fisheries Cooperative Associations also gave the green light for the release of treated water into the sea.

TEPCO has been struggling to resolve the problem of toxic water buildup at the plant for more than four years after the nuclear crisis, with radiation leakages into the environment still occurring regularly at the complex.

The company is also behind schedule on a project to build a huge underground ice wall, another key measure to prevent radioactive water from further increasing at the site.

### **Fishermen OK Tepco's plan to dump Fukushima plant water into sea**

<http://www.japantimes.co.jp/news/2015/08/25/national/fishermen-ok-tepcos-plan-dump-fukushima-plant-water-sea/#.VdyVq5fwLLM>

Kyodo

FUKUSHIMA – Fishermen in Fukushima Prefecture on Tuesday approved a plan by Tokyo Electric Power Co. to take contaminated groundwater continuously flowing into the stricken Fukushima No. 1 nuclear plant and dump it into the ocean after removing almost all radioactive materials from it.

[...]

September 1, 2015

## **Final report on Fukushima disaster (2)**

## **IAEA releases final report on Fukushima accident**

[http://www3.nhk.or.jp/nhkworld/english/news/20150901\\_13.html](http://www3.nhk.or.jp/nhkworld/english/news/20150901_13.html)

The International Atomic Energy Agency says **a major factor behind the 2011 Fukushima nuclear accident was a widespread assumption in Japan that nuclear power plants were safe.**

The IAEA released a final report on Monday on the meltdown at the Fukushima Daiichi nuclear power station. About 180 experts from more than 40 IAEA member countries contributed to the 1,200-page-plus report.

The report says that Japan was not sufficiently prepared for a severe nuclear accident due to the assumption that nuclear plants were safe. It says the Fukushima Daiichi plant had weaknesses in design and emergency preparedness.

The March 2011 accident came after a major earthquake and tsunami struck Fukushima Prefecture and the surrounding areas of northeastern Japan.

The report says the accident demonstrated the need to consider the potential for a combination of natural hazards to occur simultaneously. It says safety standards should also be continuously re-evaluated to consider advances in knowledge.

**The report says no early radiation-induced health effects were observed among workers or members of the public.**

**It adds that although it can take decades for latent health effects to emerge, no discernible increase in such conditions is expected, given the low levels of radiation exposure among the general public.**

**The report also says thyroid abnormalities found in some children are unlikely to be associated with the nuclear accident, due to low exposure levels.**

IAEA Director General Yukiya Amano says some of the factors that resulted in the Fukushima accident were not unique to Japan.

Amano says continuous questioning and openness to learning from experience are key to safety and are essential for everyone working in the industry.

The IAEA plans to submit the report to its General Conference this month to share the lessons on a wide scale and help improve the safety of nuclear plants.

## **Final report on Fukushima disaster (3)**

## **Child thyroid cancer unlikely to rise in Fukushima but extent of radiation exposure unclear: IAEA**

<http://www.japantimes.co.jp/news/2015/09/01/national/science-health/iaea-fukushima-linked-child-cancers-unlikely-rise-extent-radiation-exposure-unclear/#.VeVMOpfwmic>

Reuters

UNITED NATIONS – An increase in thyroid cancer among children is unlikely after the disaster at the Fukushima No 1 nuclear plant four years ago, but it remains unclear exactly how much radiation children in the vicinity were exposed to, International Atomic Energy Agency said in a new report. Increased thyroid cancer is generally the leading health concern after exposure to nuclear radiation, but that may not be the case after the three reactor meltdowns at the Tokyo Electric Power Co. plant in March 2011, the Vienna-based watchdog said in the report, which was released Monday.

“Because the reported thyroid doses attributable to the accident were generally low, an increase in childhood thyroid cancer attributable to the accident is unlikely,” the report says.

“However, uncertainties remain concerning the thyroid equivalent doses incurred by children immediately after the accident,” it adds.

Those uncertainties are largely due to a lack of reliable personal radiation monitoring data immediately after the disaster started, when radioactive iodine and other radioactive materials were spewed into the environment, the report says.

The earthquake and following tsunami made emergency response measures difficult, if not impossible, to implement.

Adding to the uncertainty was the fact that the administration of “stable iodine” to protect children’s thyroid glands was not done uniformly at the time, “primarily due to the lack of detailed arrangements,” the report says.

Detailed screening of children’s thyroid glands is being undertaken now in Japan as part of a survey aimed at the early detection and treatment of diseases.

The report highlights areas where improvements are needed in light of the Fukushima catastrophe. The IAEA said more sustainable solutions are needed for the management of highly radioactive water and radioactive waste being collected at the plant, “including the possible resumption of controlled discharge into the sea.”

The reports adds that countries should prepare detailed scenarios and train workers for coping with worst-case natural disasters, including situations where more than one disaster is combined with a nuclear accident. They should also plan for cleanup operations in the wake of such incidents.

The report calls for strengthened international cooperation in the event of such accidents.

## **U.N. nuclear watchdog makes comprehensive report on Fukushima accident**

<http://mainichi.jp/english/english/newsselect/news/20150901p2g00m0dm048000c.html>

VIENNA (Kyodo) -- The International Atomic Energy Agency on Monday released a comprehensive report on the causes and consequences of the 2011 disaster at the Fukushima Daiichi nuclear power plant, saying that a major factor behind the accident was "the widespread assumption in Japan" that nuclear power plants were safe and an accident of that magnitude unthinkable.

The report, which comes with technical volumes totaling more than 1,000 pages, will be presented to the next annual meeting of the U.N. nuclear watchdog's general conference scheduled to start Sept. 14. Director General Yukiya Amano said that the safety assumption was accepted by nuclear power plant operators and that regulators and the government did not challenge it. "As a result, Japan was not sufficiently prepared for a severe nuclear accident in March 2011," he said in the report. The report is a result of a collaboration of some 180 experts from 42 countries. It compiles lessons learned from the accident triggered by a tsunami following a massive earthquake as well as Japan's emergency responses, radiological consequences and post-accident recovery.

## Final report on Fukushima disaster (4)

### Japan Thought Major Nuclear Accident Was 'Simply Unthinkable', Says IAEA Fukushima Report

<http://www.nucnet.org/all-the-news/2015/09/01/japan-thought-major-nuclear-accident-was-simply-unthinkable-says-iaea-fukushima-report>

A major factor that contributed to the March 2011 accident at the Fukushima-Daiichi nuclear station was the widespread assumption in Japan that its nuclear power plants were so safe that an accident of this magnitude was "simply unthinkable", a report by the director-general of the International Atomic Energy Agency says.

The report, which is more than 200 pages long and is published with five technical volumes, says this assumption was accepted by nuclear station operators and not challenged by regulators or by the government. "As a result, Japan was not sufficiently prepared for a severe nuclear accident in March 2011," the report says.

IAEA director-general Yukiya Amano said in his foreword to the report that the accident, the worst emergency at a nuclear power plant since the Chernobyl disaster in 1986, exposed "certain weaknesses" in Japan's regulatory framework. Responsibilities were divided among a number of bodies, and it was not always clear where authority lay.

Mr Amano said there were also certain weaknesses in plant design, in emergency preparedness and response arrangements and in planning for the management of a severe accident.

"There was an assumption that there would never be a loss of all electrical power at a nuclear power plant for more than a short period," he said. "The possibility of several reactors at the same facility suffering a crisis at the same time was not considered. And insufficient provision was made for the possibility of a nuclear accident occurring at the same time as a major natural disaster."

Mr Amano said since the accident, Japan has reformed its regulatory system to better meet international standards. It gave regulators clearer responsibilities and greater authority. The new regulatory framework will be reviewed by international experts through an IAEA Integrated Regulatory Review Service mission. Emergency preparedness and response arrangements have also been strengthened.

The IAEA said the report assesses the causes and consequences of the accident, which was triggered by a tsunami that followed a massive earthquake. It considers human, organisational and technical factors and aims to provide an understanding of what happened, and why, so that lessons learned can be acted upon by governments, regulators and nuclear power plant operators.

The report considers the accident itself, emergency preparedness and response, radiological consequences of the accident, post-accident recovery and the activities of the IAEA since the accident. It examines measures taken, both in Japan and internationally.

“Although nuclear safety remains the responsibility of each individual country, nuclear accidents can transcend national borders,” Mr Amano said. **“The Fukushima-Daiichi accident underlined the vital importance of effective international cooperation.”**

Mr Amano had announced in 2012 that the IAEA would prepare an assessment of the accident, addressing both its causes and consequences. The IAEA said the report is the result of an extensive collaboration that involved some 180 experts from 42 IAEA member states and several international bodies.

The report is online: <http://bit.ly/1hQl49S>

## Final report on Fukushima disaster (5)

### Assumption of safety behind Fukushima debacle: final IAEA report

<http://www.japantimes.co.jp/news/2015/09/01/national/assumption-safety-behind-fukushima-debacle-final-iaea-report/#.VeaWPJfwmic>

JJI

BERLIN – The widespread assumption that nuclear plants were safe was behind the March 2011 accident at the Fukushima No. 1 nuclear plant, the International Atomic Energy Agency said in its final report on the crisis.

Before the catastrophe, “there was a basic assumption in Japan that the design of nuclear power plants and the safety measures that had been put in place were sufficiently robust to withstand external events of low probability and high consequences,” the report, released Monday, says.

Because of this assumption, “there was a tendency for organizations and their staff not to challenge the level of safety,” the report says. This “resulted in a situation where safety improvements were not introduced promptly.”

The IAEA report stresses the need to “take an integrated approach that takes account of the complex interactions between people, organizations and technology” in order to better identify plant vulnerabilities to natural disasters and other unexpected events.

The report was compiled by around 180 experts from 42 countries. The plant was damaged in the tsunami caused by the powerful earthquake that hit off the Tohoku coast on March 11, 2011.

Some of the factors that contributed to the accident were “not unique to Japan,” IAEA Director General Yukiya Amano says in the report, adding that “continuous questioning and openness to learning from experience are key to safety culture and are essential for everyone involved in nuclear power.”

The Fukushima No. 1 plant’s vulnerability “to external hazards had not been reassessed in a systematic and comprehensive manner during its lifetime,” the IAEA report says.

“The assessment of natural hazards needs to consider the potential for their occurrence in combination, either simultaneously or sequentially,” it says.

Tokyo Electric Power Co. was “not fully prepared for the multiunit loss of power and the loss of cooling caused by the tsunami.”

“Operators had therefore not received appropriate training and had not taken part in relevant severe accident exercises, and the equipment available to them was not adequate in the degraded plant conditions,” the report says.

Furthermore, the report argues that “it was not fully clear which organizations had the responsibility and authority to issue binding instructions on how to respond to safety issues without delay.”

It points to a lack of “coordinated arrangements for responding to a nuclear emergency and a natural disaster occurring simultaneously.”

On the accident’s effects on human health, the Vienna-based IAEA said that thyroid cancer in children is “the most likely health effect.”

However, it adds that “because the reported thyroid doses attributable to the accident were generally low, an increase in childhood thyroid cancer attributable to the accident is unlikely.”

Still, the report notes that uncertainties remain “concerning the thyroid equivalent doses incurred by children immediately after the accident.”

As for the return home of people who have been evacuated following the accident, the IAEA stressed the need to consider “factors such as the restoration of infrastructure, and the viability and sustainable economic activity of the community.”

The long-term goal of post-accident recovery is to re-establish an acceptable basis for a fully functioning society in areas affected by the nuclear crisis, the report notes.

“Communication with the public on recovery activities is essential to build trust,” it says. For effective communication, “it is necessary for experts to understand the information needs of the affected population and to provide understandable information through relevant means.”

September 3, 2015

## Oceans can't complain

### **TEPCO begins pumping up groundwater before dumping in ocean**

<http://mainichi.jp/english/english/newsselect/news/20150903p2g00m0in042000c.html>



TOKYO (Kyodo) -- The operator of the crippled Fukushima Daiichi nuclear power plant on Thursday began pumping up groundwater from wells around the reactor buildings as part of its plan to dump it into the ocean after treatment.

The plan is aimed at curbing the amount of toxic water buildup at the complex. Tokyo Electric Power Co. says radiation levels in the groundwater are much lower than in the highly toxic water being pooled inside the reactor buildings, adding **it will discharge it only after confirming it does not contain radioactive materials exceeding the legally allowable limit.**

Even so, fishermen in Fukushima Prefecture had long opposed the plan amid concerns over pollution of the ocean and marine products. They approved it last week on condition that the government and TEPCO continue paying compensation to them for as long as the nuclear crisis continues to cause damage to their business, among other requirements.

**TEPCO now plans to dump some 4,000 tons of already-decontaminated groundwater, which was pumped up on a trial basis last year, in mid-September in the first such release.**

The amount of radioactive water at the plant is increasing every day, as some 300 tons per day of groundwater is seeping into the reactor buildings and mixing with highly radioactive water generated in the process of cooling the reactors that suffered meltdowns in the 2011 nuclear disaster.

With the latest plan to cope with toxic water buildup, TEPCO and the government expects the amount of groundwater flowing into the reactor buildings to be halved.

TEPCO has been struggling to resolve the problem of toxic water buildup for more than four years, with radiation leakages into the environment still occurring frequently.

The company is also behind schedule on a project to build a huge underground ice wall, another key measure to prevent radioactive water from further increasing at the site.

September 03, 2015 (Mainichi Japan)

## **TEPCO pumps up groundwater for release into sea**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the Fukushima Daiichi nuclear plant has begun pumping up groundwater from around reactor buildings with the aim of releasing it into the sea.

Tokyo Electric Power Company, or TEPCO, hopes the move will slow the accumulation of radioactive wastewater in the buildings, which is building up at a rate of 300 tons a day due to the inflow of groundwater.

The utility will target groundwater from wells dug around the No.1 through No.4 reactor buildings. It plans to filter out much of the radioactive material before releasing the water into the ocean.

Workers on Thursday began pumping up groundwater from 20 wells. They plan to remove 200 tons through the afternoon and store it in special tanks.

TEPCO has yet to reach an agreement with local authorities and fishermen about when to release the decontaminated water, but it will likely be later this month.

The utility claims **the drainage will cut the amount of wastewater in the reactor buildings by about half.**

But local authorities and fishermen worry about what could happen to the environment if something goes wrong.

## Cooling restarted in No.3 pool

### TEPCO resumes cooling in No.3 spent fuel pool

[http://www3.nhk.or.jp/nhkworld/english/news/20150903\\_29.html](http://www3.nhk.or.jp/nhkworld/english/news/20150903_29.html)

The operator of the Fukushima Daiichi nuclear power plant has restarted the cooling system for a spent fuel pool at the No.3 reactor, after a **temporary suspension due to a leak of oil from heavy machinery**.

Tokyo Electric Power Company said it switched off the water circulation system **for about 4 hours** on Thursday to remove oil that had leaked into the pool. The pool is located on the top floor of the No.3 reactor building.

The pool stores **566 spent nuclear fuel assemblies**.

TEPCO officials said the system was switched back on shortly after noon, and that the water temperature taken an hour later was 26.1 degrees Celsius, showing that it had not risen much from what it was before the switch-off.

The utility says the leaked oil remained within the oil fence of the fuel pool and there were no effects on other equipment.

The oil leak occurred at around 8AM during work to remove debris scattered in the spent fuel pool. A pressurized oil hose on heavy machinery used for cutting up the debris hit a component in the pool, causing the oil leak. It stopped when the machinery was turned off.

## New robot to decontaminate No3. building

### Robot to decontaminate reactor building

[http://www3.nhk.or.jp/nhkworld/english/news/20150903\\_30.html](http://www3.nhk.or.jp/nhkworld/english/news/20150903_30.html)

Engineers have tested a robot designed to remove radioactive substances from high places in nuclear reactor buildings at the crippled Fukushima Daiichi power plant in northeastern Japan.

The plant's operator, Tokyo Electric Power Company, plans to use the device as soon as October to decontaminate the building of the facility's No. 3 reactor.

The robot emits high-pressure jets of frozen carbon dioxide grains onto walls and scrapes off the coating along with radioactive substances. The machine's ladder-like structure with a nozzle can reach as high as 8 meters.

Engineers at electronics maker Toshiba tested the robot on Thursday at a factory in Toyohashi City, Aichi Prefecture. Part of the reactor building was simulated at the factory.

The engineers operated the robot remotely while watching footage from 22 cameras attached to the machine. They carefully scraped a blue coating off a 3-meter-high wall.

The device is expected to speed up decommissioning work at the plant, where other robots could not remove radioactive substances from high places. High radiation levels in the reactor buildings prevent workers from entering them.

Toshiba senior engineer Hitoshi Sakai said little is known about contamination at high places in the buildings. He added that his firm wants to create an environment that's accessible for workers by removing radioactive substances.

September 5, 2015

## 700,000 tons of radioactive water



Reporters observe the dismantling of bolted flange-type tanks to store radiation-contaminated water at the Fukushima No. 1 nuclear power plant during a media tour Sept. 4. (Pool)

## **Nearly 700,000 tons of radioactive water stored at Fukushima plant**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201509050017>

By HIROMI KUMAI/ Staff Writer

OKUMA, Fukushima Prefecture--Almost 700,000 tons of radiation-contaminated water have accumulated at the crippled Fukushima No. 1 nuclear power plant, Tokyo Electric Power Co. disclosed Sept. 4.

The water is stored in rows of massive tanks on the plant's premises.

Contaminated water has been a persistent problem since the 2011 earthquake and tsunami disaster triggered a triple meltdown at the plant, resulting in a vast amount of radiation being spewed from the facility.

Each day, about 300 tons of groundwater still seeps into the basements of the reactor buildings, where it mixes with melted nuclear fuel and becomes highly contaminated, the utility officials said.

The storage tanks TEPCO has constructed to store the water are 10 meters tall and positioned on the inland, and not seaward, side of the reactor buildings.

The plant operator said it had lowered the radiation level of a large portion of the contaminated water using a multinuclide removal apparatus called ALPS (advanced liquid processing system) and other equipment.

The utility completed processing the most highly contaminated water stored in tanks by the end of May. TEPCO has also worked to replace flange-type bolted storage tanks that are susceptible to leakage with welded tanks to reduce the risk of accidental seepage.

To intercept clean groundwater before it flows into contaminated reactor buildings, TEPCO started a "subdrain plan" Sept. 3 to pump tons of groundwater from "subdrain wells" before it reaches the contaminated reactor buildings each day. The water will be released into the sea after undergoing decontamination treatment.

September 8, 2015

## **Removing third roof panel off No.1**

### **Third ceiling panel removed from Fukushima reactor**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Workers at the Fukushima Daiichi nuclear plant have removed half of the ceiling panels covering a damaged reactor building. The work is part of efforts to decommission the facility.

The No.1 reactor building was heavily damaged by a hydrogen explosion during the 2011 meltdown. Tokyo Electric Power Company installed a cover around it to prevent the spread of radioactive material.

The utility is now removing the cover so it can clean up debris inside the facility. Two of the 6 ceiling panels that make up the cover were removed between late July and early August.

The utility then halted the work to monitor radiation levels and check the conditions of the debris. Since no abnormalities were found, workers removed a 3rd panel on Tuesday using a remote-controlled crane.

**TEPCO says there's been no change in radiation levels around the reactor buildings.** It says measurements taken before the work on Tuesday showed that wind blowing inside the cover was weaker than expected.

The utility plans to finish dismantling the cover by around late next year.

## Water to be released into sea

### Groundwater to be released into the sea on Monday

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the Fukushima Daiichi nuclear plant plans to start releasing groundwater from around reactor buildings into the sea next Monday.

The government and the operator, Tokyo Electric Power Company, are to formally decide on the discharge date on Wednesday. The water has already been decontaminated.

Officials hope the move will help to curb the accumulation of radioactive wastewater in the reactor buildings. The contaminated water is increasing at a rate of 300 tons a day as the groundwater flows in.

The officials plan to first release some 4,000 tons of water pumped up from the wells around the buildings on a trial basis since August last year.

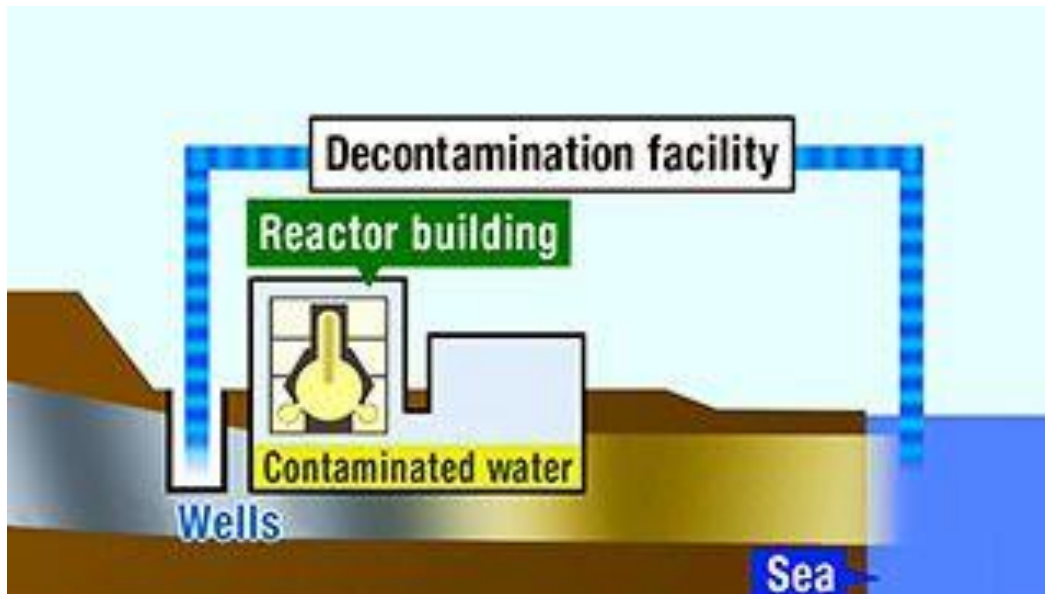
They say they will continue to pump up water and release it after removing radioactive materials.

Later this week, the utility also plans to resume the construction of steel walls along the coast to stop the groundwater seeping directly into the sea.

The construction work has been suspended until the release of the groundwater becomes possible.

September 9, 2015

## Groundwater Release Plan



### Groundwater Release Plan : Nuclear Watch video

<http://www3.nhk.or.jp/nhkworld/english/news/nuclearwatch/20150909.html>

The operator of the crippled Fukushima Daiichi nuclear plant plans to release decontaminated groundwater into the sea from next week in order to prevent the buildup of radioactive water. The utility will first release about 4 million liters of water pumped up from wells dug around the reactor buildings and treated to remove radioactive substances.

Contaminated water is increasing at a volume of 300,000 liters a day as groundwater flows into the compound. TEPCO and the government expect to formally decide the discharge date on Wednesday. Later this week, the utility also plans to resume construction of steel walls along the coast to stop groundwater seeping directly into the sea. The work was suspended until it became possible to release the groundwater.

September 11, 2015

## Radioactive rainwater flows into sea

### Rainwater overflows from Fukushima plant

[http://www3.nhk.or.jp/nhkworld/english/news/20150911\\_22.html](http://www3.nhk.or.jp/nhkworld/english/news/20150911_22.html)

The operator of the crippled Fukushima Daiichi nuclear power plant has found that rainwater has intermittently overflowed a drainage channel and spilled directly into the sea.

This happened after the area was hit by the recent heavy rains.

Tokyo Electric Power Company said on Friday that it confirmed the leaks through video footage of the complex. The operator said the leaks occurred at 3 AM, 5:20 AM and 6 AM on Friday -- for a total of more than 2 and a half hours.

TEPCO is now checking the radioactive levels of rainwater samples taken from the channel.

Radioactive rainwater was first found spilling into the sea from the channel in February.

As a stopgap measure, TEPCO built a barrier at the channel's far end to pump up water before it reached the sea.

The channel repeatedly floods during heavy rains.

Work to reroute the drainage channel so that the rainwater does not leak outside the plant's port, which began in May, has yet to be completed.

September 14, 2015

## **Treated contaminated water dumped into sea**

### **TEPCO releases first batch of decontaminated Fukushima groundwater to sea**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201509140069>



Equipment to decontaminate radioactive groundwater collected from subdrains set up around the main buildings of the Fukushima No. 1 nuclear power plant in Okuma, Fukushima Prefecture, last October. (Asahi Shimbun file photo)

By HIROMI KUMAI/ Staff Writer

Tokyo Electric Power Co. was set to release **850 tons** of treated radioactive groundwater into the sea off the Fukushima No. 1 nuclear power plant by sundown on Sept. 14.

The discharge marks the first release under the utility's "subdrain plan," an additional measure conceived to help diminish the build-up of contaminated groundwater at the crippled facility.

TEPCO began discharging water **after a third-party panel confirmed that the radioactive content was below the standard set by the utility.**

The plan utilizes subdrains, which are essentially wells set up around the main buildings of the power plant to collect groundwater flowing into the complex. Once the groundwater has been pumped from those wells, it undergoes decontamination in a special facility for release into the ocean after being checked for radioactive content.

The Fukushima Prefectural Federation of Fisheries Cooperative Associations gave the green light to the operation on Aug. 11, and TEPCO began pumping in earnest on Sept. 3.

The release of the first batch of decontaminated groundwater, which had been stored in a tank since last year, started around 10 a.m. The water collected from Sept. 3 will be released in a few days.

**TEPCO's standard is set at 1 becquerel of radioactive cesium per liter of decontaminated groundwater, 3 becquerels for elements that emit beta rays and 1,500 becquerels for tritium--a substance which is very hard to treat.**



As for now, the utility plans to pump 100 to 200 tons of groundwater daily, but will increase the volume to 500 tons if it does not encounter any problems with the decontamination facilities.

TEPCO believes the subdrains can halve the approximately 300 tons of daily groundwater buildup at the plant. However, the utility is uncertain how many months it will take to see whether this holds true.

## **Tepco dumps treated groundwater in Pacific to ease toxic water buildup at Fukushima No. 1**

<http://www.japantimes.co.jp/news/2015/09/14/national/tepcu-dumps-treated-groundwater-in-pacific-to-ease-toxic-water-buildup-at-fukushima-no-1/#.VfbnkZfwlLN>

Kyodo

FUKUSHIMA – Tepco on Monday discharged into the ocean filtered groundwater taken from wells around the damaged reactor buildings at the Fukushima No. 1 nuclear plant in an effort to curb the buildup of toxic water.

The project has been touted as one of Tokyo Electric Power Co.'s key measures in tackling the contaminated water problem.

Some 300 tons of untainted groundwater seeps into the buildings each day, where it mixes with water made radioactive by keeping the damaged reactors cool.

By pumping up groundwater through 41 wells and discharging it into the sea after treatment, the government and Tokyo Electric Power Co. hope to halve the amount flowing into the reactor buildings. On Monday, Tepco released some 850 tons of filtered groundwater — part of some 4,000 tons pumped up last year on a trial basis and stored in tanks — after confirming that radiation levels were below measurable limits.

Tritium, which cannot be removed with existing technology, measured 330 to 600 becquerels per liter, well below the legally allowable limit of 1,500 becquerels, the utility said, citing analyses conducted by the company and an outside organization.

Fishermen in Fukushima Prefecture had long opposed releasing the water over concerns it would pollute the ocean and contaminate marine life, but signed off on the plan in August.

In exchange, the fishermen demanded among other things that Tepco and the government continue paying compensation for as long as the nuclear plant damages their business.

Tepco is running behind schedule on a project to build a huge underground ice wall at the site, another key measure to prevent groundwater from reaching the reactor building basements.

## **TEPCO starts releasing treated underground water into ocean at Fukushima plant**

<http://mainichi.jp/english/english/newsselect/news/20150914p2a00m0na019000c.html>

Tokyo Electric Power Co. (TEPCO) has started releasing treated underground water pulled up from wells around reactor buildings at the disaster-stricken Fukushima No. 1 Nuclear Power Plant, the utility announced on Sept. 14.

TEPCO says the radiation levels of the water fall within standards set by it and the government. Around 850 metric tons of water -- from some 4,000 tons gathered from August through November last year -- is planned to be released on the first day of the program. The radiation level standards for the released water are 1 becquerel or less of cesium radiation per liter, 3 becquerels or less of beta-emitting radiation from materials like strontium per liter, and 1,500 becquerels or less of tritium radiation, which cannot be removed in the treating process, per liter. These standards are stricter than the World Health Organization's standards for drinking water.

At the Fukushima plant, the amount of contaminated water increases by around 300 tons every day due to the inflow of underground water, but with the start of the water release program, this amount can be halved, estimates TEPCO. The program will give TEPCO more control over underground water levels, and on Sept. 10 it resumed construction on a water-blocking wall on the ocean-side of the No. 1 through No. 4 reactor buildings, which had been halted.

TEPCO had been pulling up and releasing underground water into the ocean at the plant since before the 2011 meltdowns, but the pumps for this operation were broken in the tsunami that followed the Great East Japan Earthquake, and the radiation levels of underground water were raised by the hydrogen explosions and other radiation releases of the disaster, all of which prevented TEPCO from resuming the pumps until now.

## **Groundwater release starts at Fukushima Daiichi**

[http://www3.nhk.or.jp/nhkworld/english/news/20150914\\_22.html](http://www3.nhk.or.jp/nhkworld/english/news/20150914_22.html)

The operator of the crippled Fukushima Daiichi nuclear plant has started releasing groundwater into the sea pumped up from around reactor buildings. The water is decontaminated and monitored before releasing.

The government and Tokyo Electric Power Company say the release is aimed at reducing the daily production of radioactive wastewater by half. The work began at around 10 AM on Monday.

300 tons of contaminated water has been produced daily in the damaged reactor buildings due to flow-in of groundwater.

By evening the operator plans to release some 850 tons of groundwater. This is from the 4,000 tons it has already pumped up from wells around reactor buildings since August last year. The groundwater has been cleaned to permissible radioactive levels.

Workers will continue to release the stored water for 3 more days this time.

Municipalities and local fishermen worry about possible effects on the environment if something goes wrong. The government and the Tokyo Electric Power say they will conduct strict monitoring of the discharge.

September 20, 2015

## No standards for radioactive rainwater...

### Radioactive rain releases can't be curbed due to lack of laws: NRA

<http://www.japantimes.co.jp/news/2015/09/20/national/radioactive-rain-releases-cant-curbed-due-lack-laws-nra/#.Vf7JQZfwmid>

Fukushima Minpo

### **Tokyo Electric Power Co.'s stricken Fukushima No. 1 power plant has released rainwater tainted with radioactive substances into the Pacific Ocean at least seven times since April.**

The Fukushima Prefectural Government, pressured by worried residents and fishermen, has pressed the Nuclear Regulation Authority to set maximum radiation limits for rainwater releases, but the regulator hasn't acted yet, citing the lack of specific laws on radioactive rainwater.

The plant's K channel, a gutter that was built to drain rainwater accumulated around the six reactors, leads directly to the sea. After rainwater was found tainted with radiation in April, Tepco, as a temporary fix, installed eight pumps and a special underwater curtain in its artificial bay to segregate the water from the open ocean.

With the pumps and the curtain, Tepco claims it can keep radioactive runoff within the bay as long as the rainfall stays at 14 mm per hour or less. But on Aug. 17, rainfall at the plant exceeded 18 mm per hour, and some untreated rainwater overflowed the K channel and got into the ocean. The same thing happened again on Sept. 9 and 11, amid flooding in the Kanto and Tohoku regions triggered by Typhoon Etau.

**When the drainage system is overwhelmed by heavy rain, it is difficult to measure the tainted water and its radiation level,** the utility said.

In May 2014, when Tepco succeeded in measuring rainwater on the premises, the cesium-137 level was gauged at 770 becquerels per liter, or over eight times the 90-becquerel limit for water the plant can release into the sea.

**To rectify the situation, Tepco has been trying to change the K gutter's path so it will flow into the artificial bay instead. But the rerouting work will take until March 2016.**

While Tepco says the problem will be solved in six months, prefectural officials are demanding Tepco resolve the problem as soon as possible, because if the leaks are allowed to continue throughout the typhoon season, public distrust in the government will deepen, making the decommissioning process even more difficult.

Fishery officials are meanwhile worried that their industry could be damaged further if the unregulated rainwater releases continue.

The prefecture is specifically asking that a new pump be installed close to the source of the tainted rainwater, but Tepco has been reluctant, saying such a pump is structurally impossible to install because the part of the drainage system where tainted water is leaking from is underground.

Tepco has been cleaning the drainage gutters on a regular basis to reduce the radiation levels, but to no avail.

Kiyoshi Takasaka, a prefectural expert on atomic power, wants the NRA to place radiation limits on rainwater immediately.

However, **the NRA's position is that there are no laws that regulate radiation-tainted rainwater and therefore it cannot set numerical limits. One industry source said doing so would require revisions to existing laws, which will take a lot of time.**

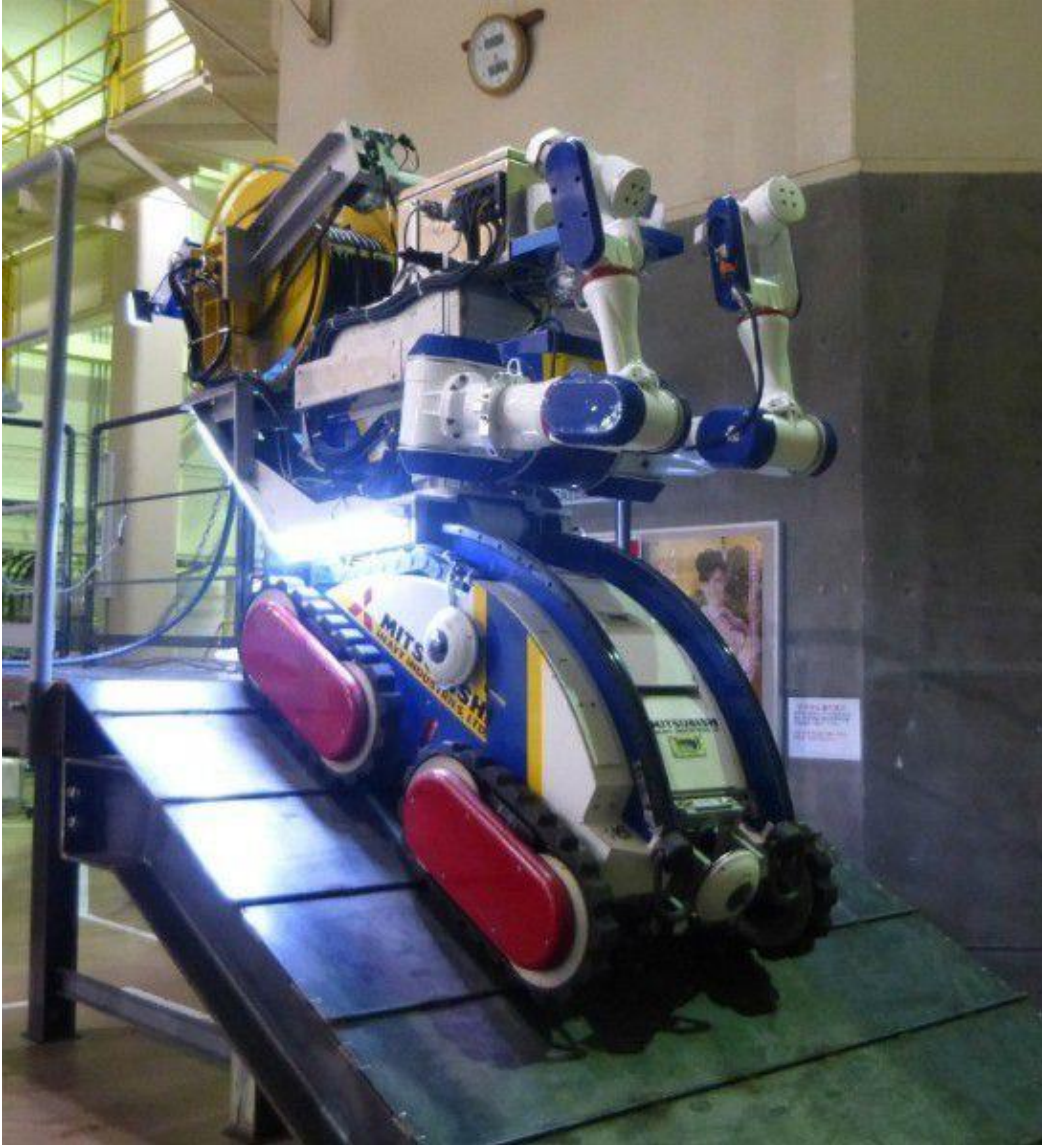
"I'm worried because we don't know how much radiation-tainted rainwater has leaked out," said Tomomitsu Konno, a 56-year-old fisherman in Soma, Fukushima Prefecture. "Tepco should fully investigate the problem and show the results to the fishermen."

*This section, appearing every third Monday, features topics and issues covered by the Fukushima Minpo, the largest newspaper in Fukushima Prefecture. The original article was published on Sept. 13.*

September 21, 2015

## **New robot for Fukushima Daiichi**

## New advanced robot to join cleanup effort at Fukushima No. 1 nuclear plant



A new robot set to go join reactor decommissioning operations at the Fukushima No. 1 nuclear plant is seen in this photo provided by Mitsubishi Heavy Industries. Ltd.

<http://mainichi.jp/english/english/newsselect/news/20150921p2a00m0na002000c.html>

An advanced remote-controlled robot capable of assessing its surroundings in detail and designed to help decommission reactors at the disaster-stricken Fukushima No. 1 nuclear plant is set to start its performance trials next month.

Plant operator Tokyo Electric Power Co. (TEPCO) is set to confirm the operational abilities of the robot, equipped with cameras with a 360-degree view and lasers capable of mapping the surroundings in 3D, before using it for decontamination work.

Decommissioning the No. 1 plant's reactors is expected to take 30-40 years. Along the way, workers will eventually have to enter the reactor buildings, but TEPCO must first carry out decontamination work in the structures to reduce high radiation levels. The utility has been attempting to clean up the reactor

building interiors by using other robots. However, efforts have been hampered by the lack of information on just how much wreckage has been strewn about and where it is, and the many obstacles have frequently halted work.

The new robot's 360-degree view cameras -- developed by the University of Tokyo, the University of Tsukuba and the International Research Institute for Nuclear Decommissioning (IRID), among other organizations -- will help cleanup workers get a better look at what they're up against. The device is in fact four cameras mounted high on the tracked robot, with the video feed displayed on-screen as a single all-round view.

"We've expanded the field of vision, so it should give the workers operating the robot a bird's-eye view of what they're doing," commented the project chief at IRID.

Meanwhile, the onboard lasers will allow the robot to calculate where surrounding wreckage and machinery is in the reactor buildings' interiors, and the information will be displayed in the video feed in 3D.

September 22, 2015

## How effective is Fortum's processing system?

### Fortum Wins New Order For Fukushima Ion Exchange Materials

<http://www.nucnet.org/all-the-news/2015/09/22/fortum-wins-new-order-for-fukushima-ion-exchange-materials>

22 Sep (NucNet): Fortum of Finland has received "a significant additional order" from American company EnergySolutions for its 'Nures' ion exchange materials for purification of radioactive water at the Fukushima-Daiichi nuclear power station in Japan, the company said. Fortum's ion exchange materials have been used in the advanced liquid processing system (Alps) at Fukushima-Daiichi to purify radioactive waters for the past three years. The order is one of Fortum's largest deliveries of ion exchange materials to date, a statement said. The ion exchange materials remove radioactive material such as **caesium and strontium** from radioactive water. Nures contains extremely selective ion exchange materials to absorb radioactivity. **Fortum says its method significantly reduces the need for intermediate and final disposal repository space for radioactive liquids.** Fortum initially developed Nures for use at its own Loviisa nuclear power plant.

September 26, 2015

### Up to 100% of No. 2 reactor fuel may have melted

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

A group of researchers says it is highly likely that 70 to 100 percent of fuel has melted at one of the damaged reactors at the Fukushima Daiichi nuclear power plant.

The group includes researchers from Nagoya University. It has been probing the plant's No. 2 reactor since April of last year, using a device that uses elementary particles called muons to see into its interior.

The researchers say the results of their study show few signs of nuclear fuel at the reactor core, in contrast to the No. 5 reactor where fuel was clearly visible at its core.

This led them to believe that 70 to 100 percent of fuel at the reactor has likely melted.

The researchers say further analyses are needed to determine whether molten fuel penetrated the reactor and fell down.

The No.2 reactor is said to have released large amounts of radioactive substances following the March 2011 accident.

Tokyo Electric Power Company, the plant's operator, has estimated that part of nuclear fuel at the reactor remains at its core.

**The locations of nuclear fuel will have a significant impact on the process to remove it from the damaged reactors, the most difficult step of the decommissioning work.**

The Japanese government and TEPCO plan to scan the No. 2 reactor once again using a different device.

They are also preparing to use robots around the reactor.

The group will announce the results of its study at a meeting of the Physical Society of Japan in Osaka on Saturday.

September 27, 2015

## **Confirmed: 70 to 100% fuel likely melted in No.2**

### **Researchers: More than 70% of No. 2 reactor's fuel may have melted**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201509270023>

By HIROMI KUMAI/ Staff Writer

More than 70 percent of the fuel may have melted in one of the three reactors at the Fukushima No. 1 nuclear power plant that suffered meltdowns in the wake of the 2011 nuclear disaster, researchers reported on Sept. 26.

The group, which includes researchers from Nagoya University, concluded that it is highly likely that 70 to 100 percent of the fuel has melted in the No. 2 reactor through inspecting the interior using a fluoroscopic device, which utilizes elementary particles called muons.

It was the second time that researchers successfully scanned the interior of the damaged reactors using a fluoroscopic device since a group led by Tokyo Electric Power Co., the operator of the crippled plant, announced the results of its survey inside the No. 1 reactor in March.

In cooperation with the electronics firm Toshiba Corp., the group, led by Nagoya University researchers, has conducted a probe into the No. 2 reactor since last year.

The survey detected few signs of nuclear fuel remaining in the reactor core, in contrast to the No. 5 reactor, which was not affected by the nuclear disaster, triggered by the Great East Japan Earthquake and tsunami in March 2011.

The researchers released their report at a meeting of the Physical Society of Japan in Osaka on Sept. 26. TEPCO had reported earlier that it is likely that a portion of the nuclear fuel remains in the core of the No. 2 reactor based on the results of its computer analysis.

By HIROMI KUMAI/ Staff Writer

September 28, 2015

## **Confirmed (2): 70 to 100% fuel likely melted in No.2**

### **Study find it likely that 70% of nuclear fuel melted at Fukushima No. 2 reactor**

<http://www.japantimes.co.jp/news/2015/09/28/national/study-find-it-likely-that-70-of-nuclear-fuel-melted-at-fukushima-no-2-reactor/#.Vgj20Jfwmif>

Kyodo

More than 70 percent of the nuclear fuel in one of the reactors at Tokyo Electric Power Co.'s Fukushima No. 1 nuclear power plant is highly likely to have melted in the wake of the massive 2011 earthquake and tsunami, according to a university research team.

Using special film that can detect muons, which form when cosmic radiation reaches the Earth, penetrates most matter and changes direction after colliding with uranium in nuclear fuel, the team at Nagoya University has confirmed the high possibility of 70 to 100 percent of the fuel having melted in the plant's No. 2 reactor.

The finding comes after the team first reported in March that it confirmed a core meltdown had occurred in the No. 2 reactor.

Tepeco said in the same month it found through a similar test method that nearly all fuel in the No. 1 reactor at the plant had melted.



Three reactors suffered core meltdowns in the Fukushima disaster.

The conclusion was reached after observing muons around the reactor's pressure vessel and comparing results with those of the No. 5 reactor, which was unaffected by the 2011 disaster.

Since results on the bottom of the pressure vessel are less accurate, however, the team says it will continue analysis to see how much of the molten fuel remains in the vessel.

Kunihiro Morishima, designated assistant professor at the university's Institute of Advanced Research, said he hopes the finding will help future work to remove the molten fuel from the reactor.

TEPCO and the International Research Institute for Nuclear Decommissioning, a Tokyo-based research body that consists of power plant makers, utilities and government organizations, are also trying to look into the inside of the No. 2 reactor at the plant.

September 29, 2015

## Additional tanks still needed

### TEPCO to install additional storage tanks for contaminated water at Fukushima plant

<http://mainichi.jp/english/english/newsselect/news/20150929p2a00m0na011000c.html>

Storage tanks for radioactively contaminated water at the stricken Fukushima No. 1 Nuclear Power Plant will be increased by 14,000 metric tons in volume by April next year, the government and Tokyo Electric Power Co. (TEPCO) announced on Sept. 28.

The planned installation is aimed at preparing for additional tainted water in case impermeable walls currently under construction at the plant turn out to be less effective than expected. The walls are meant to prevent an influx of groundwater into nuclear reactor buildings by freezing underground soil surrounding those buildings.

Currently, there are underground water storage tanks and other tanks with a combined capacity of some 950,000 metric tons. As of Sept. 24, contaminated water had taken up some 700,000 tons of the capacity, leaving around 250,000 tons worth of room. **TEPCO is planning to install 20 additional tanks with a capacity of 700 tons each at two vacant lots on the plant's premises.**

A daily amount of roughly 300 tons of contaminated water has been accumulating at the plant due to the inflow of groundwater into reactor buildings. In order to keep the amounts down, the government and TEPCO have been building the impermeable walls. Earlier this month, TEPCO started releasing into the ocean treated underground water, which had been pulled up from wells around the reactor buildings.

**Because the effects of such measures are "still unforeseeable,"** according to an official at the Ministry of Economy, Trade and Industry, the government and TEPCO decided to introduce additional tanks.

## Pumping up rainwater further upstream?

### Reduction of radioactive rainwater urged at plant

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The prefectural government of Fukushima has again called on the operator of the crippled Daiichi nuclear plant to address the outflow of radioactive rainwater into the ocean after a heavy rainfall.

Tokyo Electric Power Company said on Tuesday it will deal with the leak as soon as possible, by introducing a new measure.

After a heavy downpour, rainwater flows into a drain at the plant and then flows directly into the sea. The water is thought to absorb higher-than-permitted-levels of radioactive substances while flowing through the plant site.

On Tuesday, officials from the prefecture and TEPCO met.

The prefecture's crisis management section chief Takao Kikori called on the utility to **speed up the work to reroute the drainage system into the plant's port**. Most of the port area is surrounded by breakwaters and other barriers.

The official also told the TEPCO officials to make greater efforts to prevent contaminated water from flowing into the ocean.

TEPCO representative Naohiro Masuda said **the firm is considering pumping up rainwater further upstream from the drain in question and redirecting it to other drains flowing into the port**.

Masuda said TEPCO hopes to find a spot to pump up the water as soon as possible and **take action before any typhoons approach**.

September 30, 2015

## Where did it go?

### Fukushima: the World's Never Seen Anything Like This

<http://www.counterpunch.org/2015/09/30/the-worlds-never-seen-anything-like-this/>

by Robert Hunziker



The Fukushima Daiichi Nuclear Power Plant No. 2 nuclear reactor fuel is missing from the core containment vessel. (Source: Up to 100% of No. 2 Reactor Fuel May Have Melted, NHK World News, Sept. 25, 2015.)

Where did it go? Nobody knows.

Not only that but the “learning curve” for a nuclear meltdown is as fresh as the event itself because “the world has never seen anything like this,” never.

Utilizing cosmic ray muon radiography with nuclear emulsion, researchers from Nagoya University peered inside the reactors at Fukushima. The nuclear fuel in reactor core No. 5 was clearly visible via the muon process. However, at No. 2 reactor, which released a very large amount of radioactive substances coincident with the 2011 explosion, little, if any, signs of nuclear fuel appear in the containment vessel. A serious meltdown is underway.

“The researchers say further analyses are needed to determine whether molten fuel penetrated the reactor and fell down,” *Ibid.* In short, researchers do not yet know if the molten hot stuff has penetrated the steel/concrete base beyond the containment vessel, thus entering Mother Earth.

The Nagoya University research team, in coordination with Toshiba Corporation, reported their findings at a meeting of the Physical Society of Japan on Sept. 26th.

Thus, therefore, and furthermore, it is advisable to review what’s at stake:

“High-level nuclear waste is almost unimaginably poisonous. Take for example cesium-137, with a half-life of 30 years, which makes up the largest fraction of long-lived radionuclides residing in spent nuclear fuel. One gram of radioactive cesium-137 (about half the size of a dime) contains 88 Curies of radioactivity. 104 Curies of radioactive cesium-137, spread evenly over one square mile of land, will make it uninhabitable for more than a century,” Comments on Draft of Nuclear Waste Administration Act of 2013, Physicians for Social Responsibility, May 23, 2013.

As for example, there are 1,090 square miles of land surrounding the destroyed Chernobyl reactor that Ukraine classifies as an uninhabitable radioactive exclusion zone because radioactive fallout left more than 104 Curies of cesium- 137 per square mile on the land that makes up the zone. Scientists believe it will be 180 to 320 years before Cesium-137 around Chernobyl disappears from the environment.

Here's the big, or rather biggest, problem: Cesium is water-soluble and makes its way into soils and waters as it quickly becomes ubiquitous in a contaminated ecosystem.

Chernobyl, on the other hand, is a different animal than Fukushima because it's explosion was much more widespread and more dense than Fukushima, where 80% of initial radiation was blown out to the Pacific Ocean. Hmm.

Whereas, during the Three Mile Island incident, a partial core meltdown occurred but the reactor vessel was not breached, so there was no major radiation release.

Categorically, "Long-lived radionuclides such as Cesium-137 are something new to us as a species. They did not exist on Earth in any appreciable quantities during the entire evolution of complex life. Although they are invisible to our senses they are millions of times more poisonous than most of the common poisons we are familiar with. They cause cancer, leukemia, genetic mutations, birth defects, malformations, and abortions at concentrations almost below human recognition and comprehension. They are lethal at the atomic or molecular level," Steven Starr, senior scientist, Physicians for Social Responsibility, Director, Univ. of Missouri, Clinical Laboratory Science Program, The Implications of the Massive Contamination of Japan With Radioactive Cesium, Speech to NY Academy of Medicine, March 11, 2013.

Still, a true understanding of the dangers of the Fukushima disaster may never be fully known by the general public because of difficulties accessing solid information. Indeed, the Japanese government has made it nearly impossible to obtain information which is not indiscriminately labeled "secret," and a journalist may face up to 10 years in prison based upon which side of the bed a government employee gets up on any given morning; it's absolutely true!

The independent organization Reporters without Borders has downgraded Japan in its World Press Freedom Index from 22nd place in 2012, to 53rd in 2013 and to 59th in 2014, following the enactment of the state secrets bill. Reporters without Borders says that "Japan has been affected by a lack of transparency and almost zero respect for access to information on subjects directly or indirectly related to Fukushima," Reporters without Borders (2013). Press Freedom Index 2013: Dashed Hopes After Spring, August 2014.

Meanwhile, there is another angle to the nuclear issue. On the opposite side of the anti-nuke crowd it is instructive to note that a sizeable pro-nuke coterie claim nuclear power is safe and also claim that few, if any, serious human health problems have arisen, or will arise, from radiation exposure. In fact, some nuke addicts even claim a "little radiation exposure" is good.

That, however, has been debunked via a recent (July 2015) landmark study concluded by an international consortium under the umbrella of the International Agency for Research on Cancer / Lyon, France where a long-term study for low radiation impact was conducted on 300,000 nuclear-industry workers. The study proves, beyond a doubt, there is "no threshold dose below which radiation is harmless." Any amount is harmful, period.

Nevertheless, here's one example of the pro-side:

"The Fukushima incident will continue to attract media attention for some time to come, I imagine. It has become such a good story to roll with that it will not just go away. However, in sober reflection and retrospection one has to come to the conclusion that far from being a nuclear disaster the Fukushima incident was actually a wonderful illustration of the safety of nuclear power," Dr. Kelvin Kemm, CEO of Nuclear Africa, Physicist: There was no Fukushima Nuclear Disaster: The Terrible Toll From Japan's Tsunami Came From the Wave, not Radiation, Cfact, Oct. 12, 2013.

Back to Fukushima, depending upon whom is the source, radiation exposure is (a) extremely harmful and deadly as levels of radioactivity are widespread throughout the greater region, including Tokyo, or

contrarily, (b) radioactivity is at such nominal levels that people do not need to worry, or (c) the worst is yet to come. Thereupon the rubber meets the road, meaning the credibility issue encountered by outsiders looking inside Fukushima remains “who to believe.”

Meanwhile, the “world information system aka: Internet” is crowded with stories about melting starfish in the Pacific Ocean, dumbfounded whales, and massive animal deaths enough so that people start connecting the dots in expectation that Fukushima radiation is omnipresent; however, to date, most of the evidence is labeled conjecture by various mainstream parties. Again, the problem is who to trust. Regardless of whom to believe, it is now known for a fact, a hard fact, that Fukushima Daiichi Nuclear Power Plant No. 2 is missing its fuel within its core containment vessel. This leads to a world of unknowns, and the biggest question is: What can be done about a full meltdown should it occur (maybe it’s already occurred)? Then what?

A full meltdown would involve all of the fuel in the nuclear plant core melting and a mass of very hot molten material falling and settling at the bottom of the reactor vessel. If the vessel is ruptured, the material could flow into the larger containment building surrounding it, which is shielded by protective layers of steel and concrete (Ferguson).

“But if that containment is ruptured, then potentially a lot of material could go into the environment,” according to Charles Ferguson, president of the Federation of American Scientists (Source: Mechanics of a Nuclear Meltdown Explained, PBS Newshour, Science, March 15, 2011.)

What does a lot of material going into the environment really mean?

Sources claim deadly Cesium-137, which is only one of many dangerous isotopes, is water-soluble and makes its way into soils and waters, as it quickly becomes ubiquitous in the ecosystem. The question thus becomes would a full meltdown turn lose this deadly isotope, as well as others, on the surrounding environment? Frankly, it kinda seems like it would.

Nobody knows whether Fukushima morphs full meltdown into Mother Earth, although the signposts are not good, and not only that but nobody knows what to do about it. Nobody knows what to do. They really don’t.

The only thing for certain is that it’s not good. Going forward, it becomes a matter of how bad things get.

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October 2, 2015

## Workers needed where robot not good enough

### TEPCO gets closer to robot probe of No.2 reactor

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Oct. 2, 2015 - Updated 00:58 UTC+2

The operator of the crippled Fukushima Daiichi nuclear power plant has made progress toward a robot inspection of the interior of one of its reactors. Its workers **removed obstacles from the path to the containment vessel surrounding the reactor core.**

The operator, Tokyo Electric Power Company, plans to maneuver the robot to film molten nuclear fuel in the No.2 reactor for the first time. The reactor experienced a meltdown after the 2011 earthquake and tsunami.

The company had previously postponed its plan to run the robot probe in August as chunks of concrete were blocking the pipe to be used as an entry point for the robot. **The reactor site also had an extremely high radiation level of above 1,000 millisieverts per hour.**

**The utility decided that clearing away the concrete blocks would be difficult by remote control. Instead, its workers started to remove them by operating, in turns, heavy machinery equipped with radiation-resistant steel plates.** They completed the work on Thursday.

**The company says the workers were exposed to up to 2.5 millisieverts of radiation during the removal operation.**

Tokyo Electric says **it will take more than 2 months to decontaminate the area** and wants the robot probe in operation early next year. But the firm adds that it cannot set a specific schedule for the inspection as the cause of the high radiation level remains unknown.

October 5, 2015

## Last cover panel removed from No.1

### Last ceiling panel removed from Fukushima reactor

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

Workers at the Fukushima Daiichi nuclear power plant have removed the last remaining ceiling panel covering a damaged reactor building. It is part of efforts to take out spent nuclear fuel from the building.

On Monday, the workers used a **remote controlled crane to lift the panel**, measuring 42 meters by 7 meters, from the No. 1 reactor building.

Scattered debris near the spent nuclear fuel pool can now be seen from outside.

The plant's operator, Tokyo Electric Power Company, says **there has been no change in radiation**

## **levels around reactor buildings.**

The No.1 reactor building was damaged in the 2011 accident. TEPCO installed a cover around it to prevent radioactive materials from escaping.

In July, the utility began removing 6 ceiling panels that make up the cover. Workers plan to take out 392 units of fuel from the pool in the reactor building where they are being stored.

### **But work needs to be done to clean up debris around the pool before removing the spent fuel.**

TEPCO officials told reporters that the entire cover needs to be demolished before the spent fuel can be removed. They say top priority will be placed on safety during the process.

October 6, 2015

## **Last cover panel removed from No.1 (2)**

### **TEPCO removes final canopy panel at damaged Fukushima reactor building**

Tokyo Electric Power Co. finished dismantling a canopy covering a damaged reactor building at the Fukushima No. 1 nuclear power plant to allow workers to start removing debris.

The operation, which began in July and was completed Oct. 5, brings the process of eventual extraction of spent nuclear fuel a step closer.

A giant crane was used to raise each of the six canopy panels, each 40 meters long and 7 meters wide, above the stricken plant's No. 1 reactor building.

TEPCO officials said grit and dust contaminated with radioactive substances were contained during the work.

TEPCO plans to shortly start removing panels covering the flanks of the reactor building. At the same time, it will try to assess the state of rubble on upper parts of the No. 1 reactor building.

The plant operator will then begin clearing debris at the reactor building, which was damaged by a hydrogen explosion when cooling systems failed after the 2011 earthquake and tsunami disaster. It expects to start the work in the latter half of fiscal 2016.

October 10, 2015

## TEPCO's frozen wall ready in December?

### Tepco expects to begin freezing ice wall at Fukushima No. 1 by year-end

Bloomberg

Tokyo Electric Power Co. expects to begin freezing a soil barrier by the end of the year to stop a torrent of water entering the wrecked Fukushima nuclear facility, moving a step closer to fulfilling a promise the government made to the international community more than two years ago.

"In the last half-year we have made significant progress in water treatment," Akira Ono, chief of the Fukushima No. 1 plant, said Friday during a tour of the facility northeast of Tokyo.

**The frozen wall, along with other measures, "should be able to resolve the contaminated water issues before the (2020) Olympic Games."**

Solving the water management problems will be a major milestone, but Tepco is still faced with a number of challenges at the site. The company must still remove highly radioactive debris from inside three wrecked reactors, a task for which no applicable technology exists. The entire facility must eventually be dismantled.

Currently, about 300 tons of water flow into the reactor building daily from the nearby hills. Tepco has struggled to decommission the reactors while also grappling with the buildup of contaminated water. Even four years after the meltdowns and despite promises from policymakers, water management remains one of Tepco's biggest challenges in coping with the fallout of Japan's worst nuclear disaster.

**The purpose of the ice wall — a barrier of soil 30 meters (98 feet) deep and 1,500 meters (0.9 mile) long which is frozen to -30 degrees Celsius (-22 Fahrenheit) — is to prevent groundwater from flooding reactor basements and becoming contaminated.**

"As the radiation levels decrease via natural decay, water management becomes the main issue," Dale Klein, an independent adviser for Tepco and a former chairman of the U.S. Nuclear Regulatory Commission, said by e-mail. "It is a very important issue for the public, and good water management is needed for Tepco to restore the public's trust."

Tepco is currently testing the freezing system, aiming to have the fence fully operational by the end of December, company spokesman Yuichi Okamura said.

At the moment, the deluge of groundwater entering the reactor buildings is purified, lowering its radioactive content. The water is then stored in one of numerous barrels at the site, each of which can hold 1,000 tons of water.

To make room for the 1,000 or so barrels required to hold the water, Tepco flattened a 500 square meter (5,382 square foot) bird sanctuary on the outskirts of the facility. The company doesn't have government approval to release the water into the ocean, and there's no clear plan for its disposal, Okamura said.

Prime Minister Shinzo Abe promised in 2013 that the government would take the lead in resolving the water management issues at the site ahead of the 2020 Tokyo Olympics. Two years later, hundreds of tons of water continue to pour into the reactor building, while tainted

Prime Minister Shinzo Abe promised in 2013 that the government would take the lead in resolving the water management issues at the site ahead of the 2020 Tokyo Olympics. Two years later, hundreds of tons of water continue to pour into the reactor building, while tainted water at other parts of the site overflows into the ocean.



Since January, slightly tainted water has spilled from a drainage system into the ocean on nine occasions, according to company spokeswoman Yukako Handa.

The company aims to end these leaks by reconfiguring a drainage system and building a wall running 30 meters into the seabed. The drainage work will be completed next year, and the sea wall will be completed this month.

The proposed ice wall has never been done on such a scale, and there could be operational issues due to the complicated nature of the project, according to Lake Barrett, former head of the U.S. Department of Energy's Office of Civilian Nuclear Waste Management.

"Some of these areas may have different freezing and sealing capabilities," he said by e-mail. "These types of problems were encountered when Tepco tried and failed to seal the seawater trenches by freezing."

## Highly radioactive deteriorating exhaust pipe may not be priority

### TEPCO begins examination of Fukushima reactor containment vessel exhaust pipe

<http://mainichi.jp/english/english/newsselect/news/20151010p2a00m0na007000c.html>

Tokyo Electric Power Co. (TEPCO) are examining **an exhaust pipe used to release pressure inside containment vessels** at the Fukushima No. 1 nuclear plant shortly after the March 2011 nuclear meltdowns there, company officials said.

Poles supporting the pipe have begun to deteriorate in the 4 1/2 years since the outbreak of the nuclear crisis, which was triggered by the March 2011 Great East Japan Earthquake and tsunami. Although TEPCO said there is no danger that the pipe will collapse, the company decided to **examine the assembly to see if it needs to be dismantled or reinforced.**

The pipe is about **120 meters high from the ground level** and was used for the plant's No. 1 and 2 reactors.

Radiation levels at the base of poles supporting the pipe were extremely high because it was used to vent radioactive steam from the containment vessels of these two reactors shortly after the outbreak of the nuclear crisis, preventing TEPCO from examining the pipe's condition.

A measurement conducted by TEPCO using a gamma camera in summer 2011 showed that radiation levels exceeded 10 sieverts per hour. Another measurement conducted in 2013 using a dosimeter mounted on a remotely controlled vehicle suggested that the figure was actually about **25 sieverts per hour** -- a level guaranteed to be fatal.

In the ongoing examination, radiation levels at the base of the support poles will be measured again to see how they have changed. TEPCO will also check if fractures and deformations found at eight places on the support poles have worsened.

Based on the results of computer analysis of the support poles, TEPCO has concluded that **they would not collapse even if hit by a Great East Japan Earthquake-scale temblor, or an upper-6 on the 7-point Japanese intensity scale.**

Therefore, the company intends to **prioritize efforts to decommission the plant**, including work to collect spent nuclear fuel from storage pools in the reactor buildings.

However, a TEPCO official said, "We may need to either reinforce or dismantle the pipe depending on the results of the ongoing examination."

October 26, 2015

## Steel wall completed

### Walls to halt tainted groundwater from flowing into sea completed at Fukushima plant

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201510260048>

Tokyo Electric Power Co. announced Oct. 26 that the construction of seaside walls to block radiation-contaminated groundwater from seeping into the sea has been completed at the crippled Fukushima No. 1 nuclear power plant.

The walls, comprising numerous cylindrical steel pipes, were installed at a 780 meter-long stretch along the plant's coastal embankment near the damaged No. 1 to No. 4 reactor buildings.

TEPCO officials said the underground walls will reduce the daily flow of contaminated groundwater into the sea from the previous estimated 400 tons to 10 tons.

However, they said it will take a month or two to confirm the effectiveness of the barriers.

The seaside walls are one of the three pillars of TEPCO's efforts to deal with tainted groundwater accumulating at the plant.

The other projects are a plan to treat groundwater pumped from subdrain wells around the reactor buildings and release it into the sea and a frozen soil wall being constructed to divert untainted groundwater away from the damaged reactor buildings and into the ocean.

### Steel barrier completed at Fukushima plant

[http://www3.nhk.or.jp/nhkworld/english/news/20151026\\_29.html](http://www3.nhk.or.jp/nhkworld/english/news/20151026_29.html)

The operator of the Fukushima Daiichi nuclear plant has completed construction of a steel piling wall along the plant's coastal embankment. It is **a significant step toward blocking radioactive groundwater from seeping into the sea** more than 4 years after the nuclear accident.

The wall made of 600 steel pipe sheet-piles is 780 meters long and 30 meters deep. Tokyo Electric Power Company said workers on Monday closed the final gaps in the barrier with cement.

TEPCO started building the wall in 2012, one year after the accident.

Its purpose is to block the daily flow of 400 tons of groundwater into the sea.

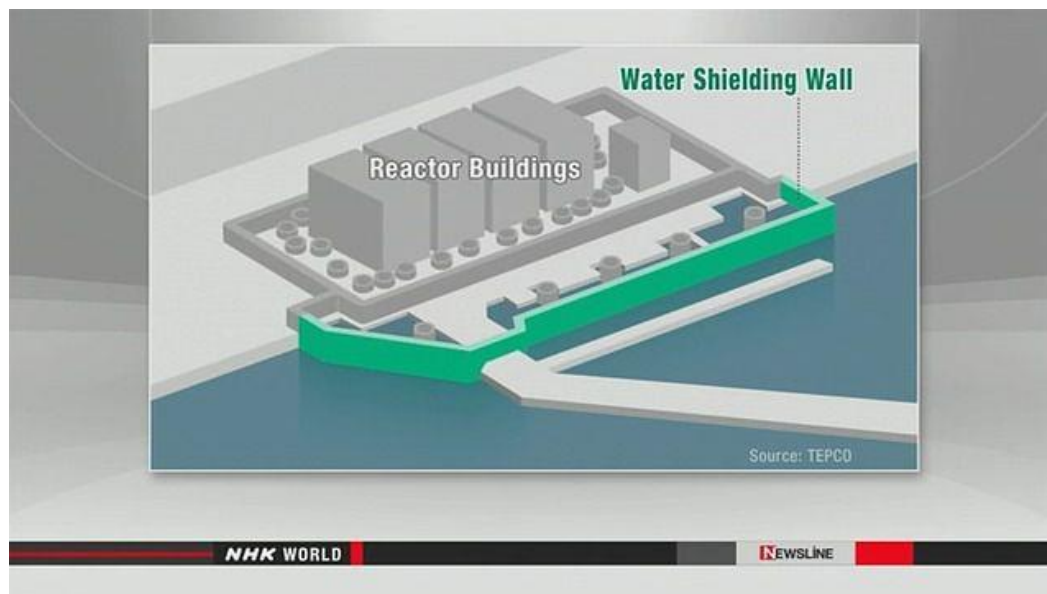
Some of the groundwater passes by the damaged reactor facilities, where it gets contaminated and becomes a source for sea contamination.

To prevent the groundwater from accumulating inside the wall and overflowing, TEPCO will pump it up and remove radioactive materials before releasing it into the sea.

The operator expects the steel wall to cut from the current 400 tons to around 10 tons the daily seepage of groundwater into the sea.

TEPCO says it will monitor groundwater levels and check radioactive substances in the sea to know whether the wall is working as planned.

### Wall expected to reduce radioactivity at sea



[http://www3.nhk.or.jp/nhkworld/english/news/20151026\\_15.html](http://www3.nhk.or.jp/nhkworld/english/news/20151026_15.html)

The operator of the crippled Fukushima Daiichi plant has spent more than 3 years trying to build a wall that would reduce the release of radioactive materials into the sea. The underground wall is located along the seaward side of the facility.

Difficulty in controlling groundwater, as well as strong opposition from local fishermen, caused the delay.

Tokyo Electric Power Company began construction of the 30 meter-deep and nearly 800 meter-long impermeable wall in May 2012, about a year after the nuclear accident. It aims to prevent groundwater that runs below the plant from seeping into the sea.

TEPCO also had to come up with a plan to pump up groundwater that gathered within the walls and decontaminate it before releasing it into the sea.

Otherwise, the contaminated groundwater would eventually flow over the walls into the sea.

Local fishermen were anxious about the releasing of once-contaminated water into the sea. They also expressed mistrust over the operator's water clean-up measures.

After long negotiations, the fishermen agreed to the plan in August this year, allowing the wall to approach completion.

Groundwater has been a major challenge for the operator as it continues to pollute the sea.

The operator says the wall will reduce the amount of cesium and strontium in the groundwater flowing into the sea by one-fortieth, and tritium by one-fifteenth.

The levels of cesium 137 inside the plant's port are currently around 10 becquerels at the highest, and several becquerels at the sea outside it. The operator will monitor the levels of the substances in the sea water to confirm the effectiveness of the wall.

Immediately after the 2011 accident, radioactive substances from nuclear fuel and highly-contaminated water that was used to cool reactors were major pollutants for the sea. Levels of cesium 137 rose to as high as several million becquerels per liter at the sea next to the plant. They dropped dramatically after one year.

October 29, 2015

## **New robot**

## Robot for decontaminating high places to be deployed at Fukushima nuke plant



A new radioactive cleanup robot is seen.  
(Mainichi)

<http://mainichi.jp/english/english/newsselect/news/20151029p2a00m0na011000c.html>

A new robot designed to help decontaminate high, hard-to-reach places at the disaster-stricken Fukushima No. 1 nuclear plant will go into service in mid-November, plant operator Tokyo Electric Power Co. (TEPCO) has decided.

The tracked robot is a compact 2 meters high, but can extend cleaning equipment about 8 meters up. Decontaminating the upper reaches of the reactor buildings has hitherto been impossible, obstructing cleanup efforts, and TEPCO hopes the new robot will help solve the problem.

The utility plans to deploy the robot on the first floor of the No. 3 reactor building, home to one of three reactors that melted down in March 2011 and especially radioactive. Decontamination work on the building's floors and other easily reachable areas has been ongoing, but piping and other spots higher up

are more complicated to get to and have not been cleaned yet. Some 70 percent of the radiation inside the No. 3 building is from contaminants in its higher reaches.

The remote-controlled robot sprays dry ice onto contaminated equipment such as piping, scrapes off the ice and sucks it up -- along with the radioactive materials.



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The new cleanup robot is seen extended to its full 8-meter height. (Mainichi)

The new cleanup robot is seen extended to its full 8-meter height. (Mainichi)

Maximum radiation levels now stand at 9 millisieverts per hour on the first floor of the No. 1 reactor building, 30 millisieverts in the No. 2 reactor building, and 125 millisieverts in the No. 3 building. TEPCO has stated that those radiation levels must be brought down to 3 millisieverts per hour or less before it will send human workers into the buildings.

October 29, 2015 (Mainichi Japan)

October 30, 2015

## Extremely high radiation levels stall checks (No.2)

### Deadly 9.4 sieverts detected outside Fukushima reactor 2 containment vessel; checks stop

<http://www.japantimes.co.jp/news/2015/10/30/national/deadly-9-4-sieverts-detected-outside-fukushima-reactor-2-containment-vessel-checks-stop/#.VjOVICt1BLN>

JJI

Tokyo Electric Power Co. said Thursday that radiation levels of up to 9.4 sieverts per hour have been detected outside a reactor containment vessel at the meltdown-hit Fukushima No. 1 nuclear power plant. People exposed to the maximum radiation dose for some 45 minutes will die. Tepco expects decontamination work to take at least one month.

Sept. 4-25 checks found the extremely high radiation levels at a cell that accommodates a pipe connected to the containment vessel of reactor 2 at the plant, which was devastated by the March 2011 earthquake and tsunami, Tepco said.

The highest contamination was detected on the floor. Details behind the situation are unknown, according to the company.

Tepco planned to start in August to check the inside of the containment vessel by using a remote-controlled robot but high radiation levels have stalled the examination.

**Extremely high radiation levels and the inability to grasp the details about melted nuclear fuel make it impossible for the utility to chart the course of its planned decommissioning of the reactors at the plant.**

November 5, 2015

## Steel wall seems to be effective

### TEPCO: Steel barrier reducing radioactivity at sea

[http://www3.nhk.or.jp/nhkworld/english/news/20151106\\_02.html](http://www3.nhk.or.jp/nhkworld/english/news/20151106_02.html)

The operator of the crippled Fukushima Daiichi nuclear power plant says the steel piling wall it built along the plant's coastal side is **reducing the amount of radioactive material in sea water**.

Tokyo Electric Power Company completed the 780-meter-long and 30-meter-deep piling wall along an embankment in late October.

The wall is designed to prevent contaminated groundwater at the plant site from flowing into the nearby harbor and sea.

TEPCO measured the levels of radioactive substances in the sea water along the embankment to determine the barrier's effects.

It says the level of beta-ray-emitting materials fell to 32 becquerels per liter on average early this month from 150 becquerels in mid-September.

The level of radioactive cesium was down to 10 becquerels from 16.

The level of radioactive strontium was 1.9 becquerels shortly before completion of the barrier compared to 140 becquerels in mid-September.

The operator says it will continue to check the levels of radioactivity near the embankment for some time to further confirm the effects of the steel wall.

November 6, 2015

## **Still leaking radioactive water**



## Photo Journal: Radioactive water still leaking from Fukushima plant



<http://mainichi.jp/english/english/newsselect/news/20151106p2a00m0na003000c.html>

A Fukushima prefectural council of experts and officials from municipalities surrounding the Fukushima No. 1 Nuclear Power Plant conduct an on-site inspection on Nov. 5, 2015, of work being done to replace drainage ditches after a series of incidents in which radiation-contaminated rainwater from the stricken nuclear station leaked into the Pacific Ocean. Council members inspected pumps that were installed by plant operator Tokyo Electric Power Co. (TEPCO) as an emergency measure upstream in the drainage canal. The canal leads directly to the ocean, and TEPCO is set to overhaul the system by March 2016 by replacing the canal with one that leads into the inner harbor.

On the same day as the inspection, a leak of at least 225 liters of radiation-tainted water was detected from pipes inside the turbine building of the plant's No. 2 reactor that transport highly radioactive water to Fukushima Harbor, prompting TEPCO to stop all transport of water. According to the utility, the water in this case did not leak into the outer seas. (Mainichi)

November 20, 2015

## New material to save time and money in dealing with contaminated water

### Researchers From UK's Imperial College Aim To Help In Fukushima Cleanup

<http://www.nucnet.org/all-the-news/2015/11/20/researchers-from-uk-s-imperial-college-aim-to-help-in-fukushima-cleanup>

20 Nov (NucNet): Researchers at Imperial College in London are collaborating with partners in the UK and Japan to develop processes for capturing and disposing of radionuclides in the approximately **3,700 tonnes of radioactively contaminated water collected every day** at the Fukushima-Daiichi nuclear site. Engineers on the site are using several decontamination facilities containing waste filters to extract radionuclides from the water, but as yet, the authorities do not have an agreed solution for safely immobilising this hazardous leftover waste material, the college said. It said a team from its centre for nuclear engineering is **developing a glass material to mix with the waste filters, which are melted to form a solid composite material that will be stable for thousands of years and suitable for disposal deep underground**. The team aims to determine whether this material will be able to withstand the heat generated by the radionuclides as they decay. **If it is sufficiently robust, this should mean the nuclear waste can be collected without the need for additional complicated processes for permanently sealing in the toxic material, processes that would be time consuming and expensive**. Since the March 2011 accident at Fukushima, water has been used to cool the damaged cores and reactor buildings. As part of the cooling process more than 3,760 tonnes of radioactively contaminated water is collected per day. Details online: <http://bit.ly/1PMeY6R>

November 24, 2015

## Giant vacuum cleaner for Fukushima Daiichi

## TEPCO using 'giant vacuum cleaner' to remove debris at crippled plant

November 24, 2015 (Mainichi Japan)



A giant vacuum cleaner-like device used to collect debris is seen. (Photo courtesy of Tokyo Electric Power Co.)

<http://mainichi.jp/english/articles/20151124/p2a/00m/0na/007000c>

Tokyo Electric Power Co. (TEPCO) has begun using a giant vacuum cleaner-like device to collect and remove debris from the No. 1 reactor building at the crippled Fukushima No. 1 Nuclear Power Plant. In October this year, work finished to remove cover panels that were installed over the building after the disaster. This month the vacuuming device will be used to remove relatively small debris like pieces of concrete. Afterwards, TEPCO will install a water sprinkling system to prevent the spread of dust that contains radioactive materials, as the company moves toward decommissioning the reactor. The vacuum device is held within a container measuring 6 meters long, 2.5 meters wide and 5.2 meters tall, and when assembled it weighs some 22 metric tons. The device is equipped with a stretchable and shrinkable nozzle and can suck up debris up to about 25 centimeters long and 20 kilograms in weight. The device will be lowered by crane from the top of the building as it is operated remotely. The collected debris will be stored according to radiation levels. TEPCO aims to begin extraction of fuel from the No. 1 reactor's spent fuel pool in fiscal 2020.

November 25, 2015

## (Just completed) wall to contain radioactive water leaning towards sea

### Groundwater wall at Fukushima plant leans slightly

[http://www3.nhk.or.jp/nhkworld/english/news/20151125\\_37.html](http://www3.nhk.or.jp/nhkworld/english/news/20151125_37.html)

The operator of the damaged Fukushima Daiichi nuclear plant has found that **a wall it built 30 meters into the ground to block the flow of radioactive water is leaning slightly.**

Tokyo Electric Power Company built the steel barrier along a coastal embankment to stop contaminated groundwater from seeping into the sea. The utility finished building the wall in late October.

TEPCO inspectors found that **the wall is leaning up to some 20 centimeters toward the sea. They say this is due to the pressure of the groundwater flow.**

The officials also blamed rising groundwater levels for cracks found in the embankment's pavement.

The utility says **workers are buttressing the wall with steel pillars. They are also repairing the cracks to keep out rainwater so groundwater levels don't rise further.**

TEPCO says the lean doesn't affect the wall's ability to block contaminated water.

December 5, 2015

## Spent fuel containers not strong enough for intended storage?

### Regulator probes fuel container strength at Fukushima nuclear plant

<http://mainichi.jp/english/english/newsselect/news/20151205p2g00m0dm033000c.html>

TOKYO (Kyodo) -- Japan's nuclear regulatory body said Friday it has launched an investigation into metallic spent fuel containers at Tokyo Electric Power Co.'s Fukushima Daiichi nuclear plant as they may not have sufficient strength.

Members of the Nuclear Regulation Authority raised the issue Friday at a meeting to discuss nuclear safety problems. The body will examine **whether the containers made by Kobe Steel Ltd. are safe for long-term use.**

**The nuclear regulation watchdog said it will also launch a probe at Japan Atomic Power Co.'s Tokai No. 2 nuclear power plant in Ibaraki Prefecture as the same type of fuel container may be used there.**

The fuel storages meet strength criteria set by the Japan Society of Mechanical Engineers. But **the metal plates inside them may not be strong enough for use in storing nuclear spent fuel.** TEPCO said it believes the strength of the containers meets the NRA's safety standards.

December 10, 2015

## High levels of radiation in tunnels

### Radiation spikes in Fukushima underground ducts

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the Fukushima Daiichi nuclear power plant says levels of radioactivity in underground tunnels have sharply risen.

Tokyo Electric Power Company has detected **482,000 becquerels per liter of radioactive cesium in water samples taken from the tunnels on December 3rd. That's 4000 times higher than data taken in December last year.**

The samples also contained **500,000 becquerels of a beta-ray-emitting substance, up 4,100 times from the same period.**

Around 400 to 500 tons of radioactive water, including seawater washed ashore in the March 2011 tsunami, is still pooled in the tunnels.

**The tunnels lie next to a structure used to temporarily store highly radioactive water, which cooled melted nuclear fuel inside the damaged reactors.**

TEPCO officials say it is unlikely the wastewater stored in the building has seeped into the tunnels.

They say the water level in the tunnels is higher than that in the building and measures are in place to stop the toxic water from leaking out.

They plan to investigate what caused the spike in radiation.

They say there has been no leakage out of the tunnels as radiation levels in underground water nearby have not risen.

December 11, 2015

## 4,000-fold radioactivity increase in Fukushima tunnels

### Radioactivity level rises 4,000-fold in duct water at Fukushima plant

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201512110041>

The concentration of radioactive materials in water in an underground duct at the Fukushima No. 1 nuclear plant soared 4,000 times from a year ago, Tokyo Electric Power Co. said.

TEPCO, operator of the crippled plant, said Dec. 9 that highly contaminated water stored at a nearby building may have leaked into the duct.

The utility said it found no increases in radioactivity levels in underground water in other areas, indicating the leak was limited to the duct.

According to TEPCO, about 420 tons of contaminated water amassed in the duct after the tsunami generated by the 2011 Great East Japan Earthquake inundated the plant with seawater.

A survey conducted on Dec. 11, 2014, found 94 becquerels of radioactive cesium-137 per liter in the underground duct. However, a survey on Dec. 3 this year found 390,000 becquerels per liter.

The cesium-137 reading in the contaminated water stored in the nearby building was 19 million becquerels per liter in a Nov. 3 survey.

TEPCO said it is considering pumping out the radioactive water in the duct and filling it with concrete.

December 15, 2015

## Decommissioning Fukushima no.1: A daunting task

### Fukushima decommission chief: 'No textbook' for cleanup

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201512150079>

THE ASSOCIATED PRESS

The man leading the daunting task of dealing with the Fukushima nuclear plant that sank into meltdowns in northeastern Japan warns with surprising candor: **Nothing can be promised.**

How long will it take to decommission the three breached reactors, and how will it be accomplished, when not even robots have been able to enter the main fuel-debris areas so far? How much will it ultimately cost? Naohiro Masuda, tapped last year as chief of decontamination and decommissioning for plant owner Tokyo Electric Power Co., acknowledges he is a long way from answering those questions definitively.

"This is something that has never been experienced. A textbook doesn't exist for something like this," Masuda told The Associated Press in an interview at TEPCO's Tokyo headquarters on Dec. 14.

It's only recently the daily situation at Fukushima No. 1 nuclear power plant has even started to approach "normal," he said. Since the March 2011 meltdowns, TEPCO has had to face one huge challenge after another, including storing masses of leaking radioactive water, clearing up rubble and removing fuel rods from a crumbled building.

"Before, it was a war zone," Masuda said quietly.

Masuda's approach contrasts with the sometimes ambitious, sometimes wishful announcements by the Japanese government, which pronounced the disaster "under control" as early as late 2011, just months after a devastating tsunami knocked out power to the plant, setting off the meltdowns.

But in June, the government and TEPCO acknowledged the target dates in the official "road map" for decommissioning had to be pushed back by about two years. Now even the most optimistic projections estimate the work will take about half a century.

Masuda said without hesitation that more delays could be in order. No one knows exactly where the melted nuclear debris is sitting in the reactors, let alone how exactly the debris might be taken out.

Computer simulation and speculative images are all he has so far.

New science will have to be invented for the plant to be cleaned up. Each step of the way, safety and consequences must be weighed, for workers and for the environment alike, Masuda added.

Under the latest plan, the removal of the fuel debris is expected to start within a decade. Still, Masuda likened such goals to reminders not to slack off, rather than hard deadlines based on real-life assessments. The March 2011 catastrophe is unprecedented. Unlike the 1979 partial meltdown at Three Mile Island in the United States, the containment, where the morass of fuel lies, has been breached at the Fukushima No. 1 plant. Radioactive water is piling up: 300 tons a day by the latest count. And as devastating as the 1986 Chernobyl disaster was in what is now Ukraine, that involved one reactor, not three.

When asked about what he wanted to tell the people worried about contaminated fish, such as on the West Coast of North and South America, Masuda said the radiation leak into the Pacific Ocean has been reduced to a level one-millionth of what it was in 2011.

That's equivalent to what is deemed safe for drinking water, he said. Some radiation will continue to leak through rainfall because rainwater will pick up radiation from the plant grounds, and some of it will eventually fall into the ocean.

"They don't need to worry, and, if there is anything to worry about, we will be out with that information," he said.

Masuda, who has worked for TEPCO for more than 30 years, won praise for preventing meltdowns or explosions at the Fukushima No. 2 nuclear power plant, a sister facility that also lost electricity after the 2011 tsunami. As then head of that plant, Masuda acted quickly and decisively, leading his team, despite the chaos unfolding, to connect the reactors to surviving power sources.

His company's image is much different. TEPCO's reputation in the Japanese public eye was badly tarnished because of its bumbling response in the early days of the disaster.

The utility has undergone a public bailout and has readied 2 trillion yen (\$17 billion) for decommissioning. The Japanese government has earmarked 54 billion yen of public funds for researching decommissioning technology through this fiscal year.

Such money doesn't include compensation or damage lawsuits. The Fukushima catastrophe spewed radiation into the air, ocean and surrounding areas through hydrogen explosions, and displaced some 100,000 people.

The way TEPCO is spending money has drawn some criticism from experts abroad. Unlike the U.S. system, there is **no open bid** or escrow fund in Japan to dole out the massive decommissioning funds.

**Much of the work is going to the Japanese manufacturers that constructed the plants, such as Toshiba Corp. and Hitachi Ltd., under long-term contracts. Some outside international consultants are involved, and some foreign companies have gotten water-decontamination and other contracts.**

Akira Tokuhiko, an American and nuclear expert who teaches at the University of Idaho, supports an open bidding process that invites more international expertise. He noted that Japan has no, or very little, decommissioning experience, compared to the Americans, the French and the Russians.

"An international effort has the potential to reduce both time and cost, while maintaining safety, transparency and cost," he said.

Douglas Chapin, of MPR, a U.S. nuclear engineering organization that has advised the American and Japanese nuclear industries, was less critical, defending the Japanese method as simply different.

Masuda said awarding contracts without opening bidding is what's best for Fukushima, and that TEPCO needs to take primary responsibility.

"We don't think competition is beneficial as that will mean people doing the work will keep changing," he said. "The system we have is better."

But Masuda also acknowledged that Japan has not done as good a job as it should have on relaying the harsh realities at the plant. He said it's his mission to relay all information, the good and the bad.

**"When I took this job, I promised to work as an interpreter, to relay our work in a way that's understandable to regular people, and to communicate within the company what people are interested in and worried about,"** he said.

"If the interpreter is good, the conversation will be lively. If the interpreter is good, dialogue will follow."

December 16, 2015

## New decontamination robot (2)





## **New Decontamination Robot for Fukushima Unveiled**

<http://www3.nhk.or.jp/nhkworld/english/news/nuclearwatch/20151216.html>

Engineers have unveiled a robot designed to facilitate decontamination work in reactor buildings at the crippled Fukushima Daiichi nuclear plant in northeastern Japan.

The developers showed the robot to the media on Wednesday. They include Mitsubishi Heavy Industries and the plant operator, Tokyo Electric Power Company.

The engineers say the new robot can reach upper floors and deep inside the buildings where other clean-up robots could not operate.

Decontamination work is needed before decommissioning the damaged reactors. Workers have used robots for the work in the past. But the need to supply materials to scrape off thin layers of contaminated surfaces has prevented the devices from reaching distant locations.

The new robot is made up of 4 devices connected by hoses and cables that can extend up to 65 meters. The front device is capable of decontamination work. The 2 central devices supply chemicals and other materials. And the last one is used for communication.

Each device has been made compact so the robot can operate deep inside reactor buildings.

Tokyo Electric officials say they hope to deploy the robot at the plant after April next year.

A Mitsubishi official says the robot is capable of cleaning upper floors, so he expects it to help advance work on the reactors.

December 17, 2015

## **No promises in Fukushima cleanup, director says**

<http://www.japantimes.co.jp/news/2015/12/17/national/no-promises-fukushima-cleanup-director-says/#.VnKDAr8R-id>

by Yuri Kageyama

AP

The man leading the daunting task of dealing with the Fukushima No. 1 nuclear plant warns with surprising candor: Nothing can be promised.[...]

## **Heat-resistant safety valves urgently needed**

### **TEPCO: Key pressure relief valves failed at No. 2 reactor during Fukushima disaster**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201512170031>

By MASANOBU HIGASHIYAMA/ Staff Writer

A set of critical valves designed to release pressure inside the No. 2 reactor at the Fukushima No. 1 nuclear power plant likely failed **due to surging temperatures and extreme stresses that built up in the early stage of the 2011 disaster**, the plant's operator said Dec. 17.

In its report on this specific aspect of the catastrophe, Tokyo Electric Power Co. concluded that the failure of the valves to reduce pressure likely prevented water from being injected into the reactor.

The accident was triggered by the magnitude-9.0 Great East Japan Earthquake that struck March 11, 2011, and spawned towering tsunami that inundated the site.

Workers at the plant attempted to open eight "pressure-releasing safety valves" early on the morning of March 15, but failed to release pressure inside the No. 2 reactor's containment vessel, TEPCO said. The pressure level was reduced around 1 a.m. only after one of the valves finally opened.

TEPCO, until now, has tried to confirm whether the valves, a key safety feature, functioned properly.

After a thorough analysis, the utility concluded that **the valves did not function as pressure inside the No. 2 reactor was too high.**

**The valves are designed to open under the pressure of nitrogen gas piped in from tanks and other sources.**

TEPCO concluded that the valves initially functioned properly after the earthquake and tsunami hit.

But after the meltdown of nuclear fuel inside the reactor, heat and pressure levels rose significantly in the late hours of March 14, preventing the valves from opening.

**The rising heat inside the reactor likely caused sealing materials and other bits of equipment to disintegrate, apparently leading to nitrogen gas leakage.**

## **Melting of key parts blamed for Fukushima meltdown**

[http://www3.nhk.or.jp/nhkworld/english/news/20151217\\_05.html](http://www3.nhk.or.jp/nhkworld/english/news/20151217_05.html)

The operator of the Fukushima Daiichi power plant says excessive heat from nuclear fuel at one of its damaged reactors may have caused some key parts to melt.

Officials at Tokyo Electric Power Company believe the loss of those components made it difficult to stop the Number 2 reactor from melting down and spewing out large amounts of radioactive substances following the March 2011 accident.

Four days after the onset of the accident, the emergency cooling system at the reactor stopped working.

In an attempt to cool fuel inside the reactor, the workers had no choice but to pour in water from a fire engine.

But they were unable to inject water as planned because of the high pressure that had built up inside the reactor.

The officials also could not use safety relief valves to release pressure. Those valves were designed to open when hit by high-pressure gas from a tank.

**The TEPCO analysis determined that key parts of the gas feeding system may have melted, leading to a**

gas leak. The analysis says the temperature inside the reactor exceeded 200 degrees Celsius, far beyond the limit of the parts' durability.

Those parts are present in all other reactors in the model line used at the Fukushima Daiichi plant. The utility plans to replace the parts at its other nuclear power plant in central Japan with heat-resistant ones.

## Melting of key parts: Nuclear Watch video



### Melting of Key Parts Blamed for Fukushima Meltdown

<http://www3.nhk.or.jp/nhkworld/english/news/nuclearwatch/20151217.html>

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## TEPCO "explains" mid-March 2011 leak

### TEPCO: Leak likely from No.3 reactor

[http://www3.nhk.or.jp/nhkworld/english/news/20151217\\_27.html](http://www3.nhk.or.jp/nhkworld/english/news/20151217_27.html)

The operator of the Fukushima Daiichi nuclear plant says radioactive fallout that polluted the environment in mid-March of 2011 was likely caused by a leak directly from a containment vessel of the facility's No.3 reactor.

Officials of Tokyo Electric Power Company, or TEPCO, on Thursday reported their latest findings on what happened at the plant in northeast Japan during the 2011 crisis.

Workers at the plant repeatedly vented the vessel after the March 11th accident to release water vapor and reduce pressure in the container.

But TEPCO officials said data showed only a moderate drop in pressure after a third venting at 9 PM on March 13th, indicating that operations failed after that.

They concluded that radioactive contamination of the environment between the night of March 14th and the 16th was likely caused not by the vent operations but failure of the vessel.

They said the vessel likely lost airtightness due to heat from nuclear fuel, leading to the direct release of radioactive substances into the environment.

Studies to locate the exact cause of the pollution are still underway as **some experts disagree with the TEPCO report.**

December 18, 2015

## Too much salt for water to be decontaminated

## Steel barrier creating more contaminated water

[http://www3.nhk.or.jp/nhkworld/english/news/20151218\\_27.html](http://www3.nhk.or.jp/nhkworld/english/news/20151218_27.html)

The operator of the Fukushima Daiichi nuclear plant says a steel barrier that it built along the plant's embankment is causing an unexpected problem.

Tokyo Electric Power Company, or TEPCO, **installed the steel piling wall in October to prevent contaminated groundwater from flowing into the sea.**

The utility had planned to pump up the blocked water, remove radioactive materials from most of it, and release it into the sea.

But on Friday, TEPCO officials told nuclear regulators that **the water has too high a salt content to be processed by decontamination equipment.**

They also said **the amount of pumped-up water was larger than expected. The officials say workers are therefore releasing the water not into the sea, but into reactor buildings. They say the amount is about 400 tons per day.**

The utility had previously been reducing the flow of water into the plant's buildings.

Workers have been pumping up groundwater from wells inside the compound, and had managed to reduce its inflow into buildings from 400 tons to 200 tons per day.

TEPCO says it plans to pump up more groundwater upstream so that less reaches the embankment.

It says it will also try to process the salty water by monitoring changes in its quality.

December 26, 2015

## From bad to worse

### TEPCO confronts new problem of radioactive water at Fukushima plant

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201512260045>

By HIROMI KUMAGAI/ Staff Writer

Tokyo Electric Power Co. has unexpectedly been forced to deal with an increasingly large amount of radioactive water accumulating at the crippled Fukushima No. 1 nuclear power plant after seaside walls to block the flow of groundwater were constructed in October.

TEPCO completed the walls on Oct. 26 to block contaminated groundwater from flowing into sea. The utility began pumping up groundwater from five wells dug between the walls and the plant's reactor buildings. **The plan called for releasing the less contaminated water into the sea after a purification process, but TEPCO discovered that the water had larger amounts of radiation than it had expected.** TEPCO officials said the situation has left the utility with no option but to transfer 200 to 300 tons of groundwater each day into highly contaminated reactor buildings since November, a move that could further contaminate the water.

**Comprised of numerous cylindrical steel pipes measuring 30 meters tall, the seaside walls were installed on the coastal side of the No. 1 to No. 4 reactor buildings to block contaminated groundwater flowing out of the highly contaminated buildings from reaching the ocean.**

To control groundwater levels, TEPCO planned to release the less contaminated groundwater from the five wells into sea after a purification process.

However, the water from four of the wells was discovered to have high levels of tritium--a radioactive substance that is hard to remove--at levels higher than 1,500 becquerels per liter, which means the water cannot be released into sea.

To compound the problem, **the seaside walls have also significantly raised groundwater levels, forcing the utility to pump a lot more groundwater than it originally planned.**

**TEPCO has been forced to temporarily transfer large amounts of the groundwater into highly contaminated reactor buildings, where it could become contaminated to an even further degree by being exposed to melted nuclear fuel.**

The utility said it suspects the high levels of radiation found in the groundwater from the wells is due to the water being exposed to highly contaminated soil near the plant's coastal embankment.

To reduce the amount of contaminated water at the plant, TEPCO began operations in September to pump up the groundwater in wells constructed around the reactor buildings to release it into the sea after a purification process.

The company initially announced that the project had reduced the amount of groundwater flowing into the contaminated reactor buildings from 300 tons to 200 tons a day.

The increasing amount of contaminated water has been stored in tanks constructed in the plant's compound after going through operations to reduce contamination.

TEPCO plans to increase the amount of water it pumps from wells located elsewhere on the plant site to help reduce the amount of contaminated groundwater accumulating in the seaside wells.

**Company officials admitted they are not sure when it can turn things around and reduce the amount of contaminated water at the Fukushima plant.**

December 29, 2015

## **Fox finds its way into No.2 reactor building (2)**



Security camera footage shows the animal inside the No. 2 reactor building of the Fukushima No. 1 nuclear power plant on Dec. 21. The circular door in the background is the carry-in entrance to the reactor's containment vessel. (Provided by Tokyo Electric Power Co.)

## **Animal spotted prowling inside Fukushima nuclear plant's reactor building**

[http://ajw.asahi.com/article/behind\\_news/social\\_affairs/AJ201512290056](http://ajw.asahi.com/article/behind_news/social_affairs/AJ201512290056)

By KOJI KITABAYASHI/ Staff Writer

A fox appears to have been traipsing around a highly radioactive area inside a reactor building at the crippled Fukushima No. 1 nuclear power plant, Tokyo Electric Power Co. said Dec. 28.

The plant operator said a security camera mounted at a section **next to the containment vessel** of the No. 2 reactor captured footage of the animal around 6 a.m. on Dec. 21. It said the creature appeared intermittently for seven to eight minutes.

Although the animal's den and current whereabouts remain unknown, a TEPCO official said the intrusion is unlikely to adversely affect work being done in preparation for decommissioning the reactor.

According to TEPCO, the security camera showed the 1.3-meter-long animal wandering back and forth near the carry-in entrance to the reactor's containment vessel.

The area where the animal was spotted is highly radioactive, with a maximum of 10 sieverts of radiation per hour being detected. Entry by humans is strictly restricted.

Decontamination work in the area is being done using robots.

Although **the infiltration route has not yet been determined**, the official said: "It is possible the animal entered via a gap through which cables are passed or a damaged door which has remained unrepaired since the Fukushima nuclear disaster (in 2011)."

December 31, 2015

## Helpless efforts to reduce radioactive water

### Radiation contaminated water at Fukushima plant on the rise

<http://mainichi.jp/english/articles/20151231/p2a/00m/0na/022000c>

FUKUSHIMA -- **Efforts to reduce the amount of radiation contaminated water at the crippled Fukushima No. 1 Nuclear Power Plant have proven helpless, and the overall amount of such water has actually increased**, it has been learned.

Tokyo Electric Power Co. (TEPCO), the operator of the plant, had initially planned to halve the daily amount of contaminated groundwater to 150 metric tons by pumping up groundwater from wells called "groundwater drains" on the ocean side and "subdrains" inland. However, because the pumped water was found to be highly radioactive, the utility was unable to release it into the ocean, resulting in **up to around 400 tons a day of tainted water being transferred back to the side of reactor buildings**.

TEPCO started pumping up groundwater from the ocean-side drains in October, but gave up on releasing the water into the ocean after detecting a high concentration of radioactive materials and salt content in the water pumped from four of the five wells on the plant premises. Meanwhile, the amount of groundwater increased after its flow was stemmed by the 780-meter-long seaside impermeable wall, which is designed to prevent tainted groundwater from flowing out into the ocean. **The resultant high water pressure warped the impermeable wall by about 20 centimeters, prompting TEPCO to reinforce the wall**.

While TEPCO had boasted that it was able to significantly reduce risks at the plant thanks to the completion of the impermeable wall, the situation still remains unstable.

**"We ended up building extra tanks** (due to the increase of overall contaminated water), but we will never leak such water to the outside," Naohiro Masuda, president of TEPCO's Fukushima Daiichi Decommissioning Co., told a press conference.

TEPCO aims to cut the influx of groundwater into reactor buildings to somewhere under 100 tons a day by the end of fiscal 2016, and ultimately make the daily increase of tainted water close to zero by the end of 2020 -- the year of the Tokyo Olympics and Paralympics -- by putting the multi-nuclide removal equipment called ALPS into operation. TEPCO is planning to complete the entire decommissioning process by 2041-2051.



January 2, 2016

## Robot to be used to capture images of fuel in reactors

### TEPCO to tackle removal of molten nuclear fuel

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the crippled Fukushima Daiichi nuclear power plant is expected to take on the challenge of removing the molten fuel from reactors that suffered meltdowns in 2011.

Soon it will be nearly five years since the massive earthquake and tsunami triggered a nuclear accident at the plant.

Workers have not been able to determine the extent of damage or find the molten fuel at the No.1, 2 and 3 reactors. Experts believe some of the fuel penetrated the reactor cores and is sitting at the bottom of the respective containment vessels.

**TEPCO officials will bring in a remote-controlled robot that can withstand extremely high radiation levels to capture images of the fuel at the No. 2 reactor as early as next month. A similar undertaking is to take place at the No. 1 reactor.**

The officials will then decide ways to remove the fuel. Filling the reactor containment vessels with water before extracting it is one option to shield workers from the intense radiation.

TEPCO's Chief Decommissioning Officer Naohiro Masuda says removing the fuel is their final goal. He added that **finding its whereabouts would be a big step toward decommissioning the plant.**

January 27, 2016

## Reducing 20-km ban radius?

### Fukushima fishermen to expand operations off crippled nuclear plant

<http://www.japantimes.co.jp/news/2016/01/27/national/fukushima-fishermen-to-expand-operations-off-crippled-nuclear-plant/#.VqkknFKDmot>

JII

FUKUSHIMA – Fishermen in Fukushima Prefecture said Wednesday they plan to scale down their self-imposed fishing ban in waters off the damaged nuclear power plant due mainly to a **substantial decline in radioactive cesium levels.**

**The Fukushima Prefectural Federation of Fisheries Cooperative Associations is considering narrowing the area subject to the ban to a 10-kilometer radius from the Fukushima No. 1 nuclear power plant from the current 20-kilometer radius.**

The move comes as plant operator Tokyo Electric Power Co. last autumn completed the construction of a shielding wall to prevent leaks of contaminated groundwater into the sea. Since the completion, radiation levels in sea waters at the plant's port have been declining.

In addition, **prefectural research shows the radioactive cesium levels of marine products caught in coastal areas have dropped substantially.**

The proportion of marine products with cesium levels exceeding the state standards of 100 becquerels per kilogram fell to less than 0.1 percent last year from some 40 percent between April and December 2011, soon after the nuclear accident at the plant in March that year. No products have surpassed the level in checks since last April.

The federation is scheduled to make a **final decision late next month.** "The environment of the seas of Fukushima has improved, and conditions for reviving fisheries are being laid out," federation leader Tetsu Nozaki told reporters.

After the tsunami-triggered triple meltdown at the nuclear plant, the federation voluntarily halted all of its coastal fishing. In June 2012, it started trial operations in a limited area, which has since expanded in steps.

January 29, 2016

## Poor visibility: Robot inspections delayed

### TEPCO delays robotic surveys at Fukushima nuclear reactors

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201601290050>

By HIROMI KUMAI/ Staff Writer

Tokyo Electric Power Co. has postponed inspections by robots to finally confirm the location and state of melted fuel at two damaged reactors of the Fukushima No. 1 nuclear plant.

The camera-equipped robots were scheduled to enter the containment vessels of the No. 1 and No. 2 reactors within fiscal 2015, which ends in March. But TEPCO said Jan. 28 that a series of unexpected circumstances, such as poor visibility caused by murky radioactive water, have ruined that plan.

The robot for the No. 1 containment vessel will be redesigned, and the remote-controlled survey will be conducted in fiscal 2016, the utility said, without offering a more specific timetable.

Nuclear fuel assemblies in the No. 1 to No. 3 reactors are believed to have melted and fallen to the bottom of the containment vessels following the March 2011 earthquake and tsunami.

Radiation levels inside the containment vessels remain extremely high, making them too dangerous to be approached by workers.

The remote-controlled robotic probe was seen as crucial in determining conditions inside the containment vessels for the eventual decommissioning of the nuclear plant.

TEPCO conducted a preliminary survey using an industrial endoscope in the containment vessel of the No. 1 reactor. It found accumulated waste turned the water murky and blocked the view.

For the No. 2 reactor, TEPCO had planned to locate the melted nuclear fuel using a robot last summer. But decontamination and cleanup work near the entrance to the containment vessel proved difficult. That prevented TEPCO from carrying out robotic survey as planned.

## Ice wall almost finished

### Fukushima ice wall near completion

[http://www3.nhk.or.jp/nhkworld/english/news/20160129\\_04.html](http://www3.nhk.or.jp/nhkworld/english/news/20160129_04.html)

An underground ice wall designed to curb the buildup of radioactive water at the Fukushima Daiichi plant will see near completion on Friday. But it's not yet clear when it can be put into service as the nuclear regulator has not yet given a green light to its use.

The barrier will almost be finished Friday. Only the last procedure, which involves filling underground pipes with coolant, remains.

**The wall made of frozen soil stretches about 1.5 kilometers around 4 reactor buildings.**

Tokyo Electric Power Company aims to cut the amount of groundwater that seeps into the buildings and then becomes contaminated. The utility expects the barrier to reduce the inflow to 10 tons a day. That's less than one tenth the current level.

**The project to build the wall began in June 2014 at a cost of about 290 million dollars from the national coffers. The plan is to start operation by the end of March.**

**But the Nuclear Regulation Authority has not given its approval. It fears radioactive water could leak from the reactor buildings if the wall makes the level of groundwater lower than that of contaminated water.**

TEPCO says it will closely monitor groundwater levels and inject water if the levels fall too far.

**But the regulator insists changes in groundwater levels could cause unintended consequences.**

## Kurion and tritium removal

### An innovative method for tritium removal.

<http://www.bloomberg.com/news/articles/2016-02-04/how-kurion-plans-to-clean-up-fukushima-s-tritium-nuclear-waste>

By Caroline Winter  
*From Bloomberg Business*

**Innovator:** Gaëtan Bonhomme

**Age:** 39

Chief technology officer at Kurion, a nuclear waste cleanup company with 200 employees that was acquired on Feb. 3 by Veolia, a French waste company

#### Form and function

Tritium is an especially tough nuclear waste to remove, because it's a form of hydrogen and naturally bonds with water molecules. Kurion's hardware separates contaminated water into component elements.

#### Background

In 2014, Kurion began removing strontium from 400,000 tons of contaminated water at Japan's Fukushima nuclear power plant.

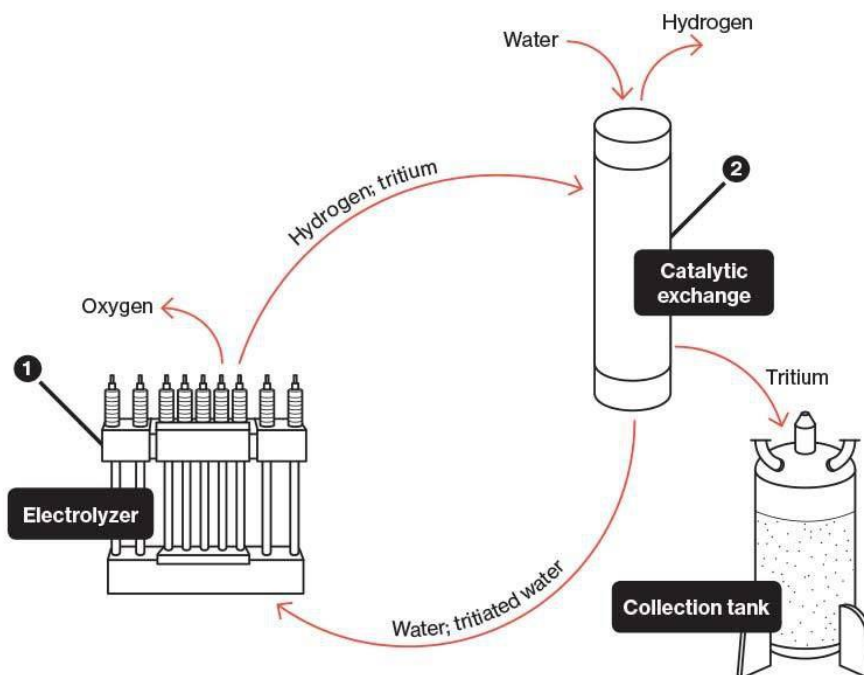


Illustration: 731

#### 1. Separation

An electrolyzer splits the water's oxygen molecules off from its contaminated hydrogen. The oxygen exits

through one of the device's tubes, while the hydrogen and tritium gas flows into a catalytic exchange column, where it's combined with water.

## **2. Reduction**

Kurion's proprietary equipment keeps the hydrogen isolated in an ever smaller amount of water cycled through the exchange column. The net effect: 99 percent less contaminated water.

## **Revenue**

Bonhomme says Kurion took in about \$100 million last year selling cleanup equipment and services, like using chemicals and heat to turn toxic waste into glass.

## **Funding**

Japan's economic ministry has granted the company \$8.3 million for research.

## **Next Steps**

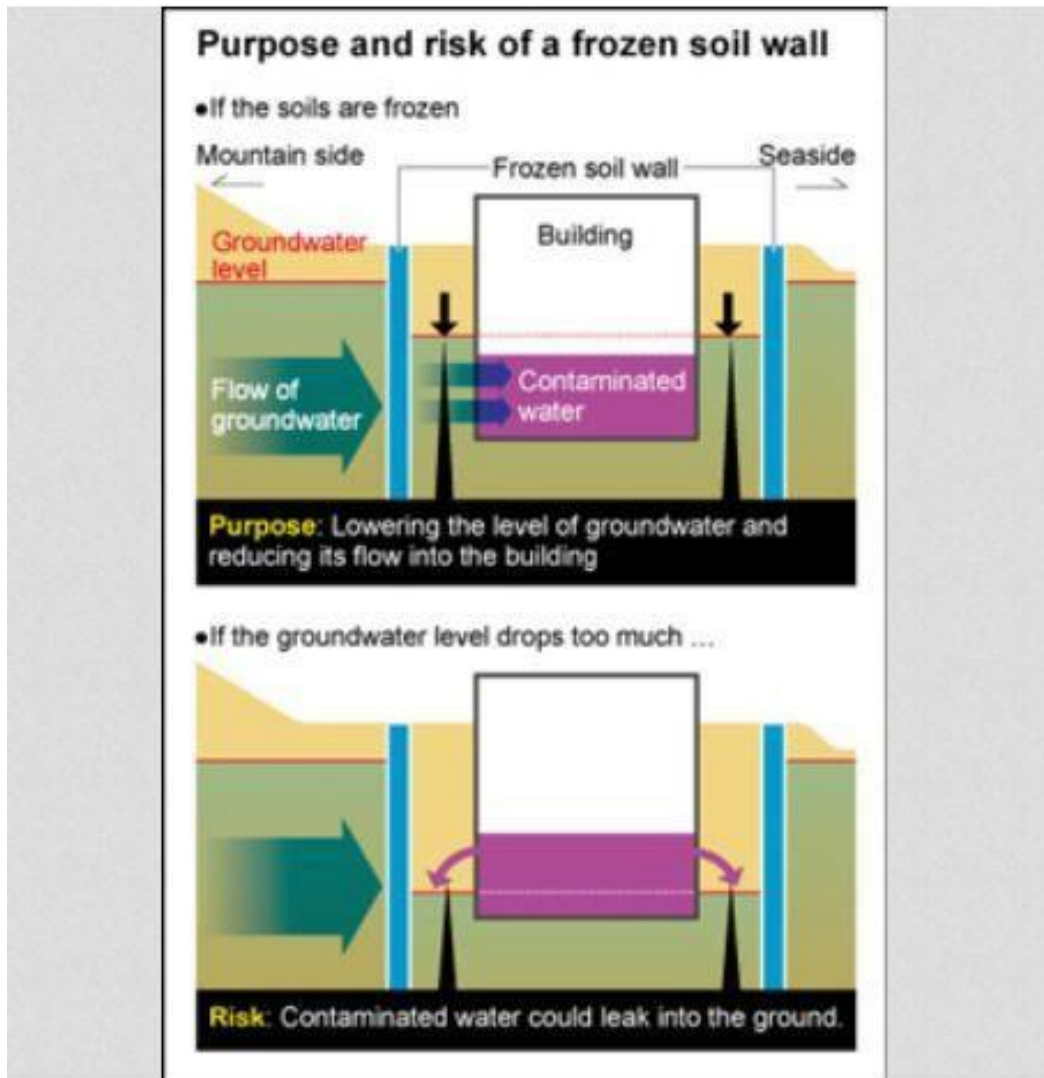
To show it can handle the tritium at Fukushima, Kurion brought a large-scale demo online at its Richland, Wash., office late last year. Kurion says it could begin processing Fukushima's tritium-contaminated water in as little as 18 months, but that Japan's government will likely take until 2018 to evaluate its technology. "We expect to be processing tritium-contaminated water in the U.S. before then," says Bonhomme. (Corrects the amount of time it could take to begin processing tritium-laced water at Fukushima in the last paragraph.)

February 10, 2016

## **NRA opposes TEPCO's frozen wall**

### **NRA calls a halt to TEPCO's plan to freeze soil at Fukushima plant**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201602100079>



By HIROMI KUMAI/ Staff Writer

The nation's nuclear watchdog has put the kibosh on plans by Tokyo Electric Power Co. to start freezing underground soil at the crippled Fukushima No. 1 nuclear power plant--**a stunningly expensive project** intended to solve the crisis of accumulating radioactive groundwater at the site.

TEPCO has maintained that once the soil is frozen, it will form a circular barrier and reduce the flow of groundwater into the reactor buildings; and that, in turn, will prevent water contaminated with radioactive substances from accumulating.

But the Nuclear Regulation Authority contends that contaminated water accumulated in the reactor buildings could leak into the groundwater if the level inside the frozen soil wall drops too much.

TEPCO planned to construct a 1,500-meter-long frozen soil wall around the four reactor buildings by inserting 1,568 pipes to a depth of 30 meters at 1-meter intervals. Each pipe will freeze the soil around it once liquid of minus 30 degrees circulates inside the cylinder.

On Feb. 9, TEPCO completed the last part of the project to install temperature indicators, allowing it to start freezing the soil at a moment's notice.

Groundwater is continuing to flow into basements of reactor buildings with melted nuclear fuel, adding to the amount of highly contaminated water being produced.

In May 2013, a committee of the Ministry of Economy, Trade and Industry drew up a report on the merits of constructing a frozen soil wall to reduce the volume of contaminated water.

Based on the report, TEPCO started the construction work in June 2014. The government has already spent about 34.5 billion yen (\$300 million) on the project.

TEPCO maintained that once the frozen soil wall is completed, it should reduce the flow of groundwater into the reactor buildings from about 400 tons a day to 100 tons in tandem with other measures, including work to pump out groundwater from wells dug around the reactor buildings.

**From the outset, the NRA cast doubt on the effectiveness of the frozen soil wall, saying that highly contaminated water accumulated in reactor buildings could leak into the ground if the groundwater level inside the wall drops too much.**

The NRA repeatedly asked TEPCO whether the frozen soil wall would prove truly effective in reducing the amount of contaminated water.

“TEPCO is scattering a strange illusion that the problem of contaminated water can be solved completely if a frozen soil wall is constructed,” NRA chairman Shunichi Tanaka said in spring 2015.

In a test operation which started that spring, the reduction of groundwater levels was larger than expected in some places. The speed and direction of the groundwater flow could not be clarified in some locations.

**Because it takes two months or so for the soil to thaw out, countermeasures cannot be taken immediately if problems crop up.**

TEPCO acknowledges that there are limits to its crystal ball-gazing with regard to the problem of groundwater. However, it contends that it can prevent contaminated water from leaking into the groundwater by pouring water into the ground through wells if the level drops too much.

In December, the NRA took the rare move of proposing to TEPCO in a written document that the utility operate the frozen soil wall only in places where contaminated water is unlikely to leak into the ground. However, TEPCO dug in its heels and said it intended to operate the frozen soil wall as a whole. But it also plans to consider the NRA’s proposal.

On Feb. 9, TEPCO President Naomi Hirose visited the NRA office and told Tanaka, “We will consider your proposal and get back to you in a most sincere manner.”

## Only "the first stage of a mountain"

### **Nuclear plant head says another disaster would not threaten cleanup**

<http://www.japantimes.co.jp/news/2016/02/10/national/fukushima-nuclear-plant-head-says-another-disaster-would-not-threaten-cleanup/#.Vrtk3VKDmot>



A worker wearing a protective suit and mask is seen from a bus transporting journalists during a media tour near the No. 3 reactor building at Tokyo Electric Power Co's tsunami-crippled Fukushima No. 1 nuclear power plant in Fukushima Prefecture on Wednesday. | AFP-JIJI/POOL

AFP-JIJI

The chief of Japan's shuttered Fukushima nuclear power plant warned Wednesday that the biggest risk the crippled facility faces is another major earthquake and tsunami — though he insisted the chaos of nearly five years ago would not be repeated.

On March 11, 2011, a magnitude 9.0 undersea earthquake off the northeastern coast of Honshu sparked a massive tsunami that swamped cooling systems and triggered reactor meltdowns at the Fukushima No. 1 plant, run by operator Tokyo Electric Power Co.

Radiation spread over a wide area and forced tens of thousands of people from their homes — many of whom will likely never return — in the worst nuclear disaster since Chernobyl in 1986.

Now with the fifth anniversary of the disaster approaching next month, Tepco opened up the facility to journalists on Wednesday to provide an update on the cleanup process, which is expected to take decades.

"If a major earthquake hits and then a tsunami comes again, that would be the most tense moment for us," Akira Ono, head of the plant, told reporters when asked what would be the greatest risk to the plant.

Tepco has been blamed for a delay in securing power to cool fuel in the reactors that triggered meltdowns and subsequent hydrogen explosions that spewed radiation over the area and forced residents to flee.

"But we will not fall into confusion like before," Ono said, explaining that **energy levels at the plant are much lower than those after the accident, while the company has carried out disaster drills to prepare.**

He also said **the firm had built temporary coastal barriers that can block waves of up to 15 meters, matching levels of the 2011 tsunami.**

Some 8,000 workers, ranging from nuclear experts to civil engineers, are still battling daily to control the reactors that melted down, as their decommissioning process is still in the initial stage.



Some progress has been made as massive wreckage, including overturned vehicles, was removed and workers are no longer required to wear full-face masks in many areas of the site.

In a newly built rest station inside the facility, workers can have hot meals and check their radiation exposure levels through state-of-the-art whole-body counters.

But the scar of the catastrophe is still visible in other areas as steel frames gnarled by the hydrogen explosions can be seen at the plant's No. 3 reactor, where radiation levels are still extremely high.

About 1,000 huge tanks for storing contaminated cooling water occupy large parts of the site some 230 km northeast of Tokyo.

And more tanks will be needed as massive amounts of groundwater flows into the reactors each day and mixes with the cooling water.

Ono, the plant chief, says the reactors are now stable but need to be kept cool to prevent them running out of control again.

Tepco estimates that it is likely to take up to four decades to completely clean up the site, but some experts warn the unprecedented decommissioning may be delayed further.

**"I feel like we have just climbed over the first stage of a mountain," Ono said, using a colloquial Japanese expression meaning that only 10 percent of the journey is finished.**

## Washington Post on Fukushima cleaning



### **How is Fukushima's cleanup going five years after its meltdown? Not so well.**

[https://www.washingtonpost.com/world/asia\\_pacific/five-years-after-nuclear-meltdown-no-one-knows-what-to-do-with-fukushima/2016/02/10/a9682194-c9dc-11e5-b9ab-26591104bb19\\_story.html](https://www.washingtonpost.com/world/asia_pacific/five-years-after-nuclear-meltdown-no-one-knows-what-to-do-with-fukushima/2016/02/10/a9682194-c9dc-11e5-b9ab-26591104bb19_story.html)

By Anna Fifield

FUTABA, Japan — Seen from the road below, the Fukushima Daiichi nuclear power station looks much as it may have right after the catastrophic earthquake and tsunami that caused a triple meltdown here almost five years ago.

The No. 3 reactor building, which exploded in a hydrogen fireball during the disaster, remains a tangle of broken concrete and twisted metal. A smashed crane sits exactly where it was on March 11, 2011. To the side of the reactor units, a building that once housed boilers stands open to the shore, its rusted, warped tanks exposed.

The scene is a testament to the chaos that was unleashed when the tsunami engulfed these buildings, triggering the world's worst nuclear disaster since the one at Chernobyl, in Ukraine, in 1986. Almost 16,000 people were killed along Japan's northeastern coast in the tsunami, and 160,000 more lost their homes and livelihoods.

Tokyo Electric Power Co. (Tepco), the utility company that runs the Fukushima plant and drew fierce criticism for its handling of the disaster, says the situation has improved greatly.

A worker leaves a room with shelves lined with helmets at the plant. The Tepco utility still faces enormous challenges in connection with the disposal of contaminated water, soil and nuclear fuel debris. (Toru Hanai/Reuters)

"In the last five years, radiation levels have been reduced substantially, and we can say that the plant is stable now," said Akira Ono, the Tepco plant superintendent.

Efforts to contain the contamination have progressed, according to Tepco, including the completion Tuesday of a subterranean "ice wall" around the plant that, once operational, is meant to freeze the ground and stop leakage. Moves to decommission the plant — a process that could take 30 or 40 years, Ono estimated — are getting underway.

People will be allowed to return to their homes in the nearby town of Naraha next month and to Tomioka, even closer to the plant, next year. For now, Tomioka and neighboring Okuma remain ghost towns, lined with convenience stores, fast-food restaurants and gambling parlors that haven't had a customer in five years. Bicycles lean near front doors, and flowerpots sit empty on windowsills.

A sign on the road to the plant showed a radiation reading of 3.37 microsieverts per hour, at the upper end of safe. At a viewing spot overlooking the reactor buildings, it shot past 200, a level at which prolonged exposure could be dangerous. Both readings are hundreds of times lower than they were a couple of years ago.

After about 20 minutes at the viewing spot, a Tepco official hustled visiting reporters, wearing protective suits, onto a bus. "We don't want you out here too long," he said. Below, men continued working on the site.

But one huge question remains: What is to be done with all the radioactive material?

A worker is seen from a bus carrying members of the media near the No. 3 reactor building at the plant on Wednesday. (Toru Hanai/Reuters)

There's the groundwater that is flowing into the reactor buildings, where it becomes contaminated. It has been treated — Tepco says it can remove 62 nuclides from the water, including strontium, which can burrow into bones and irradiate tissue. It cannot filter out tritium, a radioactive isotope of hydrogen that can be used to make nuclear bombs but is not considered especially harmful to humans.

The water initially was stored in huge bolted tanks in the aftermath of the disaster, but the tanks have leaked highly contaminated radioactive water into the sea on an alarming number of occasions. Now Tepco is building more-secure welded tanks to hold the water, theoretically for up to 20 years. There are now about 1,000 tanks holding 750,000 tons of contaminated water, with space for 100,000 tons more. The company says it hopes to increase capacity to 950,000 tons within a year or two, as well as halve the amount of water that needs to be stored from the current 300 tons per day. As part of those efforts, Tepco built the 1,500-yard-long ice wall around the four reactor buildings to freeze the soil and keep groundwater from getting in and becoming radioactive. Company officials hoped to have the wall working next month; on Wednesday, however, Japan's nuclear watchdog blocked the plan, saying the risk of leakage was still too high. The options for getting rid of the contaminated water include trying to remove the tritium from it before letting it run into the sea; evaporating it, as was done at Three Mile Island, the Pennsylvania plant that melted down in 1979; and injecting it deep into the ground, using technology similar to that used to extract shale gas. A government task force is considering which option to choose.

"These all have different advantages and disadvantages; they have different costs and different social acceptance," said Seiichi Suzuki, manager of tank construction at the plant.

Then there's the radioactive soil that has been collected from areas around the Fukushima Daiichi plant during cleanup efforts. More than 700 million cubic feet of soil — enough to fill 8,000 Olympic-size swimming pools — has been packed into large black plastic bags and is being stored, row upon row, in local fields.

More than 700 of the bags, which contain radioactive cesium isotopes, were swept away during floods last year, some ending up in rivers 100 miles away. The government has said that 99.8 percent of the soil can be recycled.

Finally, and most problematically, there's the nuclear fuel from the plant itself.

The fuel that melted down remains in containment vessels in its reactors, and this part of the plant is so dangerous to humans that robots are used to work there. Getting to this fuel and removing it safely is a task that will take decades.

Asked about the decommissioning process, Tepco's Ono said the work was about 10 percent done.

"The biggest challenge is going to be the removal of the nuclear fuel debris," he said. "We don't even know what state the debris is in at the moment."

Japan does not have a nuclear waste dump, and there is vehement resistance to disposing of contaminated material on land.

As a result, one of the options the government is considering is building a nuclear waste dump under the seabed, about eight miles off the Fukushima coast. It would be connected to the land by a tunnel so it would not contravene international regulations on disposing of nuclear waste into the sea. A government study group is set to report on that proposal by the end of the summer.

Many groups, from fishermen to anti-nuclear activists, staunchly oppose the idea of burying the radioactive material at sea in such a seismically active area.

"At some point it would leak and affect the environment," said Hideyuki Ban, co-director of the Citizens' Nuclear Information Center. "Some say it'll be fine, as it will be diluted in the ocean, but it's unclear whether it will be diluted well. If it gets into fish, it could end up on someone's table."

Aileen Mioko Smith, executive director of Green Action, a Kyoto-based anti-nuclear group, agreed.

“The seabed is just like land. It’s not flat, but has mountains and valleys,” she said. “Japan sits on multiple tectonic plates and is earthquake-prone. It’s too easy to think, ‘If not on land, how about the seabed?’ ” Yuki Oda in Tokyo contributed to this report.

February 13, 2016

## 1,106 water tanks: Rapidly running out of space



Rows of massive tanks storing radiation contaminated water line the compound of the Fukushima No. 1 nuclear power plant in early February. (Satoru Semba)

**PHOTO: More than 1,100 water storage tanks at Fukushima plant ... and counting**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201602130025>

By SATORU SEMBA/ Staff Writer

OKUMA, Fukushima Prefecture--From the air, the rows of different colored water storage tanks at the crippled Fukushima No. 1 nuclear power plant resemble a giant integrated circuit board.

As the fifth anniversary approaches of the earthquake and tsunami disaster that unleashed the nuclear catastrophe, **the stricken facility is fast running out of space to position the tanks holding highly contaminated radioactive water.**

**As of Feb. 12, there were 1,106 massive water tanks on the premises.**

Tokyo Electric Power Co., operator of the plant, constructed the tanks to store radiation-contaminated water that has been accumulating at the plant since the disaster unfolded in March 2011.

**The utility plans to construct 20 more water storage tanks to accommodate 30,000 tons of water that is expected to be generated in the remaining months of 2016.**

**As the tanks occupy much of the parking lots, green spaces and vacant areas, TEPCO has no choice but to build new tanks in the narrow alleys between the huge containers.**

The accumulation of contaminated water has been a persistent problem at the plant, which is only in the very early stages of decommissioning, a process that will take 30 to 40 years.

February 15, 2016

## Short video on Fukushima plant

### Scars from 2011 disaster still visible at crippled Fukushima nuclear plant

<http://mainichi.jp/english/articles/20160215/p2a/00m/0na/020000c>

2 minute-video

FUKUSHIMA -- Mainichi Shimbun reporters entered the crippled Fukushima No. 1 Nuclear Power Plant on Feb. 12 ahead of the fifth anniversary of the Great East Japan Earthquake and ensuing tsunami.

The levels of radiation dosage remained high around No. 1 to 3 reactors that melted down, still showing scars from the disaster.

## Revised plan for underground icewall

### TEPCO revises plan on contaminated groundwater

<http://www3.nhk.or.jp/nhkworld/english/news/nuclear.html>

The operator of the Fukushima Daiichi nuclear power plant has drafted a new plan to deal with contaminated groundwater, in an effort intended to prevent leaks into the sea.

Tokyo Electric Power Company presented the revised plan on an underground ice wall to the country's Nuclear Regulation Authority on Monday.

A large volume of groundwater is continuing to flow into the site and the damaged reactor buildings,

where it becomes contaminated with radioactive particles.

Earlier this month, TEPCO completed construction of a wall made up of pipes that will carry refrigerant liquid. The wall stretches about 1.5 kilometers around 4 reactor buildings.

It is intended to act as a barrier to prevent groundwater from seeping into the buildings, where it becomes contaminated and could eventually leak into the sea.

But work to inject freezing agent into the pipes has been delayed because the operator and the regulators disagreed on where to start.

TEPCO wanted to start freezing the wall from the upstream side. But regulators argued the downstream side should be frozen first to cut the risk of water levels dropping suddenly, potentially triggering a release of tainted water.

**Under the revised plan, TEPCO will freeze the downstream side wall first as the regulators suggest. It will also take steps to prevent water levels from falling too low.**

The regulators **did not oppose** the revised plan, although they said there are several points to be clarified.

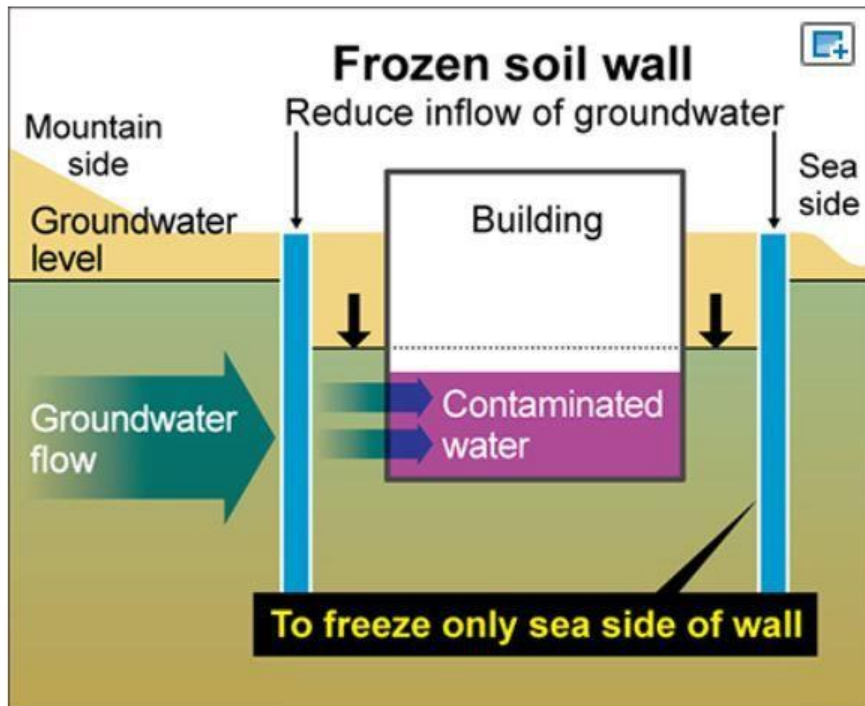
**It will take 8 months to completely freeze the wall.** TEPCO initially aimed to end the work by March.

TEPCO's senior official in charge of decommissioning the plant, Naohiro Masuda, says local residents have high interest in the ice wall and the company will implement the plan steadily to keep the public reassured.

## **Conditional permission from NRA for section of icewall**

### **NRA to allow part of frozen soil wall at Fukushima plant**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201602150062>



By HIROMI KUMAI/ Staff Writer

The nation's nuclear watchdog decided that Tokyo Electric Power Co. can start freezing soil in a limited area around crippled reactor buildings at the Fukushima No. 1 nuclear power plant to prevent radioactive water accumulating in the buildings from leaking into the ground.

The conditional permission by the Nuclear Regulation Authority on Feb. 15 means TEPCO will get the go-ahead for a section of frozen soil wall in the area of the complex facing the sea.

Initial plans called for TEPCO to surround the four reactor buildings with a 1,500-meter-long circular frozen soil wall by inserting 1,568 pipes to a depth of 30 meters at 1-meter intervals. Each pipe would then freeze the soil around it once liquid of minus 30 degrees circulated inside the cylinder.

Building the wall was intended to prevent the flow of groundwater into the reactor buildings, where melted nuclear fuel has accumulated in the basements, thereby reducing the volume of water contaminated with radioactive substances.

TEPCO completed the installation of the pipes on Feb. 9.

However, the NRA was worried that the level of groundwater inside the frozen soil wall could drop drastically once the frozen soil wall surrounds the reactor buildings, causing levels of highly contaminated water in the reactor buildings to become higher than the groundwater level. That, NRA officials feared, would cause the highly contaminated water to leak into the ground.

With caution the buzzword of the day, the NRA had called on TEPCO to change plans and operate only a part of the frozen soil wall.

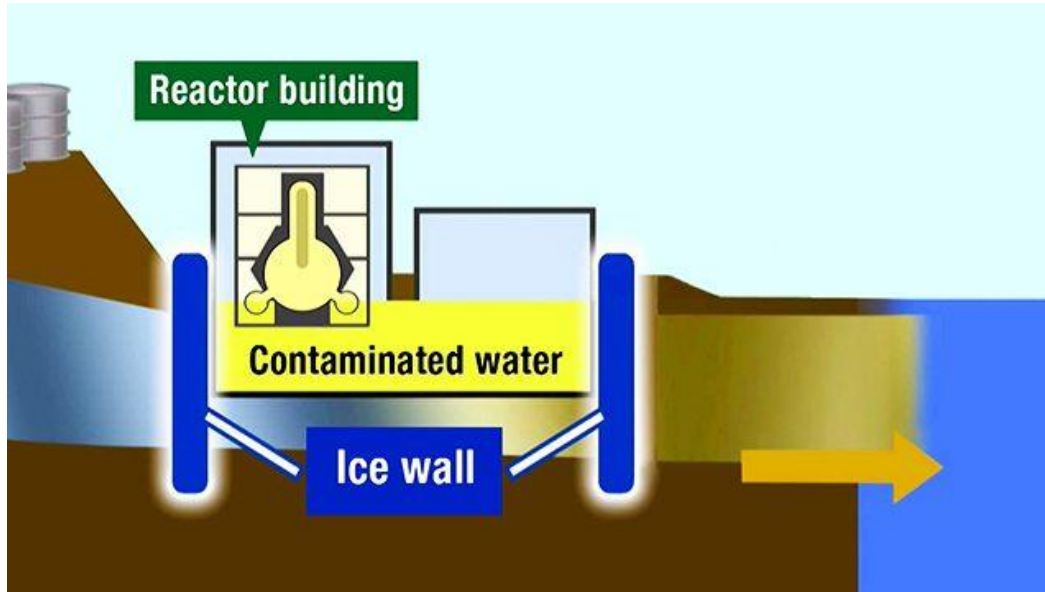
In a meeting held Feb. 15, the utility said it would freeze only the soil on the side of the stricken facility facing the sea.

Once the NRA grants official approval, TEPCO will move quickly to freeze the soil.

TEPCO also said that it wants to freeze the remaining portions in a step-by-step manner. The NRA supported the proposal, saying it would make it possible to "collect data on water levels."

However, the two sides did not reach any agreement on this other than to continue their discussions.

## Nuclear Watch video: TEPCO revises plans



### TEPCO Revises Water-Diversion Plan

<http://www3.nhk.or.jp/nhkworld/english/news/nuclearwatch/20160215.html>

Engineers at the crippled Fukushima Daiichi nuclear plant have drafted a new plan to deal with the buildup of contaminated water. And they've presented the revised method -- of creating an underground wall of frozen soil -- to nuclear regulators.

The plant's operator, Tokyo Electric Power Company, has already installed a system to circulate coolant and freeze soil around the reactor buildings.

The idea is to prevent the flow of groundwater into reactor buildings, where it could become radioactive. TEPCO officials had planned to start freezing a barrier above the reactor buildings. But regulators were concerned that tainted water in those buildings could leak into the groundwater if the level inside the frozen wall drops too much.

So TEPCO officials decided to freeze the lower wall first, and then gradually freeze the higher wall.

They say it will take eight months to complete. They had originally aimed to have it finished by next month.



February 16, 2016

## **NRA approves plan to start freezing wall of soil on ocean side at Fukushima plant**

<http://mainichi.jp/english/articles/20160216/p2a/00m/0na/009000c>

The Nuclear Regulation Authority (NRA) approved a plan on Feb. 15 to gradually freeze a wall of soil around the crippled Fukushima No. 1 nuclear plant, starting with shields on the ocean side.

The NRA had expressed concern that if all the soil walls were frozen and if the groundwater level were mismanaged, highly contaminated water could leak out from the reactor buildings. With the NRA's approval of the plan, measures to deal with contaminated water will move a step forward. But it remains to be seen how effective the plan will be, as groundwater will continue to seep into the reactor buildings from the mountains.

Tokyo Electric Power Co., the operator of the damaged plant, presented an outlook for the project which stated that if the soil walls were frozen in stages, it would take about eight months to complete work to freeze all of the walls. The NRA is likely to allow TEPCO to start freezing the walls in or after March, making it impossible for the utility to meet its target of finishing work to freeze the walls by the end of March this year.

The shields set to make use of frozen soil have been built around the No. 1 to 4 reactors at the Fukushima nuclear plant. The NRA had pointed out that if the groundwater level inside the walls were to become too low, the level of highly contaminated water in the reactor buildings would exceed that of the groundwater, threatening to flow out of the reactor buildings. At a review session held on Feb. 15, TEPCO explained that the risk of contaminated water leaking from the reactor buildings would be smaller if the soil walls on the ocean side were frozen first, rather than following its original plan to freeze the walls on the mountain side first.

TEPCO explained that it would monitor future groundwater through a total of 69 water-level gauges, injecting water into the ground during an emergency and urgently transporting contaminated water from the reactor buildings in the event of operations of the frozen walls coming to a halt, among other measures.

NRA Commissioner Toyoshi Fuketa expressed his understanding of TEPCO's plan, saying concerns of the leakage of contaminated water had basically been defused. At the same time, he deferred a decision on whether to allow TEPCO to freeze all of the walls including those on the mountain side of the reactor buildings, saying that the NRA would make a decision on whether to approve the utility's subsequent plans after having the utility submit a detailed step-by-step process.

The project to install equipment to freeze walls of soil began in June 2014 and was completed on Feb. 9, 2016. The government has put more than 32 billion yen into the project. Altogether, 1,568 pipes are being used to create frozen soil walls stretching a total of about 1.5 kilometers around the reactor buildings, and walls reaching a depth of about 30 meters have been built underground to drastically reduce the flow of groundwater into the reactor buildings. Upon completion of construction, TEPCO has said it will be able to reduce the inflow of groundwater to several dozen metric tons per day from about 150 to 200 tons.

## Blocking radioactive water from leaking into sea?



A large number of pipes and freezing equipment take up much of the space of Tokyo Electric Power Co.'s refrigerator plant at the embattled Fukushima No. 1 nuclear power plant on Feb. 19. (Yasuhiro Sugimoto)

### TEPCO nears 'deep freeze' of soil wall at Fukushima plant

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201602210030>

By HIROMI KUMAI/ Staff Writer

Packed with bulky silver pipes and freezing equipment, Tokyo Electric Power Co.'s plant to freeze underground soil at the crippled Fukushima No. 1 nuclear power plant is ready to start chilling. On Feb. 19, TEPCO officials showed the interior of the newly built facility, the heart of the project to reduce accumulating radioactive water at the nuclear complex.

The plan envisages a **frozen soil wall built around the reactor buildings by inserting 1,568 pipes to a depth of 30 meters.**

**Cooling agents, which register 30 degrees below zero, will be pumped into the pipes to freeze the surrounding soil.**

**In theory, the flow of groundwater into the reactor buildings, which would mix with contaminated water and empty out in the sea, will be blocked.**

With approval from the Nuclear Regulation Authority earlier this month, the utility plans to **start freezing the area facing the sea as early as March**, a process expected to take about two and a half months.

In total, it will take seven to eight months to complete all the freezing of the underground soil, including the mountain side of the wall, according to TEPCO's blueprint presented to the NRA this month.

That means that the project to build a frozen barrier will significantly lag behind the initial targeted completion date of the end of March.

## Icewall shown to media

### Wall to freeze soil at Fukushima nuclear plant unveiled to media for first time

<http://mainichi.jp/english/articles/20160224/p2a/00m/0na/013000c>

February 24, 2016 (Mainichi Japan)

The government on Feb. 23 gave the Mainichi Shimbun and other members of the press their first look at fully installed equipment to create a wall designed to freeze soil around the Fukushima No. 1 Nuclear Power Plant and prevent groundwater from flowing into buildings.

A refrigeration machine and pipes will create a wall of frozen soil around 1.5 kilometers in length, encircling reactor Nos. 1 through 4. A total of 1,568 pipes were inserted into the ground at a depth of around 30 meters to freeze the surrounding soil.

Work on the wall began in June 2014, and it was completed earlier this month on Feb. 9. Since permission is required from the Nuclear Regulation Authority before starting operations, however, the process of freezing the pipes has not yet begun.

Once the soil surrounding the entire area has been frozen, the government and Tokyo Electric Power Co. (TEPCO) say the amount of groundwater flowing into the premises can be reduced from a total of around 150 metric tons per day to some 50 tons.

The pipe fittings, which each have a diameter of around 50 centimeters, were positioned to encircle the reactor buildings, which are presently undergoing decommissioning. The pipe rods to be frozen were then placed into the ground 1 meter apart from one another.

Utilizing 30 freezers placed in two buildings at a high elevation, the coolant to be poured into the frozen pipes will first be chilled to a temperature of minus 30 degrees Celsius. After being circulated, the coolant will then again be returned to the refrigeration machine for cooling.

When revealing the wall to reporters, the government also showed them an incineration facility for miscellaneous solid waste. The facility will be used to dispose of materials used during the decontamination process, such as protective attire. The facility plans to burn some 66,000 cubic meters of waste that has accumulated since the nuclear disaster, in order to reduce the volume down to one-tenth of existing levels.

TEPCO aims to begin operating the incineration facility sometime in March.

February 23, 2015

### **Fukushima ice wall shown to media**

[http://www3.nhk.or.jp/nhkworld/en/news/20160223\\_32/](http://www3.nhk.or.jp/nhkworld/en/news/20160223_32/)

The operator of the damaged Fukushima nuclear power plant has shown media outlets the site where work has been completed for an underground ice wall. The wall is designed to stop underground water from flowing into the plant's reactor buildings.

Tokyo Electric Power Company, or TEPCO, began construction of the wall in 2014. Its work was completed earlier this month.

The wall is designed to freeze the soil around the Number 1 to Number 4 reactor buildings in order to keep groundwater from seeping into the structures.

TEPCO has driven about 1,500 pipes carrying refrigerant liquid into the ground around the buildings. The pipes and cooling devices were shown to the media on Tuesday.

But workers have not yet injected a freezing agent into the pipes. This is due to concerns that a sudden drop in groundwater levels may result in the release of radioactive water. TEPCO officials are examining the situation with the Nuclear Regulation Authority, or NRA.

Masato Kino of the Agency for Natural Resources and Energy is in charge of dealing with the contaminated water. He says now that the ice wall is completed, his agency is consulting with the NRA to reduce the volume of radioactive water at the plant.

TEPCO officials also showed the media an incinerator that will burn contaminated waste such as used protective suits.

Officials plan to start testing the incinerator on Thursday.

They hope it will help reduce about 66,000 cubic meters of waste that has accumulated at the plant.

February 25, 2016

### **Contaminated water: TEPCO hopeful**

## **TEPCO: Step forward to contain radioactive water**

[http://www3.nhk.or.jp/nhkworld/en/news/20160226\\_07/](http://www3.nhk.or.jp/nhkworld/en/news/20160226_07/)

The operator of the crippled Fukushima Daiichi nuclear plant says it will soon be able to stop the influx of radioactive water at some parts of the plant's reactor facility.

Basements of the 4 damaged reactors at the plant are still filled with highly radioactive water that has been used for cooling the reactors.

Contaminated water from 3 of these reactors is flowing into adjacent turbine buildings, filling their basements as well.

Tokyo Electric Power Company has been implementing measures to reduce the amount of contaminated water in the reactor facilities.

Since last September, it has been draining groundwater in areas close to the reactor facilities. The water is being released into the sea after being purified.

TEPCO has also been pumping up contaminated water directly from the facilities.

Company officials say these efforts are gradually lowering water levels in the basements of the reactor facilities. They say at the No.1 reactor the water level will be lower than a channel to the adjacent turbine building by early March. That will stem the inflow of radioactive water into the turbine building.

The operator then plans to remove contaminated water in the turbine building as soon as possible.

**TEPCO says in this way it hopes to remove radioactive water from all 3 reactors and nearby turbine buildings within 4 years.**

March 3, 2016

## **How long before icewall?**

### **TEPCO to create frozen wall soon**

[http://www3.nhk.or.jp/nhkworld/en/news/20160303\\_29/](http://www3.nhk.or.jp/nhkworld/en/news/20160303_29/)

The operator of the crippled Fukushima Daiichi nuclear power plant is expected to soon get approval to start underground freezing around its reactors. The measure is aimed at creating a frozen soil wall to cut the amount of groundwater flowing into reactor buildings.

Tokyo Electric Power Company, or TEPCO, hopes to build the wall around the 4 reactors as part of efforts to contain radioactive water, which is increasing daily due to inflowing groundwater.

The construction stage of the project finished in February, with about 1,500 of cooling pipes buried.

On Thursday, the Nuclear Regulation Authority basically approved the plan to begin the freezing.

The regulator had raised concern that such a wall could lower the groundwater level around the buildings too much, causing leaks of highly contaminated water there.

In response, TEPCO proposed doing the freezing work in stages, starting at the groundwater's downstream side. If groundwater levels were to fall too steeply, the firm would restore them by stopping the pumping up of groundwater in nearby wells.

**The regulator is to give final approval this month if it receives a concrete emergency response plan from the firm and finds no problems.**

TEPCO hopes to start the work as soon as possible. The utility expects that once it is done and other measures are taken, the groundwater inflow will be sharply reduced.

**But the work could take 8 more months.** The firm had planned to finish the wall by the end of March.

## **Fukushima Daichi: Before and after (TEPCO video)**

[http://www.tepco.co.jp/en/news/library/archive-e.html?video\\_uuid=g8wll0kc&catid=69631](http://www.tepco.co.jp/en/news/library/archive-e.html?video_uuid=g8wll0kc&catid=69631)  
2016.1.12 "The current situation at Fukushima Daiichi NPS" –From 3.11 toward the future- (ver,Jan.2016)

March 7, 2016

## **TEPCO to consult on contaminated water with local communities**

### **TEPCO to discuss radioactive water with local govt**

[http://www3.nhk.or.jp/nhkworld/en/news/20160307\\_34/](http://www3.nhk.or.jp/nhkworld/en/news/20160307_34/)

The operator of the damaged Fukushima nuclear plant plans to consult local communities on how to deal with radioactive water stored at the site.

Tokyo Electric Power Company's Chief Decommissioning Officer, Naohiro Masuda, revealed this when he spoke to NHK on Monday.

He said the company will begin consulting local communities next month on how to deal with the contaminated water. He added that **government experts are talking about several disposal methods, such as diluting and discharging the contaminated water into the sea.**

About 500 tons of contaminated water is generated daily at the plant. Purification equipment removes radioactive substances from the water except for tritium. About 600,000 tons of water containing tritium is being kept in tanks on the premises of the plant.

March 8, 2016

## **Nobody else in the world has treated so much radioactive water**

Source : AP

### **Containing Fukushima's radioactive water may be 9-year fight**

<http://bigstory.ap.org/dba4eedb33804c3f81c6c24425f5b77b>

<https://apnews.com/article/dba4eedb33804c3f81c6c24425f5b77b>

By MARI YAMAGUCHI

TOKYO (AP) — After battling radioactive water leaks for five years at Japan's crippled Fukushima Dai-Ichi nuclear plant, the utility that ran it says it will need another four to finish the job.

"We will bring an end to the problem by 2020," says Yuichi Okamura, who led the Tokyo Electric Power Co. team dealing with water at Fukushima from the early days to last summer.

The contaminated water, now exceeding 760,000 tons and still growing, has been a major challenge that has distracted workers from decommissioning the plant. It is stored in **more than 1,000 industrial tanks, covering much of the vast plant grounds.**

Okamura says TEPCO expects that by 2020, it will have collected and treated all contaminated water pooled around the reactors, and will need to continue processing only the water necessary to cool the reactors.

TEPCO has managed to reduce the flow of contaminated water and hopes to get regulators' approval within a month to activate an underground "ice wall" that would block out more water. **The final step, though, remains contentious: Getting permission to release the water into the sea, after it has been treated to remove most radioactive elements.**

Okamura, now a general manager in TEPCO's on-site nuclear power division, pledged to keep the water securely stored until a decision is made. **The volume, he said, is beyond imagination.**

"Contaminated water floating around and posing a constant risk of leaks disturbs the steady progress toward decommissioning," he told The Associated Press in an interview this week.

The most daunting element of the decommissioning process is still years from even beginning. The government and TEPCO hope to start removing nuclear debris from the reactors in 2021, a task expected to take decades.

The March 11, 2011, earthquake and tsunami knocked out power to the plant's cooling systems, sending three of its reactors into meltdown.

The three damaged reactors still need to be cooled with water to keep their melted cores from overheating. The water picks up radiation and leaks out through cracks and other damage from the disaster. The water flows to the basements, where it mixes with groundwater, swelling the volume of contaminated water.

**TEPCO has cut groundwater infiltration to 150 tons per day, nearly one-third of the amount two years ago**, mainly by pumping out groundwater upstream and directing it to the ocean. The utility hopes the underground ice barrier will eliminate all groundwater inflow.

Radioactive water continues to leak into the ocean, but at a far lesser rate than it did early in the disaster. Ocean radiation levels are about a thousandth of what they were soon after the accident, according to Ken Buesseler, a radiochemist with Woods Hole Oceanographic Institution (WHOI) who has monitored the area. Because of concerns about the health of marine life, commercial fishing is still banned in waters just off the plant.

Worries about ocean health make disposing of even treated water a contentious subject. Treating contaminated water removes all radioactive isotopes except tritium, a radioactive form of hydrogen. Nuclear plants elsewhere release water containing allowable amounts of tritium, nuclear officials said. The government is evaluating experimental technology to separate tritium, but experts at the International Atomic Energy Agency and Japan's Nuclear Regulation Authority say that is impossible. Those experts have urged the government to gain public acceptance for a controlled release of the water into the ocean. Fishermen and other local residents have been opposed and could discourage the government from going ahead.

Okamura was tasked with setting up the first water treatment system and its upgraded editions. His tenure was plagued with accidental leaks and other problems, but the project reached a milestone last year when all the stored water had been filtered.

"Nobody else in the world has treated so much highly radioactive water," he said.

March 10, 2016

## Such confusion (cooling or not cooling?)

### TEPCO: Accident info was not shared among workers

[http://www3.nhk.or.jp/nhkworld/en/news/20160310\\_38/](http://www3.nhk.or.jp/nhkworld/en/news/20160310_38/)



A survey by the operator of the damaged Fukushima nuclear plant shows that information on a cooling system at one of the reactors was not shared by plant workers at the time of the 2011 accident.

Meltdowns took place at 3 of the plant's reactors, starting with the No.1 unit. The complete loss of power at that reactor stopped all of its cooling systems.

Surveys in the year after the accident by the government, Diet, and Tokyo Electric Power Company showed that staff at the reactor did not know whether an emergency cooling system was functioning after an indicator lamp went off following the loss of power.

Different findings were obtained in a survey carried out last year by TEPCO.

One worker said he himself stopped the cooling system just before the loss of power. Another said he thought the system had not been functioning, because pressure inside the reactor was rising after the power went out.

The manager on duty at the time said he had no memory of being informed that the complete loss of power had shut down the system.

Just before the loss of power, the system was turned on and off to cool the reactor in stages.

TEPCO officials say reactor staff may have failed to share important information on the status of the cooling system amid confusion over the loss of power.

A later analysis shows that the meltdown started at the No.1 reactor in the evening of March 11th, the day of the accident.

But members of a task force set up that day believed that the cooling system was working until midnight. They included then plant chief Masao Yoshida.

The 2015 findings suggest that the delay in sharing the correct information may have affected the response to the accident.

March 24, 2016

**Not again!**

**TEPCO says 5.3 tons of tainted water leaked at nuclear plant**

<http://ajw.asahi.com/article/0311disaster/fukushima/AJ201603240048>

An estimated 5.3 tons of water contaminated with radiation leaked from a pipe in a building housing cesium removal equipment at the stricken Fukushima No. 1 nuclear power plant, the facility's operator said.

The leaked water contained 383,000 becquerels of radioactive cesium per liter and 480,000 becquerels of beta ray-emitting radioactive substances per liter.

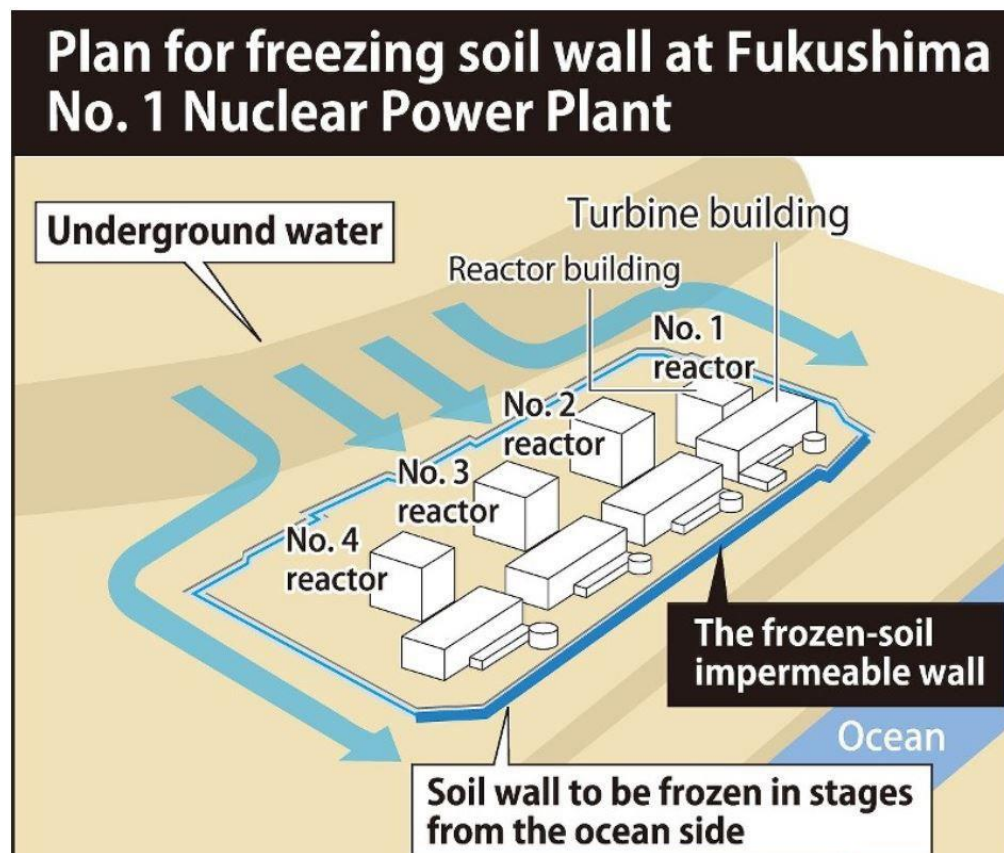
Tokyo Electric Power Co. said March 23 the water has not flowed outside the high temperature incinerator building. TEPCO said it was in the process of pumping up the water for storage.

The utility said workers doing remodeling work earlier in the day cut off a pipe inside the incinerator building. When workers subsequently operated radioactive material removal equipment in another building, contaminated water leaked from the cut section of the pipe to the floor of the incinerator building.

TEPCO said it is trying to determine the cause of the incident, adding that workers had confirmed that they closed a valve before cutting off the pipe to prevent water leakage.

March 30, 2016

## Freezing of soil can go ahead



## **NRA approves TEPCO's plan to freeze underground walls of soil at Fukushima plant**

<http://mainichi.jp/english/articles/20160330/p2a/00m/0na/012000c>

The Nuclear Regulation Authority (NRA) decided on March 30 to approve Tokyo Electric Power Co. (TEPCO)'s plan to gradually freeze underground walls of soil around the crippled Fukushima No. 1 nuclear plant, starting with shields on the ocean side.

With the NRA's approval, TEPCO, the operator of the crippled Fukushima nuclear complex, is to begin work as early as March 31 to freeze the walls built around the buildings of reactors Nos. 1 through 4 at the plant. The walls are designed to prevent underground water from flowing into the reactor buildings. But such a large-scale "wall of ice" has not been introduced anywhere in the world and it is unclear how much underground water the frozen shields will be able to prevent from flowing into the crippled nuclear complex.

Under the project to build the frozen soil walls, coolant chilled to a temperature of minus 30 degrees Celsius is to circulate through 1,568 pipes that are driven into the ground to a depth of around 30 meters, to create a "wall of ice." The project is aimed at preventing underground water from entering the reactor buildings and reducing the amount of contaminated water being generated. If the project goes as planned, work to freeze the walls is expected to be completed in about eight months. TEPCO estimates that the walls will help the utility reduce the inflow of underground water to several dozen tons per day from the current 150 to 200 tons.

TEPCO is to gradually freeze the walls, starting with the one (about 690 meters) on the ocean side first, while leaving seven sections (a total of about 45 meters) on the mountain side unfrozen. TEPCO had initially planned to freeze all of the walls at once. But if the levels of underground water around the reactor buildings drop drastically, contaminated water remaining in the reactor buildings could flow out. So the NRA called for the gradual freezing of the walls. TEPCO then accepted the NRA's suggestion. The frozen-soil wall project is considered to be a key measure to deal with contaminated water along with the so-called "subdrain" project designed to reduce the amount of water being contaminated by removing underground water from wells around the reactor buildings. TEPCO started inserting pipes into the ground in June 2014 and completed its preparations to begin freezing the walls in February this year.

## **TEPCO given OK on freezing soil at Fukushima plant**

[http://ajw.asahi.com/article/behind\\_news/social\\_affairs/AJ201603300074](http://ajw.asahi.com/article/behind_news/social_affairs/AJ201603300074)

By HIROMI KUMAI/ Staff Writer

The Nuclear Regulation Authority gave the go-ahead to Tokyo Electric Power Co.'s plan to freeze the soil around the reactors at the crippled Fukushima No. 1 nuclear power plant from the seaside on March 30. The aim of the frozen soil wall is to block the flow of groundwater into the reactor buildings to prevent it from becoming contaminated with radioactive substances.

The utility has already inserted 1,568 pipes to a depth of 30 meters in the ground around the No. 1 to No. 4 reactor buildings. The plan is to circulate liquid with a temperature of minus 30 degrees through the pipes to freeze the surrounding soil.

TEPCO's plan is to first freeze the entire wall on the seaside and about half of the wall on the mountain side.

The effects of completing the frozen wall on the seaside are expected to show after about six weeks with water being prevented from flowing through. Then, the frozen portions on the mountain side will be gradually increased. When 95 percent of the wall is frozen, TEPCO will suspend the freeze, leaving cracks in seven places to allow some water through.

The utility predicts that with 95 percent of the entire soil wall frozen, about half of the groundwater will be blocked.

To freeze the entire wall on the mountain side, TEPCO will have to gain further approval from the NRA. Initially, the electric power company planned to freeze soil only on the mountain side. However, the NRA pointed out that if groundwater is totally blocked from the mountain side, the level of water within the frozen soil near the reactors could become too low and with nothing outside to stop it, highly contaminated water inside the reactor buildings could more rapidly flow out.

Because of that, TEPCO decided in February that it will freeze the soil mainly from the seaside and collect data on the level of groundwater and, after that, it will freeze the entire wall.

"It is important to collect sufficient data in a continuous manner and implement the freezing while keeping watch," said NRA chairman Shunichi Tanaka.

The plan to create the frozen soil wall was developed by an economy ministry committee in May 2013 as an important part of measures to decrease the volume of contaminated water. The work to insert pipes into the ground was completed in February.

March 31, 2016

## TEPCO starts freezing soil



## **TEPCO starts freezing soil around reactors**

[http://www3.nhk.or.jp/nhkworld/en/news/20160331\\_21/](http://www3.nhk.or.jp/nhkworld/en/news/20160331_21/)

Work has finally begun to freeze the soil around four damaged reactors at the Fukushima Daiichi nuclear power plant. Engineers are trying to reduce the buildup of contaminated water at the site.

Tokyo Electric Power Company, or TEPCO, the owner of the plant, started the work on Thursday, after the Nuclear Regulation Authority gave the go-ahead. It took TEPCO about two years to install the system.

At around 11:20 AM, equipment began sending refrigerant liquid of minus 30 degrees Celsius flowing into pipes driven into the ground around the reactor buildings.

TEPCO says it will freeze soil in phases, first, on the downstream side of the reactors, using 1,000 of the 1,700 underground pipes. TEPCO says it will take about 45 days for the ice wall to generate effects.

Then they will gradually freeze upstream while monitoring groundwater levels. This is to prevent the ice wall from lowering the levels too much and causing radioactive water to leak from the reactor buildings.

Officials say that by summer, the wall, together with other measures, will reduce the daily flow of groundwater into the reactor buildings from 400 tons to about 90 tons. They say the flow will fall to about 50 tons when the wall is complete.

The government's Chief Cabinet Secretary, Yoshihide Suga, said on Thursday that the government hopes to quickly see a drop in the flow of groundwater into the reactor buildings.

He said preparations have been carried out with much caution, including repeated tests of the ice wall technology. He said he wants the work to be done on a safety-first principle.

## **Ice wall enters first phase**

<http://www3.nhk.or.jp/nhkworld/en/news/videos/20160331190838052/>  
video NHK

April 3, 2016

## **Until the contaminated water issue is solved...**

### **Contaminated water, fuel extraction stand in way of decommissioning Fukushima plant**

<http://mainichi.jp/english/articles/20160403/p2a/00m/0na/010000c>

With about five years having passed since the start of the Fukushima No. 1 Nuclear Power Plant disaster, nuclear workers still lack a method of treating the around 1,000 tanks of contaminated water stored on site, and the start of work to remove melted nuclear fuel from the plant remains at least five years away. "Until the contaminated water issue is solved, decommissioning of the reactors remains far off. We have to stop the water," says Tetsuo Ito, professor of nuclear energy safety engineering at the Kinki University Atomic Energy Research Institute. Akira Ono, chief of the Fukushima plant, says, "We're still at step one" of the decommissioning process, which is estimated to take until 2041 to 2051.

Tokyo Electric Power Co. (TEPCO), the plant's owner, is treating the contaminated water with its Advanced Liquid Processing System (ALPS), which can remove 62 varieties of radioactive material. However, ALPS cannot remove radioactive tritium, and because of this the treated water is stored in tanks. Tritium is extremely difficult to separate from water, because even if one of the hydrogen atoms in a water molecule is replaced by tritium, the chemical properties such as the boiling point barely change. The International Atomic Energy Agency (IAEA) has advised that tritium-containing water be released into the ocean, because its effect on the human body is very limited. Tritium-containing water is created even during the normal operation of a nuclear power plant, and it is released into the ocean in accordance with waste-disposal standards. However, there is local opposition to doing this at the Fukushima plant because of worries about its effects on the reputation of the local fishing industry, and no decision has been made on what to do with the water.

Tritium has a half-life of 12.3 years, so storing the water until the radiation naturally lessens is another option, but there is the risk of leaks during that time if the tanks' conditions deteriorate.

As for decommissioning the plant reactors, at the end of 2011 the national government put together a roadmap that estimated the decommission work would take 30 to 40 years. To decommission the No. 1 through 3 reactors at the plant, 1,573 units of spent fuel will have to be removed from the spent fuel pools of these reactors, and 1,496 units' worth of fuel that melted from the reactors will have to be removed. Safe removal of the melted fuel represents the largest problem.

The national government and TEPCO intend to decide on a plan for the fuel's extraction in the first half of fiscal 2018, and start extraction efforts at one of the reactors within the year 2021. Toyoshi Fuketa, a member of the Nuclear Regulation Authority (NRA), argues that nuclear fuel that is too difficult to take out should be stored on-site, saying, "There is the option of just removing as much (of the melted fuel) as possible, and hardening the rest (to seal off its radiation)."

The cost for decommissioning the reactors is already estimated at 2 trillion yen, and this could grow if the decommissioning schedule is delayed.

While the No. 1 through 3 reactors at the plant were shut down at the time of the Great East Japan Earthquake on March 11, 2011, they lost all power due to the proceeding tsunami and, with no way to cool the nuclear reactors, they experienced a meltdown. The tsunami measured at up to 15.5 meters, and emergency underground power supplies were flooded and failed to function.

The No. 1 reactor was equipped with a cooling system called Reactor Core Isolation Cooling (IC), but this didn't activate, and on March 12 at 3:36 p.m. the No. 1 reactor suffered a hydrogen explosion. Then, on March 14 at 11:01 a.m. the No. 3 reactor also experienced a hydrogen explosion. The No. 4 reactor was already offline at the time of the disaster for a regular inspection, but hydrogen from the adjacent No. 3 reactor leaked in, and it suffered a hydrogen explosion as well at 6:14 a.m. on March 15. The No. 2 reactor was not hit by a hydrogen explosion, but among the No. 1 through 3 reactors it is thought to have leaked

the most radiation. The disaster is rated a 7 on the International Nuclear Event Scale, the same as the Chernobyl disaster.

Masao Yoshida, the late chief of the Fukushima plant who headed up the frontline disaster-response efforts, testified to a government panel investigating the disaster, "We (who were on-site) imagined it as the destruction of eastern Japan. I really thought we were dead."

Four reports on the disaster were put together, from the national government, the Diet, TEPCO and elsewhere in the private sector. They differ on points such as why the IC in the No. 1 reactor did not activate. **The Diet probe raised the possibility that the IC system's piping was damaged in the earthquake, but the national government's investigative panel denied that earthquake damage was the cause. Due to the high radiation levels in the reactor buildings, there has not yet been an on-site investigation to better understand what happened.**

April 5, 2016

## Freezing soil proceeding "smoothly"



Rainwater is discharged from newly constructed drainage outlets into the plant's harbor during a media tour at the Fukushima No. 1 nuclear power plant on April 4. (Pool)

## Freezing of soil near Fukushima plant going well, says TEPCO

<http://www.asahi.com/ajw/artcles/AJ201604050046.html>

The freezing of soil around the Fukushima No. 1 nuclear power plant to block the flow of groundwater is proceeding "largely smoothly," the plant operator said April 4.

Tokyo Electric Power Co. started making a frozen underground wall in late March around the No. 1 to No. 4 reactors at the plant, which suffered a triple meltdown triggered by the March 2011 earthquake and tsunami.

The final part of the construction process to freeze the soil was unveiled to the media for the first time April 4 during a visit to the site by Yosuke Takagi, state minister of the economy.

To build the frozen soil wall to prevent groundwater flowing into the four reactor buildings and becoming contaminated with radioactive substances, the utility inserted 1,568 pipes to a depth of 30 meters and 1 meter apart.

The company is now circulating liquid with a temperature of minus 30 degrees through the pipes to first freeze the soil on the side of the sea so as not to drastically change the groundwater level at the plant.

As of April 4, the soil temperature had dropped to minus 4 to 6 degrees at some locations, according to TEPCO.

“While we need to keep making efforts to control the temperature deliberately, we can say that the project is proceeding largely smoothly so far,” the company spokesman said.

The utility also unveiled new drainage outlets for the K drainage channel to discharge water into the plant’s harbor and block it from being released into the outer ocean.

The construction of the new outlets was completed March 28. Radiation-contaminated rainwater coming through the K drainage channel had previously often flown into the outer ocean when it rained.

April 6, 2016

## High level of radiation near wastewater pool

### Radioactivity at buried tank up in Daiichi plant

[http://www3.nhk.or.jp/nhkworld/en/news/20160408\\_03/](http://www3.nhk.or.jp/nhkworld/en/news/20160408_03/)

The operator of the crippled Fukushima Daiichi nuclear plant says the level of radioactivity **near an underground wastewater storage pool** at the plant is more than 100 times earlier readings.

Tokyo Electric Power Company says the pools were **built 3 years ago to store highly radioactive wastewater produced within the crippled plant**. But all of them soon went out of use due to repeated leaks of contaminated water.

The utility pumped most of the water out of them, but has been checking radioactivity levels of groundwater near the pools.

**On Wednesday, equipment detected 8,100 becquerels of beta-ray-emitting radioactive substances per liter of water. On Thursday, it went up to 9,300 becquerels.**

A week ago, the level was only 87 becquerels.



TEPCO says it doesn't know why the sharp rise took place. It says **some highly radioactive water remains in the pool, but it is isolated with waterproof measures.**

TEPCO says it will continue to analyze groundwater samples around the pool, and also compare them with data on the contaminated water left in part of the tank.

April 20, 2016

## Dumping tritium into sea most "feasible" option?

### Dumping tritium from Fukushima into sea is best option: ministry

<http://www.asahi.com/ajw/articles/AJ201604200041.html>

The industry ministry concluded that releasing diluted radioactive tritium into the sea is the most feasible option in dealing with contaminated water accumulating at the Fukushima No. 1 nuclear power plant. The ministry's working group said at a meeting on April 19 that separating tritium from the contaminated water is proving extremely difficult, and that four other options studied about disposal were either too time-consuming or expensive.

Releasing the water into the sea would cost 3.4 billion yen (\$31 million) and take seven years and four months to complete, according to the group.

Tokyo Electric Power Co., the operator of the embattled nuclear plant, will decide on a disposal method based on the group's findings. The utility has said it will not release treated water that still contains radioactive substances into the sea without gaining the understanding of local fishermen.

TEPCO has been struggling to ease the buildup of polluted water at the nuclear plant. Every day, tons of groundwater become contaminated with radioactive substances after entering damaged reactor buildings. About 800,000 tons of water containing tritium are stored at the nuclear complex. This water was mostly used to cool melted nuclear fuel in the affected reactors.

TEPCO has been using a device called ALPS (advanced liquid processing system) to eliminate 62 kinds of radioactive substances, including cesium, from the water. But it cannot remove tritium.

The Ministry of Economy, Trade and Industry solicited ideas from the public on how to separate tritium from the polluted water. Six companies and one university submitted proposals.

However, experts in and out of Japan who evaluated the proposed methods concluded that none of the plans could be put into practical use in the near future.

The ministry's working group narrowed its analysis to the five options that involved disposing of water containing tritium.

One suggestion was to inject the polluted water into deep layers of the Earth. Another proposal was to electrolyze the tritium-contaminated water and release it into the atmosphere.

The highest estimated cost in the proposals was 388.4 billion yen, with the longest period for completion reaching 13 years, according to the group's study.

Ministry officials concluded that releasing water containing tritium into the sea after diluting it would be most reasonable in terms of both cost and time.

## Freezing work going well, says TEPCO

May 20, 2016

### TEPCO: Frozen soil wall proving effective

[http://www3.nhk.or.jp/nhkworld/en/news/20160520\\_03/](http://www3.nhk.or.jp/nhkworld/en/news/20160520_03/)

The operator of the Fukushima Daiichi nuclear plant says the work to freeze soil around the crippled reactors is making progress. It is designed to stop radioactive groundwater from flowing out of the facilities.

Tokyo Electric Power Company began freezing the soil in late March to make a 1.5-kilometer frozen wall surrounding the 4 reactors.

The reactor facilities have been the main source of radioactive contamination of groundwater at the plant.

TEPCO says that as of Tuesday, more than 80 percent of 6,000 checkpoints set up along the wall logged temperatures below zero. The operator says it means the freezing work is going well.

It also says that groundwater levels are rising in areas between the reactor facilities and the frozen wall along the coast. TEPCO officials assume the wall is preventing the water from seeping out. But water is still coming in through some unfrozen parts of the hillside.

Officials told reporters on Thursday that they will further carefully monitor the effect of the frozen wall and seek its completion.

## Icewall making progress

### TEPCO: Ice Wall Making Progress

<http://www3.nhk.or.jp/nhkworld/en/news/editors/21/20160520/>



The operator of the Fukushima Daiichi nuclear plant says the project to build an underground ice wall around the crippled reactors is making progress.

The wall is designed to reduce the amount of contaminated water accumulating there.

Tokyo Electric Power Company began freezing the soil in late March to build a 1.5-kilometer barrier around the 4 reactors.

Officials want to reduce the amount of groundwater flowing into the reactor buildings that becomes contaminated with radioactive substances.

TEPCO officials say that as of Tuesday, 80 percent of the checkpoints along the wall logged temperatures below zero. They say that means the freezing work is going well.

And they assume the wall is preventing water from seeping out.

They say they will carefully monitor the wall's effectiveness.

April 25, 2016

## **Dangerous steel beam to be dismantled**

### **TEPCO to dismantle top of exhaust stack at Fukushima plant due to fractures**

<http://mainichi.jp/english/articles/20160425/p2a/00m/0na/024000c>



The fractured steel beam section of the exhaust stack pillar at the No. 1 and 2 reactors of the Fukushima No. 1 Nuclear Power Plant. (Photo courtesy of TEPCO)

Tokyo Electric Power Co. (TEPCO) will begin dismantling the upper section of the joint exhaust stack for the No. 1 and 2 reactors of its Fukushima No. 1 Nuclear Power Plant in fiscal 2018, company officials announced on April 25 during a meeting with the Nuclear Regulation Authority (NRA).

NRA officials had advised TEPCO to disassemble the structure due to fractures in its pillars that increased the risk of it collapsing.

Because the vent to reduce the pressure of the nuclear reactor containment vessels contaminated the stack in the 2011 nuclear disaster at the plant, and it is releasing extremely high radiation, the work will be undertaken from a distance utilizing a large crane. The work is expected to be completed in fiscal 2019. Explaining the dismantling plans during the NRA meeting, TEPCO officials said that fractures or deformities had been detected in a total of eight different sections of the pillars' steel joints, which are found at approximately the 66 meter-mark of the exhaust stack. The structure stands at a total height of around 120 meters.

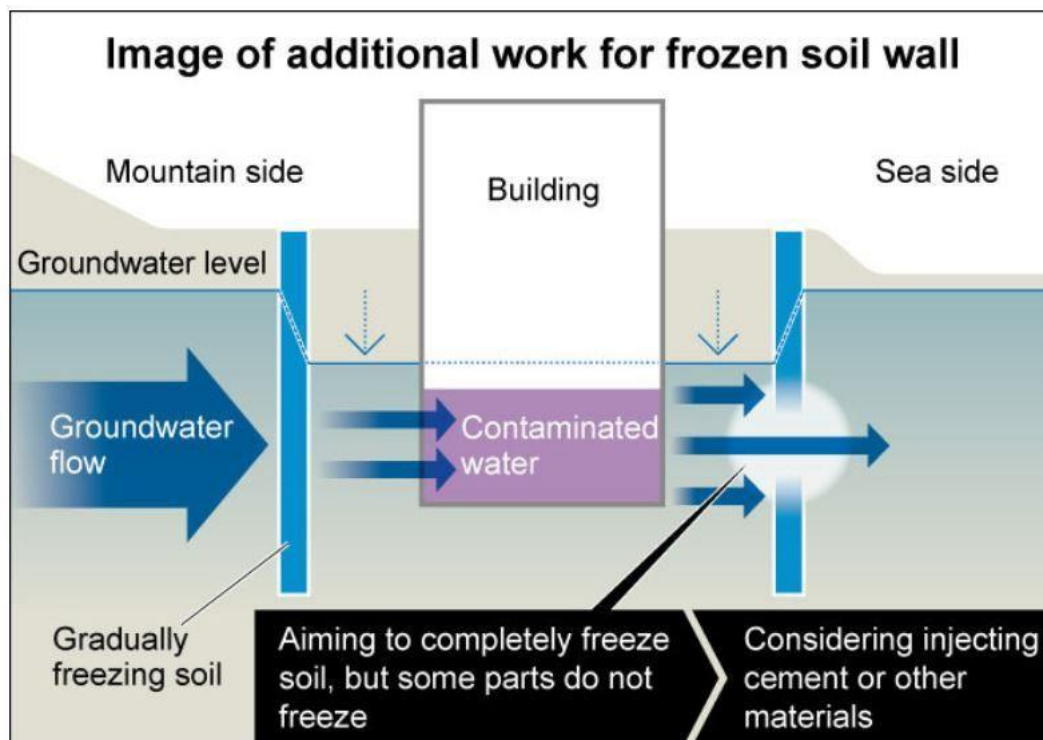
The cracks are thought to have been caused by the hydrogen explosions that occurred during the disaster. Radiation measurements conducted at the base of the structure in 2013 stood at an estimated 25 sieverts per hour -- an extremely high level that would kill nearly everyone exposed for that long.

While TEPCO has determined that the structure "would not fall over even if an earthquake of the same intensity as that which struck during the Great East Japan Earthquake (an upper level 6 on the Japanese scale) were to occur again," the utility decided to dismantle the top section as it would have repercussions on the reactor decommissioning work taking place in the area in the unlikely event of the structure's collapse.

April 26, 2016

## Icewall not so good after all

### 10% of TEPCO's frozen soil wall at Fukushima site not working



he Asahi Shimbun

The solid frozen soil wall that Tokyo Electric Power Co. is trying to create at its stricken Fukushima No. 1 nuclear power plant is falling short of expectations.

TEPCO said May 25 its attempt to freeze the soil around the crippled reactors to decrease contaminated groundwater has hit an unexpected glitch.

The utility said it has been unable to freeze the soil at about 10 percent of points it surveyed even though more than one-and-a-half months have passed since the program started.

This is due to the fact that soil temperatures have failed to drop sufficiently. In places where the temperature remains especially high, there is a possibility the soil will never freeze.

TEPCO reported the situation to the Nuclear Regulation Authority, the nation's nuclear watchdog, saying it plans to implement additional work, such as injecting cement or other materials into the soil.

The project involved the construction of a 1,500-meter-long circular frozen soil wall around the No. 1 to No. 4 reactor buildings. The utility inserted 1,568 pipes to a depth of 30 meters and 1 meter apart. The idea was that each pipe would then freeze the soil around it once liquid of minus 30 degrees circulated inside the cylinders.

The project is aimed to stop flow of groundwater into reactor buildings, where melted nuclear fuel has accumulated in the basements, and, as a result, reduce the volume of highly contaminated water.

To date, around 34.5 billion yen (\$315 million) has been spent on the project.

TEPCO started to freeze the soil in late March, with the goal of first creating an 820-meter-long portion, mainly along the side of the plant facing the sea.

According to TEPCO, the temperature of soil around pipes was lower than zero in only 88 percent of 5,800 or so sites it surveyed as of May 17. In the remaining 12 percent, temperatures were as high as 10 degrees in places.

In spots where temperatures fell short, the soil wall was riddled with holes. TEPCO plans to fill them in by injecting cement or other agents.

On the site of the plant facing a mountain, the utility has been freezing the soil in phases. Although it had planned to double the number of frozen soil sites as early as mid-May, that has not materialized.

"If the effects of the frozen soil wall fall short of what we have expected, we will hold talks with TEPCO about additional steps," said an NRA official in charge of the issue.

By KOHEI TOMIDA/ Staff Writer

April 28, 2016

## Icewall not watertight

### Fukushima plant's ice wall not watertight, says architect

<http://www.asahi.com/ajw/articles/AJ201604280098.html>

THE ASSOCIATED PRESS

Coping with the vast amounts of ground water flowing into the broken Fukushima nuclear plant--which then becomes radiated and seeps back out--has become such a problem that Japan is building a 35 billion yen "ice wall" into the earth around it.

But even if the frozen barrier built with taxpayers' money works as envisioned, it won't completely block all water from reaching the damaged reactors because of gaps in the wall and rainfall, creating as much as 50 tons of contaminated water each day, said Yuichi Okamura, a chief architect of the massive project.

"It's not zero," Okamura said of the amount of water reaching the reactors in an interview with The Associated Press earlier this week. He is a general manager at Tokyo Electric Power Co., or TEPCO, which operates the facility that melted down after it was hit by a tsunami in 2011, prompting 150,000 people to evacuate.

Workers have rigged pipes that constantly spray water into the reactors to keep the nuclear debris inside from overheating, but coping with what to do with the resulting radiated water has been a major headache. So far, the company has stored the water in nearly 1,000 huge tanks around the plant, with more being built each week.

TEPCO resorted to devising the 1.5-kilometer-long ice wall around the facility after it became clear it had to do something drastic to stem the flow of groundwater into the facility's basement and keep contaminated water from flowing back out.

"It's a vicious cycle, like a cat-and-mouse game," Okamura said of the water-related issues. "We have come up against many unexpected problems."

The water woes are just part of the many obstacles involved in controlling and dismantling the Fukushima No. 1 plant, a huge task that will take 40 years. No one has even seen the nuclear debris. Robots are being created to capture images of the debris. The radiation is so high no human being can do that job.

The ice wall, built by construction company Kajima Corp., is being turned on in sections for tests, and **the entire freezing process will take eight months** since it was first switched on in late March. **The entire wall requires as much electricity as would power 13,000 Japanese households.**

Edward Yarmak, president of Arctic Foundations, based in Anchorage, Alaska, which designs and installs ground freezing systems and made an ice wall for the Oak Ridge reactor site, says the solution should work at Fukushima.

"The refrigeration system has just been turned on, and it takes time to form the wall. First, the soil freezes concentrically around the pipes and when the frozen cylinders are large enough, they coalesce and form a continuous wall. After time, the wall increases in thickness," he said in an email.

But critics say the problem of the groundwater reaching the reactors was a no-brainer that should have been projected.

Building a concrete wall into the hill near the plant right after the disaster would have minimized the contaminated water problem considerably, says Shigeaki Tsunoyama, honorary professor and former president of University of Aizu in Fukushima.

**Even at the reduced amount of 50 tons a day, the contaminated water produced at Fukushima will equal what came out of Three Mile Island's total in just eight months because of the prevalence of groundwater in Fukushima,** he said.

Although TEPCO has set 2020 as the goal for ending the water problems, Tsunoyama believes that's too optimistic.

"The groundwater coming up from below can never become zero," he said in a telephone interview.

"There is no perfect answer."

Okamura acknowledged the option to build a barrier in the higher elevation near the plant was considered in the early days after the disaster. But he defended his company's actions.

The priority was on preventing contaminated water from escaping into the Pacific Ocean, he said. Various walls were built along the coastline, and radiation monitors show leaks have tapered off over the last five years.

Opponents of nuclear power say the ice wall is a waste of taxpayers' money and that it may not work.

"From the perspective of regular people, we have serious questions about this piece of research that's awarded a construction giant," says Kanna Mitsuta, director of ecology group Friends of the Earth Japan.

"Our reaction is: **Why an ice wall?**"

May 31, 2016

## **New device to clear debris from No.1**

### **TEPCO clearing radioactive debris from reactor**

[http://www3.nhk.or.jp/nhkworld/en/news/20160531\\_01/](http://www3.nhk.or.jp/nhkworld/en/news/20160531_01/)

The operator of the Fukushima Daiichi nuclear plant is using a vacuum-like device to clear radioactive debris from a damaged reactor building.

The No. 1 reactor building suffered a hydrogen explosion in 2011. The top floor of the building is scattered with relatively small pieces of rubble, including iron frames and concrete. The debris is an obstacle to plans to remove nuclear fuel from a cooling pool in the building.

On Monday, **a device measuring 13 meters long and 5 meters high was lifted by crane to the building. It is fitted with a hose capable of sucking up objects weighing as much as 20 kilograms.**

Tokyo Electric Power Company says **it wants to complete the work in July** and move on to larger pieces of debris next year. The company hopes to start removing the nuclear fuel in about four years.

**The company says workers are spraying chemical agents and taking other steps to prevent the spread of radioactive dust.**

TEPCO came under fire in 2013, when work to remove rubble from the No. 3 reactor building resulted in radioactive substances being dispersed to surrounding areas.

The company says that during the work on Monday, no abnormalities were detected in radiation levels or in the count of radioactive particles.

June 2, 2016

## Checking the icewall

### **TEPCO examines ice wall at Fukushima Daiichi**

[http://www3.nhk.or.jp/nhkworld/en/news/20160602\\_28/](http://www3.nhk.or.jp/nhkworld/en/news/20160602_28/)

The operator of Fukushima Daiichi nuclear power plant will conduct extra work to help freeze the ground around the buildings housing the 4 crippled reactors.

Tokyo Electric Power Company discussed the idea with officials of the Nuclear Regulation Authority on Thursday.

TEPCO made the proposal after reporting some problems with a 1.5-kilometer-long frozen soil wall it has been building around the 4 reactor buildings since March.

The wall is aimed at cutting the amount of groundwater flowing into the basement of the buildings, where it becomes contaminated with radioactive substances and can flow out of the plant in the direction of the sea.



TEPCO said **the amount of groundwater in some areas outside the wall near the sea has not yet fallen.**

TEPCO said rainfall may be partly to blame for the problem, and added that it has seen a drop in groundwater levels elsewhere, in areas much closer to where the wall has been completed successfully. TEPCO said that, overall, the wall appears to be proving effective.

But many members of the regulatory agency said TEPCO's argument is not convincing enough.

TEPCO admitted that underground temperatures at several locations along the wall have not yet fallen to zero, which indicates that the ground is not frozen there.

**TEPCO said it will start extra work to pour cement into those locations to help seal off the wall completely.**

**The utility said it will be about a month before it can determine if the extra work has started producing a positive effect in reducing the amount of groundwater flowing in.**

## Extending frozen walls

### TEPCO to extend frozen soil walls to block water leakages at Fukushima plant

<http://mainichi.jp/english/articles/20160602/p2a/00m/0na/011000c>

The Nuclear Regulation Authority approved on June 2 a plan submitted by Tokyo Electric Power Co. (TEPCO) to extend frozen soil walls at the Fukushima No. 1 Nuclear Power Plant to around virtually the whole plant to block ground water leakages.

- **【Revised】** NRA approves TEPCO's plan to freeze underground walls of soil at Fukushima plant

**The plan is to gradually extend the walls**, made by freezing underground earth, to surround the crippled plant. TEPCO also revealed plans to pour in cement to supplement parts of the existing walls that are not fully frozen.

In March this year TEPCO began freezing 820 meters of wall, or about 55 percent of the total planned length. There are fears that if the plant is completely surrounded by frozen walls, the underground water level at the plant will drop and highly-radioactive water within the reactor buildings might leak out. For this reason the company was freezing the walls gradually and keeping an eye on conditions, but due to a lack of any major problems so far they decided to extend the walls.

The frozen walls -- together with other measures like a "subdrain plan" to dig wells around the plant and drain out contaminated water -- are at the center of TEPCO's strategies to contain contaminated water leaks. A total of 1,568 pipes are to be driven into the ground and have minus 30 degrees Celsius coolant poured into them to create a "wall of ice" 30 meters deep. **When completed, the wall is expected to cut daily underwater inflow from around 200 metric tons to less than 100 tons, but there is no definite proof of this.** A date for when the wall will be completed has not been decided.

June 5, 2016

## No.2: Water leakage & meltdown

### TEPCO: Cooling water leakage likely caused meltdown

[http://www3.nhk.or.jp/nhkworld/en/news/20160605\\_02/](http://www3.nhk.or.jp/nhkworld/en/news/20160605_02/)

The operator of the damaged Fukushima Daiichi nuclear power plant says **a water leak in the number 2 reactor emergency cooling system may have contributed to its meltdown.**

The plant lost power following a massive earthquake and tsunami on March 11th 2011.

The emergency cooling system began operating right away, driven by steam generated in the reactors. The system's pumps were designed to inject coolant into the reactors during an emergency.

The number 2 reactor's emergency cooling equipment lost its function on March 14th, 3 days after the disaster.

**The exact cause of the failure remains unknown more than 5 years after the accident.**

Workers tried to inject water from outside, but were unsuccessful in cooling it down. This led to the nuclear fuel meltdown and release of radioactive substances into the air that spread across the region.

Experts at Tokyo Electric Power Company analyzed the level of contaminated water inside the number 2 reactor, as well as the amount of leaked water.

**They believe that water is leaking from a hole near the cooling system.**

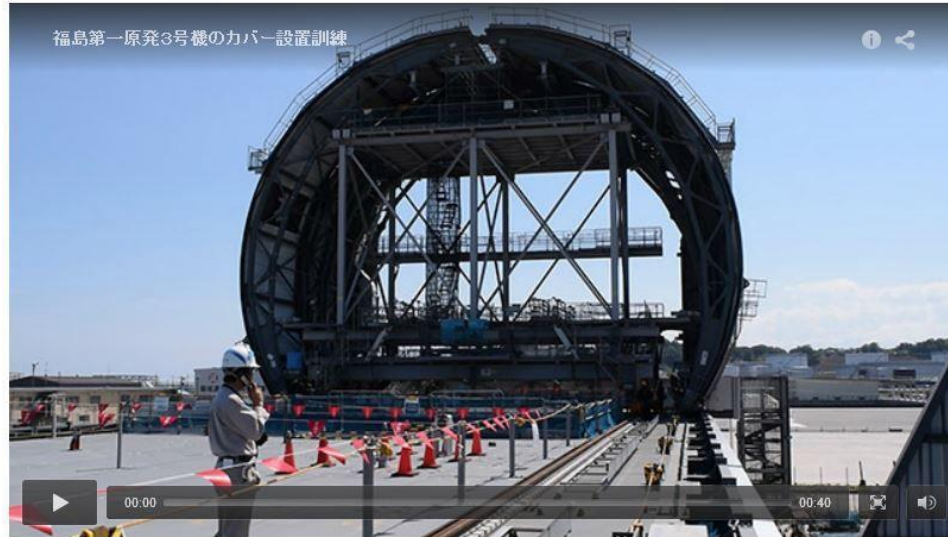
The experts suspect that cooling water began leaking from the system after the pumps had operated beyond the 8 hours for which they were designed.

They believe **the water leakage was the major cause of the reactor heating up.**

Water injected to cool the melted nuclear fuel continues to leak into the reactor building. This contaminated water is hampering decommissioning work at the plant.

June 13, 2016

## A dome for reactor No.3



An engineer with Tokyo Electric Power Co. explains how a massive cover will be built over the No. 3 reactor building of the Fukushima No. 1 nuclear power plant during a practice run at Onahama port in Iwaki, Fukushima Prefecture, on June 10. (Kenji Izawa)

An engineer with Tokyo Electric Power Co. explains how a massive cover will be built over the No. 3 reactor building of the Fukushima No. 1 nuclear power plant during a practice run at Onahama port in Iwaki, Fukushima Prefecture, on June 10. (Kenji Izawa)

### Dry run kicks off to build huge dome over damaged reactor

<http://www.asahi.com/ajw/articles/AJ201606130029.html>

By KENJI IZAWA/ Staff Writer

IWAKI, Fukushima Prefecture--A dress rehearsal is under way to install a huge "hat" over a crippled reactor building at the Fukushima No. 1 nuclear power plant.

The bulky dome-shaped cover is meant to stop the spread of radioactive material and protect equipment necessary to retrieve 566 bundles of nuclear fuel rods from a storage pool in the No. 3 reactor building.

**The simulation is designed to get workers fully drilled so they can set up the cover quickly, reducing the time they are exposed to radiation.**

Tokyo Electric Power Co., operator of the crippled plant, has started simulating the process at Onahama port in Iwaki.

On June 10, TEPCO invited reporters to witness part of the drill in which portions of the cover measuring about 18 meters high were moved on a rail for about 50 meters.

The No. 3 reactor building, where a meltdown occurred after the March 2011 Great East Japan Earthquake and resulting tsunami, still has an extremely high reading of radiation.

TEPCO plans to begin retrieving the fuel rods during fiscal 2017, starting in April next year.

The drill is expected to continue through this month to ensure there are no flaws in the working procedures and safety measures.

TEPCO plans to first decontaminate the No. 3 reactor building and put up shields so that radiation levels drop when the massive cover is installed.

The cover used in the drill will be dismantled and then shipped to the power plant for reassembly and use in the actual retrieval.

June 16, 2016

## The importance of words

### Panel: Use of words 'core meltdown' banned

[http://www3.nhk.or.jp/nhkworld/en/news/20160616\\_32/](http://www3.nhk.or.jp/nhkworld/en/news/20160616_32/)

A panel report says a former president of Tokyo Electric Power Company had instructed its officials not to use the words "core meltdown" in explaining the accident at the Fukushima Daiichi nuclear plant. The panel says the president banned use of the words following what he said was **an instruction from the prime minister's office.**

TEPCO admitted meltdowns at 3 of its reactors at the Fukushima plant 2 months after the March 2011 accident. It had instead explained that the reactors' cores had been damaged.

A third-party panel was set up by the utility in March to investigate responses to the accident. It submitted the probe results on Thursday.

The panel report says then-TEPCO president Masataka Shimizu instructed a vice president, who was attending a news conference 3 days after the accident, not to use the words "core meltdown."

The report says the ban was conveyed to the vice president through a public relations officer and that it was explained as an instruction from the prime minister's office.

But the panel says it did not carry out investigations of the prime minister's office and that it could not gain details of the instruction through interviews with Shimizu and other officials. Such details include which member of the prime minister's office gave it and how.

Another panel set up by the Niigata prefectural government has also been investigating TEPCO's handling of the accident.

TEPCO earlier told the Niigata panel that it did not use the words "core meltdown" because there is no concise definition of them and that using the words may have given misleading information.

The third-party panel referred to the fact that it took more than 2 months for TEPCO to admit core

meltdowns.

The panel report says it cannot say this was improper because TEPCO officials could not determine whether core meltdowns had taken place by inspecting the reactors at that time.

But **the report also says core meltdowns were being mentioned within the company at that time and that it could have admitted the phenomena externally.**

A panel jointly set up by Niigata Prefecture and TEPCO is expected to carry out further investigations of the matter.

June 28, 2016

## Power shortage at the plant

### Fukushima plant power outage affects some devices

[http://www3.nhk.or.jp/nhkworld/en/news/20160628\\_19/](http://www3.nhk.or.jp/nhkworld/en/news/20160628_19/)

A power failure at the Fukushima Daiichi nuclear power plant is affecting some facilities on Tuesday.

Operator Tokyo Electric Power Company says an alarm indicating an abnormality at one of the power sources in the compound sounded at around 3:40 AM.

**TEPCO officials say some equipment to treat contaminated water and to cool an ice wall surrounding the reactors has stopped operating.**

But they say **the cooling of reactors and nuclear fuel storage pools is continuing and monitoring posts in the area show no changes in radiation levels.**

Officials say 22 of the 30 devices to cool the ice wall were in operation at the time of the power failure, and they are investigating to see how many have been affected.

TEPCO is rushing to restore full power and determine the cause of the outage.

June 30, 2016

## No.2: Fuel may still be in the reactor

## Melted fuel may be at the bottom of No.2 reactor

[http://www3.nhk.or.jp/nhkworld/en/news/20160630\\_07/](http://www3.nhk.or.jp/nhkworld/en/news/20160630_07/)

NHK has learned it is highly likely that a large amount of melted nuclear fuel remains at the bottom of one of the damaged reactors at the Fukushima Daiichi nuclear power plant.

Experts from Tokyo Electric Power Company and other institutions confirmed a large black shadow at the bottom of the No.2 reactor, using a device that uses elementary particles called muons.

The probe to see into the reactor's interior has been conducted with the High Energy Accelerator Research Organization and others.

The analyses of the image led the experts to believe that **most of the melted fuel is likely located at the bottom of the reactor together with other structures in the reactor.**

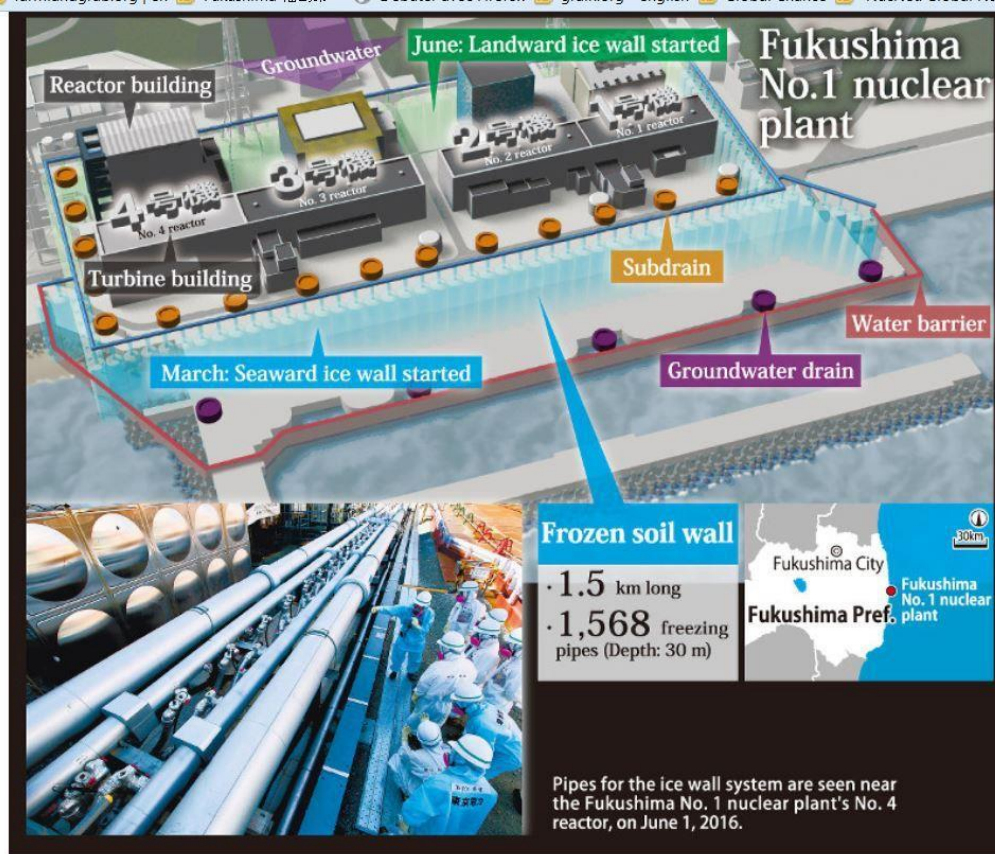
This is the first time that an image of what's believed to be molten fuel has been captured. Similar shadows are said to have been confirmed also on the walls of the reactor.

**The results of the probe have a considerable impact on a process to remove melted fuel,** the most difficult part of reactor decommissioning.

TEPCO is conducting further analyses of the reactor.

During the accident in 2011, nuclear fuel melted down in the plant's 3 reactors. Most of the fuel in the No.1 reactor is believed to have melted through the core. But the locations of the fuel in the No.2 and 3 reactors are not yet known.

## Icewall raises severe doubts



## NRA casts doubt on TEPCO ice wall project at Fukushima nuke plant

<http://mainichi.jp/english/articles/20160630/p2a/00m/0na/006000c>

In March this year, Tokyo Electric Power Co. (TEPCO) began work on a subterranean wall of frozen soil mainly on the seaward side of the disaster-stricken Fukushima No. 1 nuclear plant, with most of another wall on the landward side begun in June. The purpose of the barriers is to stop the flow of groundwater into the plant buildings -- a problem that has resulted in enormous volumes of contaminated water.

However, three months since the freezing process began, TEPCO is ominously silent on the ice wall's effectiveness, and the plan is quickly approaching its do-or-die moment.

The problem itself is simply put. Every day, some 850 metric tons of groundwater flows down from the mountains and under the Fukushima No. 1 plant property. Some of the water collects in the shattered reactor buildings, coming into contact with melted nuclear fuel and other radioactive substances and becoming heavily contaminated. TEPCO needs to stop the groundwater from getting into these buildings. In September 2015, the utility started digging a chain of wells called subdrains to catch and drain the groundwater. This is just one of many countermeasures tried so far, including the ice wall. Work on the latter began in June 2014, and eventually 1,568 pipes were sunk along a 1.5-kilometer perimeter around the No. 1-4 reactors and turbine buildings. The plan calls for coolant chilled to minus 30 degrees Celsius to be pumped into the pipes, freezing the soil around them to a depth of about 30 meters and creating a solid barrier.

"Ice walls are often used in public works projects, but the one at the Fukushima No. 1 nuclear plant is by far the largest ever tried," says Mie University associate professor Kunio Watanabe. When building a tunnel, for example, ice walls are used to prevent groundwater from flowing into the construction area after the bedrock has been fractured. In Japan, the method has been used on some 600 such projects since 1962. The largest ice wall ever created was about 37,700 cubic meters, during construction of a subway line in Tokyo. The Fukushima plant ice wall is nearly double that, at about 70,000 cubic meters. TEPCO tested the method in April 2015, freezing one section of the subterranean wall. To stop contaminated groundwater from flowing into the ocean, the utility started injecting coolant in the pipes on the seaward side and part of the landward wall in late March in an attempt to create about an 820-meter-long subterranean barrier -- or 55 percent of the eventual total length. Saying that the temperatures were dropping according to plan, the utility started freezing operations on most of the remaining landward section at the beginning of June, and now only seven sections totaling 45 meters on the landward side are left.

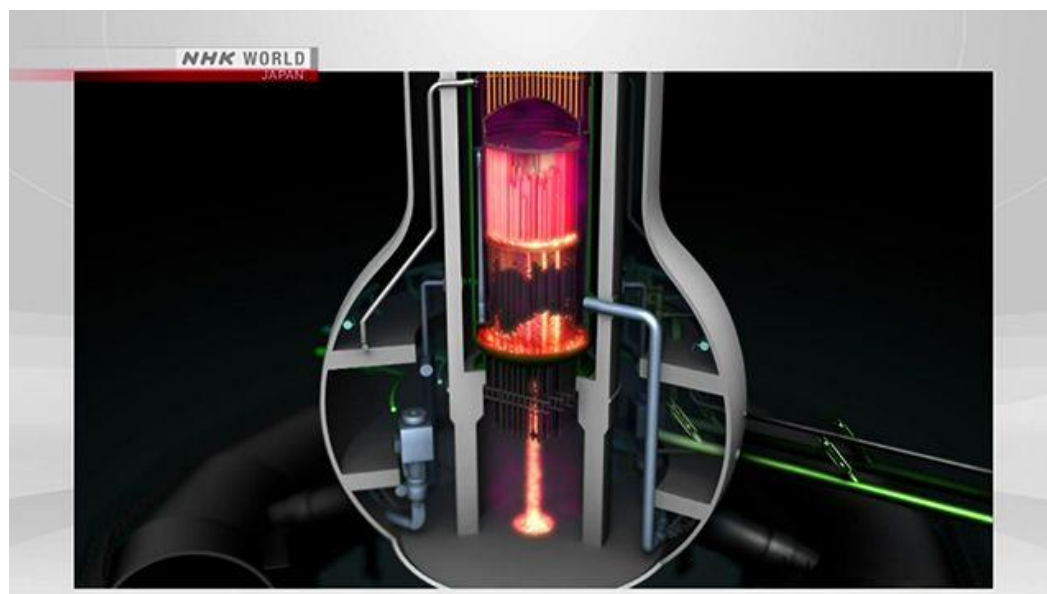
TEPCO has stated that "the ice wall is going according to plan." However, the Nuclear Regulation Authority (NRA) has pointed out that **the volume of groundwater collecting in waterfront wells has not decreased, casting doubt on TEPCO's claim.**

At a meeting this month, NRA committee member Toyoshi Fuketa stated, **"This is not a wall in a true sense. Perhaps it's more akin to a bamboo screen, with groundwater trickling through the gaps."**

TEPCO has responded that the quick flow of the groundwater likely makes it hard to freeze the soil in some places, and it is proceeding with work to create cement barriers to slow the water down.

**There are also worries that the large volumes of highly contaminated water already collecting in the reactor and turbine buildings could leak into the environment if only the landward ice wall proves effective and the seaward wall has gaps.** While TEPCO is looking to expand the ice wall, the NRA has not altered its stance that it must first confirm the effectiveness of the freezing operations already undertaken. **The ice wall has already cost 34.5 billion yen in government funds.**

## Signs of molten fuel in No.2





## Probe Spots Signs of Molten Nuclear Fuel

Workers who are trying to decommission the crippled nuclear reactors in Fukushima say they've made a discovery that might lead to the first step in the process.

They've told NHK they think they've located the molten fuel in one of the reactors.

Experts from Tokyo Electric Power Company and other institutions say it's highly likely there's still a large amount of fuel at the bottom of the No.2 reactor.

Finding the fuel has been a long and costly challenge.

Scientists developed a device that fires elementary particles called muons into the reactor, then takes an x-ray-like image.

It showed a large black shadow at the bottom of the reactor, and they saw similar shadows on the reactor walls.

Meltdowns occurred at 3 reactors after the earthquake and tsunami in March 2011.

Earlier surveys suggested the fuel in the No.1 reactor melted through the pressure vessel. But the experts have been struggling to determine what happened in reactors 2 and 3.

July 7, 2016

## TEPCO will reuse flange-type tanks to store treated water

### TEPCO to reuse tanks holding radioactively contaminated water at Fukushima plant

<http://mainichi.jp/english/articles/20160707/p2a/00m/0na/003000c>

Tokyo Electric Power Co. (TEPCO) will reuse highly contaminated tanks at the crippled Fukushima No. 1 Nuclear Power Plant to store radioactively contaminated water after treatment, company sources said.

- **【Related】** As I See It: Has nothing been learned from TEPCO's 'meltdown' cover-up?
- **【Related】** Reuse of radioactive soil feared to trigger illegal dumping
- **【Related】** Ministry green-lights reuse of radioactive soil for public works projects

The company will return contaminated water to flange-type tanks that had held such water after removing radioactive materials from the water using the Advanced Liquid Processing System (ALPS). This is **because TEPCO has failed to prevent contaminated water from being generated on the premises of the plant or to secure enough storage tanks to hold treated water.**

TEPCO had submitted the reuse plan to the Nuclear Regulation Authority, which approved it on July 6 or earlier. TEPCO is set to begin reusing contaminated tanks as early as this month.

Flange-type tanks are assembled by tightening multiple steel plates with bolts. Since such tanks have higher risks of leaking contaminated water, TEPCO is gradually replacing them with tanks assembled by welding steel plates together.

TEPCO is trying to freeze underground soil to surround reactor buildings at the Fukushima power plant to prevent underground water from flowing beneath them and becoming contaminated with radioactive materials.

However, **as the efforts have proven ineffective, the utility has decided to reuse flange-type tanks, which it had initially planned to dismantle.**

Massive amounts of water are flowing onto the premises of reactor buildings at the atomic power station, generating some 400 tons of radioactively contaminated water a day. TEPCO uses ALPS to purify contaminated water, but **the system cannot remove radioactive tritium.**

The power company has stored the treated water mainly in welded-type tanks. There are already 1,000 water tanks on the premises of the power station.

July 12, 2016

## Contaminated rainwater leak

### Fukushima plant workers recover tainted rainwater

[http://www3.nhk.or.jp/nhkworld/en/news/20160712\\_12/](http://www3.nhk.or.jp/nhkworld/en/news/20160712_12/)

The operator of the Fukushima Daiichi nuclear power plant says contaminated rainwater leaked into a ditch but workers were able to recover all of it. Tokyo Electric Power Company blamed the accident on human error.

TEPCO says the leak occurred on Monday while workers were using a vacuum truck to remove rainwater from a storage tank. Company officials say **a hose came loose and about 80 liters flowed out, and some of it went into an underground ditch.**

**They say the rainwater contained 1,200 becquerels per liter of strontium and other beta ray-emitting radioactive substances. The figure is 40 times the government limit for releasing strontium tainted water into the ocean.**

TEPCO says workers blocked the ditch with sandbags and recovered all the water, so **none of it is expected to flow into the ocean.** It says a radiation monitor installed in a drainage channel downstream has picked up no abnormalities.

The utility says right after the March 2011 nuclear accident the tanks were used to store wastewater tainted with relatively high levels of radiation. It says they're no longer used, and there are no barriers around them to prevent water from leaking into the ditch.

TEPCO says workers will decontaminate the ditch, and investigate what caused the hose to come off.

July 19, 2016

## **TEPCO urged to cut risk of radioactive water leak**

[http://www3.nhk.or.jp/nhkworld/en/news/20160719\\_33/](http://www3.nhk.or.jp/nhkworld/en/news/20160719_33/)

Japan's nuclear regulator has urged the operator of the crippled Fukushima Daiichi nuclear power plant to reduce the risk of leaking of highly radioactive water from the facility into the sea, in case of another tsunami.

About 60,000 tons of such water is believed to have pooled in reactor buildings at the plant. The operator, Tokyo Electric Power Company, or TEPCO, is injecting water into the buildings to cool melted nuclear fuel, and groundwater is flowing into their basements.

The Nuclear Regulation Authority instructed TEPCO at a meeting on Tuesday to urgently study measures to lower the amount and radiation levels of the water.

**The authority proposed 2 measures to TEPCO. One is building more tanks to store the water, even though the plant has about one thousand tanks. The other is treating the water using a system designed to filter out radioactive material, and circulating the water in a cooling system.**

NRA member Toyoshi Fuketa said the utility cannot keep the water in the buildings forever. He said TEPCO should handle the water problem either along with that of other radioactive water or first of all.

Following the NRA's instruction, TEPCO is to report the results of its study at a meeting next month or later.

July 20, 2016

## **TEPCO cannot keep radioactive water in buildings forever**

### **NRA pushes for early processing of radioactive water at Fukushima plant**

<http://mainichi.jp/english/articles/20160720/p2a/00m/0na/007000c>

The Nuclear Regulation Authority (NRA) on July 19 instructed Tokyo Electric Power Co. (TEPCO) to begin considering early processing of radioactive water at the disaster-struck Fukushima No. 1 Nuclear Power Plant in order to prevent it leaking and affecting the environment.

The water is contaminated with a high concentration of radioactive substances, and the NRA committee that gave the instruction worries that in the event of another large-scale tsunami, the water could escape and cause massive environmental damage.

A total of around 60,000 metric tons of contaminated water is held in the reactor and turbine buildings for the No. 1 through 4 reactors at the plant. TEPCO is processing the water to remove the radioactive contents other than tritium, and it is storing the processed water elsewhere in tanks. However, new tanks are not being constructed quickly enough to allow large-scale processing of the water, and with new underground water flowing in, the amount of contaminated water in the structures has not decreased.

## TEPCO cannot keep radioactive water in buildings forever (2)



The Fukushima No. 1 nuclear power plant packed with a large number of tanks holding contaminated water in March 2016 (Asahi Shimbun file photo)

### TEPCO told to solve problem of harmful water at Fukushima plant

<http://www.asahi.com/ajw/articles/AJ201607200060.html>

The nation's nuclear watchdog exhorted Tokyo Electric Power Co. to do something about the accumulation of tens of thousands of tons of highly radioactive water at the stricken Fukushima No. 1 nuclear plant, calling the situation intolerable.

“We cannot allow the danger of highly polluted water at the plant to continue any longer,” Toyoshi Fuketa, a commissioner of the Nuclear Regulation Authority, said at a July 19 meeting to discuss work on the plant’s decommissioning.

Fuketa urged TEPCO to consider pumping the highly radioactive water or diluting it, citing the risk of spill if another tsunami hits.

About 60,000 tons of water containing extremely high levels of radiation have accumulated in the basements of the No. 1 through No. 4 reactor and turbine buildings.

Water leaking to the basement floors of the facilities after being used to cool melted nuclear fuel at the plant has mixed with underground water flowing there.

The concentration of radioactive cesium is estimated at between hundreds of thousands becquerels and tens of millions of becquerels per liter.

Fuketa said the utility should weigh either pumping or taking measures to reduce radiation levels of polluted water.

NRA's directive is intended to prevent the leakage of contaminated water into the nearby sea or outside the buildings in the event of a tsunami unleashed by another powerful earthquake.

TEPCO is expected to present the results of its study of steps it could take as early as August.

The company has been trying to reduce the volume of contaminated water by building a frozen underground wall around the reactor and turbine buildings. The frozen soil wall was expected to prevent groundwater from flowing into the plant.

TEPCO started the freezing of the soil in late March, but not all of the wall is in an ice state, with the result that a huge volume of groundwater is still flowing to the nuclear complex.

## TEPCO admits icewall cannot block off groundwater

### In first, Tepco admits ice wall can't stop Fukushima No. 1 groundwater

<http://www.japantimes.co.jp/news/2016/07/20/national/first-tepco-admits-ice-wall-cant-stop-fukushima-no-1-groundwater/#.V5B6LaJdeot>

by Tomoko Otake

Staff Writer

The much-hyped ice wall at the crippled Fukushima No. 1 nuclear power plant has failed to stop groundwater from flowing in and mixing with highly radioactive water inside the wrecked reactor buildings, operator Tokyo Electric Power Co. Holdings Inc. has admitted.

Tepco officials also said at a meeting of the Nuclear Regulation Authority in Tokyo that it is not the utility's ultimate goal to shut out groundwater with the ice wall, which has been built around the four damaged reactor buildings at the plant.

Tuesday's announcement was apparently the first time the utility publicly said it is technically incapable of blocking off groundwater with the frozen wall.

Five years after the March 2011 quake and tsunami triggered the nuclear crisis, Tepco continues to be plagued by radiation-tainted groundwater, mostly rainwater that is mixing with contaminated water in the basement of the damaged reactor buildings.

In response, Tepco has completed most of the 1.5-km-long sunken wall of frozen soil around the stricken reactors to keep groundwater out. It has also built "subdrain" wells around the buildings to pump up the tainted groundwater for treatment and ultimate discharge into the Pacific.

While the completed sections of the ice wall began operating in March, it has not made a visible impact in reducing the amount of groundwater inflows. According to Tepco, the amount of groundwater pumped up from subdrains averaged 321 tons per day in June, just 31 tons less than the daily average in May.

Asked whether Tepco plans to eventually block rainwater from seeping through the ice wall, a Tepco official said it is not technically feasible "to keep out the groundwater 100 percent," according to a video of the meeting released Tuesday by the NRA.

"We are aiming to control the amount of water going into the reactor buildings, with the ice wall and subdrains," said Tomohiko Isogai, an official in charge of dismantling the plant.

Kiyoshi Takasaka, a nuclear expert at the Fukushima Prefectural Government, said it was the first time he had heard such a comment from Tepco, pressing the firm on whether it marked a "change of policy."

A Tepco official denied this, saying that while it wants to "close off the wall as much as possible," its ultimate goal has been to "curtail" groundwater inflow, not halt it.

Also at the meeting, NRA acting head Toyoshi Fuketa demanded that Tepco move quickly to reduce the amount of highly radioactive water inside the reactor buildings, saying such water presents the risk of escaping in the event of another monster tsunami. Some 60,000 tons of highly tainted water remain in the leaking basements of reactor buildings 1, 2, 3 and 4.

"We want the amount of (radioactive water) inside the buildings to be reduced as much as possible," he said.

July 23, 2016

## What is normalcy?

### **VOX POPULI: There's no end to Fukushima crisis while melted fuel remains**

<http://www.asahi.com/ajw/articles/AJ201607230013.html>

Vox Populi, Vox Dei is a daily column that runs on Page 1 of The Asahi Shimbun.

A massive concrete structure encases the wrecked No. 4 reactor at the Chernobyl nuclear power plant, site of the catastrophic 1986 accident.

Dubbed the "sarcophagus," it was erected to contain the fuel that could not be extracted from the crippled reactor.

I never expected this word ("sekkan" in Japanese) to crop up in connection with the 2011 Fukushima nuclear crisis.

Local governments raised objections to the use of this word in a report compiled by a government organ that supports the decommissioning of the Fukushima No. 1 nuclear power plant.

While the report discusses the extraction of melted fuel as a requirement, it is written in such a way as to suggest that the construction of a sarcophagus is an option that should not be dismissed out of hand.

This outraged the governor of Fukushima, Masao Uchibori, who lashed out, "Containing (the melted fuel) in a sarcophagus spells giving up hope for post-disaster reconstruction and for returning home."

The government organ has since deleted the word from the report, admitting that it was misleading and that constructing a sarcophagus is not under consideration.

The report lacked any consideration for the feelings of local citizens. But more to the point, just deleting the word does not settle this case.

Even though five years have passed since the disaster, nothing has been decided yet on how to extract the melted fuel. How, then, can anyone guarantee that the fuel will never be "entombed"?

I am reminded anew of the sheer difficulty of decommissioning nuclear reactors. The Fukushima edition of The Asahi Shimbun runs a weekly report on the work being done at the Fukushima No. 1 plant.

The report portrays the harsh realities at the site, such as leaks of contaminated water and accidents involving workers. Efforts to decommission the crippled reactors continue day after day, but the task is expected to take several decades.

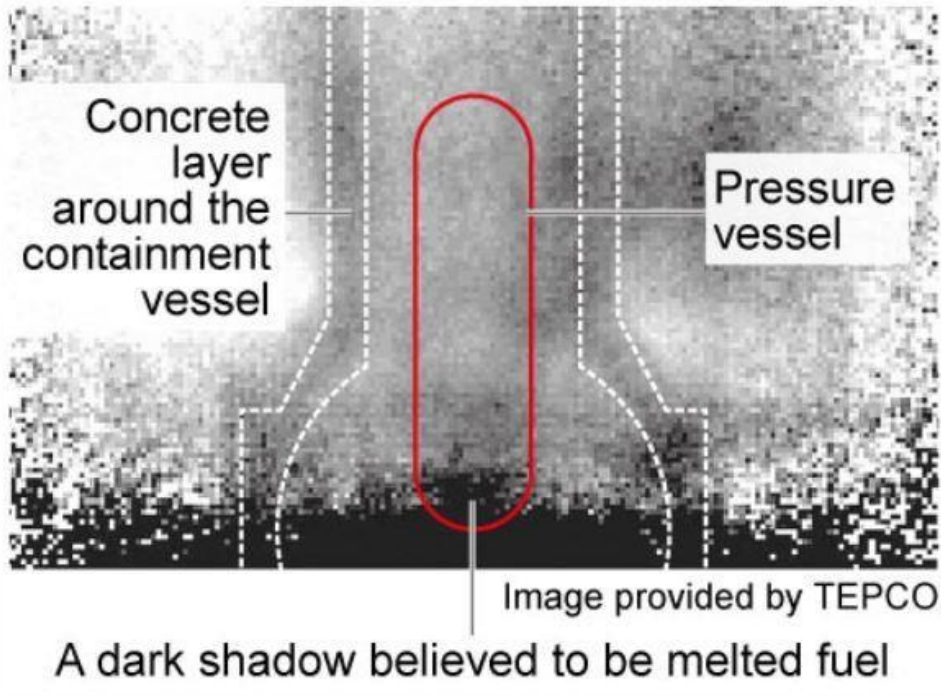
Elsewhere in Japan, the rule that requires nuclear reactors to be decommissioned after 40 years is becoming toothless, and preparations are proceeding steadily for restarting reactors that have remained offline.

"Normalcy" appears to be returning, but there is a huge gap between that and the unending hardships in the disaster-affected areas.

July 29, 2016

## **Most fuel in No.2 did not melt, says TEPCO**

## A tomographic image of the No. 2 reactor at the Fukushima No. 1 nuclear power plant



### Fukushima No. 2 reactor 'X-ray' shows most fuel was contained

<http://www.asahi.com/ajw/articles/AJ201607290050.html>

Most of the nuclear fuel inside the No. 2 reactor at the Fukushima No. 1 nuclear power plant did not melt through the pressure vessel as previously believed, research using muon tomography has revealed.

The assessment was made based on a study that utilized muons, an elementary particle that travels from outer space, to capture the interiors of the crippled reactor building like an X-ray.

Tokyo Electric Power Co., the ill-fated facility's operator, made the announcement on July 28.

According to the utility, the technique captured a black shadow estimated to account for 180 to 210 tons of substances in the lower part of the reactor's containment vessel.

There was about 160 tons of nuclear fuel inside the No. 2 reactor, which was operating when it suffered a meltdown in the accident that resulted from the 2011 Great East Japan Earthquake and tsunami.

As the nuclear fuel, control rods and other materials that would have melted down totaled about 210 tons in weight, TEPCO deemed that "a large portion of the nuclear fuel is presumed to be contained within the pressure vessel."

The latest finding negates past studies that have suggested that most of the nuclear fuel inside the reactor had melted through the vessel.

"We hope to effectively come up with a method to extract the melted fuel," said Naohiro Masuda, president of TEPCO's Fukushima Daiichi Decontamination & Decommissioning Engineering Co.



Muons are known to travel through materials such as concrete, but are unable to penetrate highly dense substances such as uranium.

The International Research Institute for Nuclear Decommissioning, an organization made up of the utility and nuclear power plant manufacturers, had been using the particles' properties to peer inside the No. 2 reactor since March.

## **Bulk of melted fuel at bottom of Fukushima No. 2 reactor vessel**

TOKYO (Kyodo) -- Most of the melted nuclear fuel inside the No. 2 reactor at the disaster-hit Fukushima Daiichi power plant is likely located at the bottom of its pressure vessel, Tokyo Electric Power Company Holdings Inc. said Thursday.

According to a study that used a cosmic ray imaging system, an **estimated 130 tons** of the so-called fuel debris remains at the bottom of the vessel, the first time the location and amount of the melted fuel have been estimated.

The finding is important as the data could help the operator to narrow down methods to remove the fuel debris, the most challenging task in decommissioning the plant's Nos. 1 to 3 reactors that experienced meltdowns in the nuclear crisis that began in March 2011.

The study was carried out by a **team involving Tokyo Electric and the High Energy Accelerator Research Organization in Ibaraki Prefecture.**

As high radiation levels are continuing to hamper direct access to the reactors, researchers have tracked muon elementary particles, which are produced as cosmic rays collide with atmospheric particles and change course when coming into contact with nuclear fuel.

The No. 2 reactor was in operation when the nuclear crisis was triggered by a powerful earthquake and subsequent tsunami that devastated Japan's northeast.

**About 160 tons of fuel assemblies are estimated to have been present inside the reactor vessel prior to the crisis.** Most of the fuel is believed to have fallen to the bottom of the pressure vessel and mixed with nearby structures to form debris.

In the nuclear crisis, massive amounts of radioactive substances were released into the environment, with the Nos. 1, 3 and 4 reactor buildings damaged by hydrogen explosions.

The No. 4 reactor was offline for periodic maintenance work and all of its fuel was stored in the spent fuel pool, avoiding a meltdown.

August 16, 2016

## **Mysteriously missing fuel**

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## The Mysteriously Obtuse Case Of The Missing Fukushima Fuel

<http://www.activistpost.com/2016/08/mysteriously-obtuse-case-missing-fukushima-fuel.html>

By Richard Wilcox, PhD



“Nature knows no indecencies; man invents them.” – Mark Twain

As the world forever hurtles toward Armageddon, the Fukushima nuclear disaster has largely faded from the front pages. But the issue is far from resolved. Radiation from nuclear accidents is not easily dispelled with estimates of clean-up time at Fukushima ranging from 40 to 500 years, and nearly six years have already passed. Even safely stored nuclear material is dangerous for 100,000 years (1).

### Elvis Has Left The Building

The major question regarding the situation at Japan’s Fukushima Dai-ichi (no.1 nuclear power plant) regards the location of the melted fuel at reactor units 1, 2 and 3.

Recent evidence of the location of the fuel in unit 2 was disputed, with Tokyo Electric Co. (Tepco) and the mainstream media taking one view and independent scientists taking another. Is the melted fuel still inside the container in the reactor building, or has it leaked out and is now penetrating in scattered areas laterally and vertically into the ground?

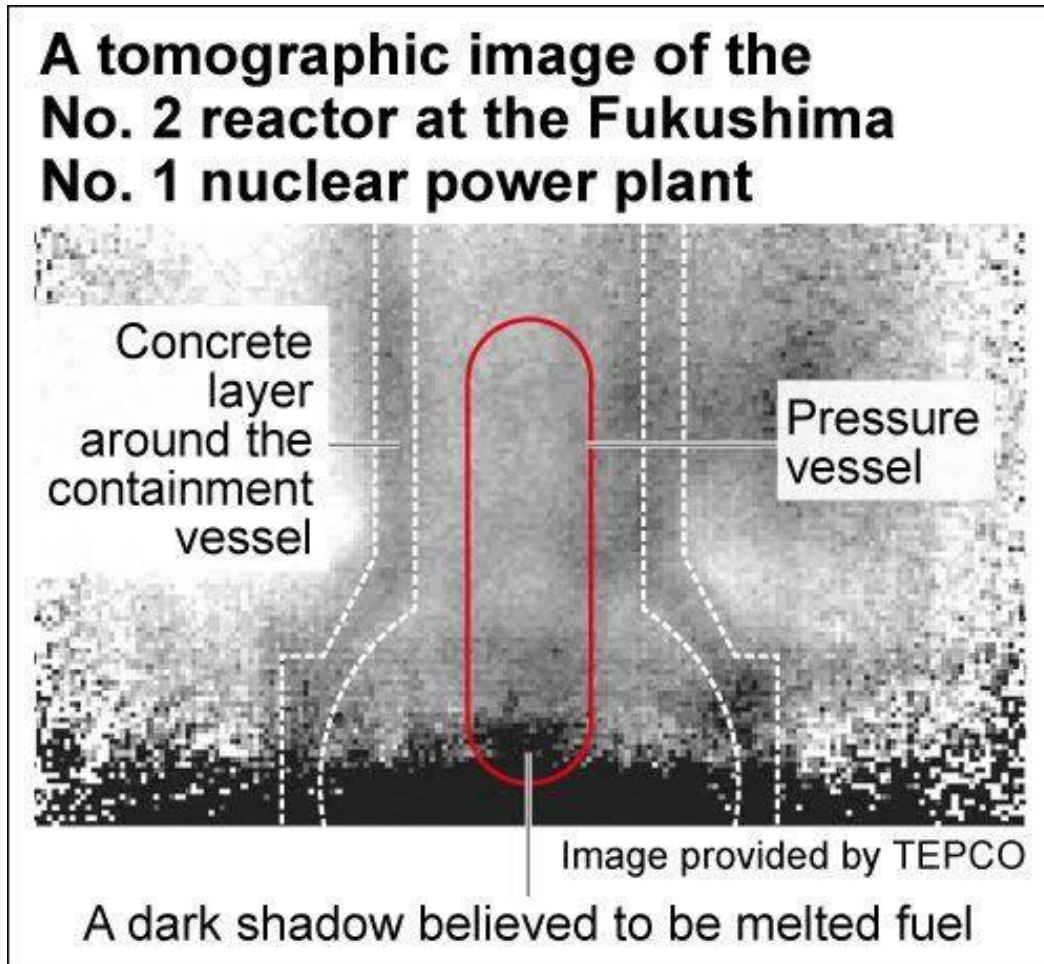
Large amounts of melted fuel could reach the ground water, and even the aquifer which is ultimately connected to the Tokyo water supply.

Let’s compare two assessments on this important issue based on the use of “Muon tomography”:

According to the *Asahi Shimbun* (newspaper) version of reality which relies solely on the Tepco report: Most of the nuclear fuel inside the No. 2 reactor at the Fukushima No. 1 nuclear power plant apparently did not melt through the pressure vessel (2).

Large amounts of melted fuel could reach the ground water, and even the aquifer which is ultimately connected to the Tokyo water supply.

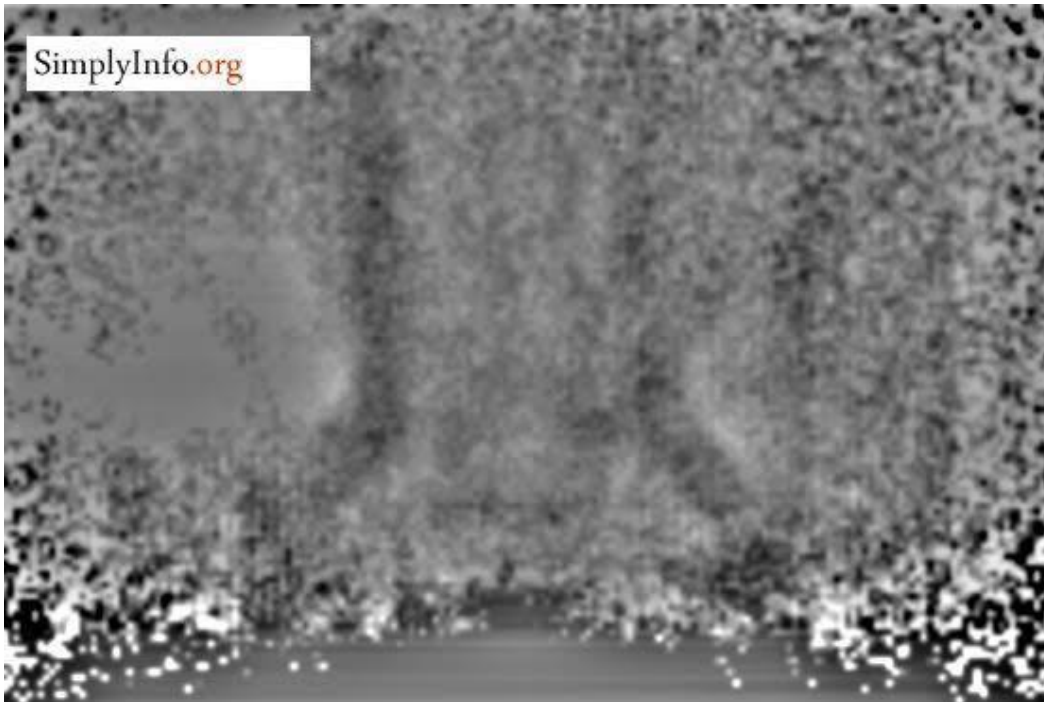
Let's compare two assessments on this important issue based on the use of "Muon tomography":



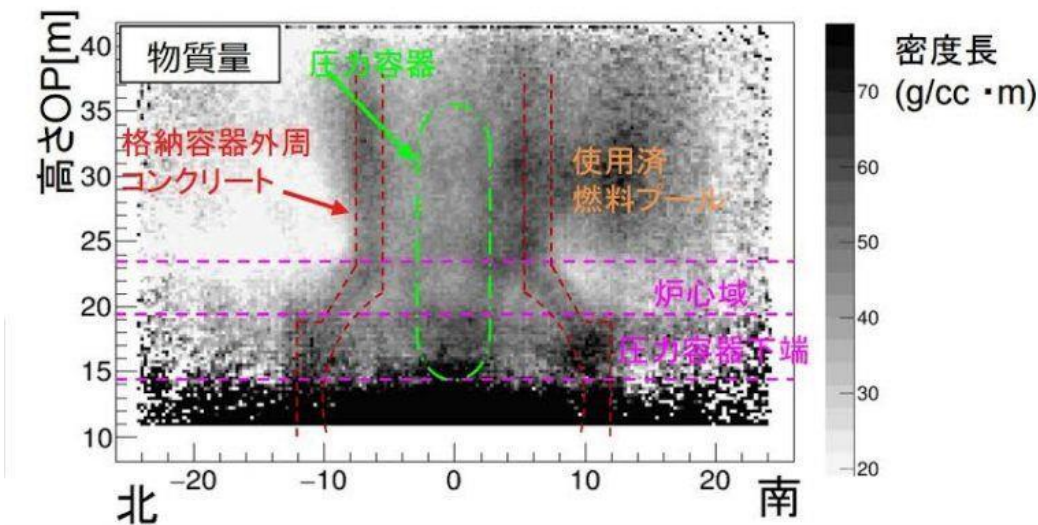
Is it that simple? Tepco's record of reliability has become rather tarnished over the years.

Note that in the graphic image above, the word "believed" is used, which reinforces the word "apparently" used in the text of the article referring to the uncertainty of the location of the melted fuel. However, the title of the article is more confident, stating that "most fuel was contained." The title is blatantly misleading and since most readers just skim the news, that will be what they take away from the report. On the other hand, the independent scientists at the *Simply Info* website differ about the location of the fuel in relation to the container, the "Reactor Pressure Vessel" (RPV):

Tepco's superimposed mask demarcates the bottom head too low including fuel inside the rpv which according to the refined image is clearly shown below the bottom head...." **there is no fuel in the bottom of the RPV in any significant amount**" (3).



This graphic indicates that a different method was used by these scientists to view the location of the melted fuel.



In this graphic the Simply Info scientists argue that the container drawing was placed too low in the Tepco version, whereas in their version, it is higher, making it less obvious that the fuel is in the container. Careful reading of this article reveals that Tepco's analysis, as so glibly presented by the mainstream media, was based on technological smoke and mirrors, clearly intended to deceive. Tepco and the media should report on the range of plausible possibilities, not only the small slice of reality they wish the public to see (4; 5).

So will the *Asahi Shimbun* correct their fallacious reporting? Both the *Japan Times* and the *Asahi Shimbun* are heavily owned and controlled by foreign investors and media. The *Asahi* shares offices with the *New York Times* in Tokyo and many Japanese English dailies rely on Western news wires such as the agenda driven, oligarchic news sources, *Reuters* and the *Associated Press* (6).

## **Decommissioning Or Out Of Commission?**

In fact, in over five years much progress has been made to control the situation at the destroyed Fukushima nuclear plant. Much of the rubble has been cleaned up and fresh coats of paints are on the buildings, but the place is still intensely radioactive, and no human can approach the specific reactor meltdown sites.

The second major issue at Dai-ichi concerns the future plans for the decommissioning of the plant. All along Tepco has said they will retrieve the melted fuel and complete decommissioning within 40 years. In fact the technology to retrieve the fuel has not yet been invented. Not only is it impossible for human workers to approach the area, but even robots break down due to the radiation short circuiting their wires.

It was recently revealed that Japan is still considering an option that many people feel would be very dangerous in the long term, and that is the “sarcophagus” solution (7). The only time this has been tried is at Chernobyl — it looks like a high-tech barn placed over the site (8). Unlike Chernobyl where the ground is rock hard, at Fukushima the ground is akin to a wet sponge with soft topsoil, so while covering it will reduce radioactive atmospheric fallout, the radiation will continue to leak downwards to the aquifer and outwards to the ocean unless appropriate engineering measures are taken.

Nevertheless, progress is slow with efforts “underway to develop the equipment needed to retrieve corium (melted fuel) samples from inside the containment structures of units 1-3 at the plant. No solid time frame” has yet been mentioned (9).

## **The Nuclear Story**

In an interesting aside, the best documentary film on Fukushima I have seen so far, *Fukushima: A Nuclear Story* was released in 2015 (10). It is an Italian production but with English narration and subtitles. The plot follows journalist Pio d’Emilio during the nuclear crisis as he tries to uncover the real situation in Fukushima. The film is engaging and educational at the same time, covering new ground and combining dramatic events as they unfold at the time with scientific explanations done in an entertaining, “manga” comic book style.

The film emphasizes the near catastrophe of Tepco’s panic during the accident, and the courage and wisdom of then prime minister Naoto Kan, and the Fukushima 50, led by the plant manager Masao Yoshida whose snap judgement literally “saved the world.”

The film raises one very interesting piece of information that I did not know about which is that it was only the luck of the pool fuel gate at unit 4 *not closing*, in other words, malfunctioning, which allowed water in to cool the scorching fuel rods. Had that not occurred, the fuel rods could have caught fire spreading massive radiation for hundreds of miles.

Note that had the Fukushima accident happened at night or on the weekend there would have been far fewer workers at the plant to tackle the problem, possibly leading to a completely out-of-control situation.

## **The Ice Wall Cometh...**

The “ice wall” that Tepco built in order to freeze the ground around the plant to block water flow in and out of the plant, continues to have problems. It is a very expensive operation to build and maintain, prone to technical problems and no one really knows when or if it will ever be fully implemented (i.e., taxpayer boondoggle) (11; 12). Even if the ice wall operates as intended it will not stop all of the water flow allowing some to be contaminated (13).

Is this why the sarcophagus option is still on the table? Critics have argued that the ice wall was poorly conceived from the start because it did not address dealing with the source of water flow which is at the water shed above the plant in the nearby mountains (Tepco balked at the project due to the high cost).

### **Japan Nuke News**

Various nuclear related issues pop up from time to time around country. Since the nuclear accident in 2011, the overwhelming public sentiment has been strongly anti nuclear, despite efforts by the Abe administration to downplay the accident and restart as many of the reactors around the country as possible. The logic of the restarts against public opinion is in order to satisfy the big banks who have financed Japanese utility company operations while reactors have remained idle (expensive but not profit producing) over the past years.

Ever since the hugely destructive earthquakes earlier in 2016 on the island of Kyushu, nuclear plant restarts along the path of the fault line, which basically travels through the middle of the entire country, have been in doubt. Still we see for example in Shikoku that nuclear reactors are restarting despite local opposition (14).

Although prime minister Abe keeps pushing for resumption of nuclear operations, he probably would not want to work at the Fukushima nuclear disaster clean up site himself. It was recently reported by Japanese scientists that insoluble radioactive cesium has been detected in workers exposed to high levels of radiation at the plant (15).

Indeed, the wildlife in Fukushima prefecture has long been reported to be contaminated with radiation, recently a wild boar was detected with massive levels of radiation in its body (16). This is an indication of the general contamination of the environment there.

This doesn't stop the Fukushima tourist board from advertising how safe and wonderful life is there. In order to drum up tourist dollars the national government has carried out a massive public relations campaign despite the lingering possibility of numerous radioactive hotspots in the area (17; 18).

### **Trump Threatens Nuclear Cartel**

Maybe things will change a bit if Donald Trump can be elected president in the United States. Trump has promised to reduce US military presence in Japan and let them sort out their own military affairs. This does not bode well for the US-Japan military racket which siphons off billions of dollars in tax revenue to satisfy the greed of both country's military industrial complexes, which are intensely tied up with the nuclear weapons and power industries (20).

Isn't it ironic that the bogeyman of North Korea which is constantly conjured by Japan to justify its own growth in militarism, obtained its original nuclear weapon technology from Britain, a supposed Japan ally (21).

Funny old world ain't it.



Nuclear pollution is not healthy for children and other living things

*\* Special thanks to the Simply Info website for their continuous work on the Fukushima issue; and to Activist Post for their continued reporting.*

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August 19, 2016

## Frozen wall not watertight

### Panel: TEPCO's 'ice wall' failing at Fukushima nuclear plant

<http://www.asahi.com/ajw/articles/AJ201608190060.html>

By KOHEI TOMITA/ Staff Writer



Devices to freeze the earth are set up on the southern side of the No. 4 reactor building at Tokyo Electric Power Co.'s Fukushima No. 1 nuclear power plant in Fukushima Prefecture in 2014. (Pool)

Tokyo Electric Power Co.'s "frozen wall of earth" has failed to prevent groundwater from entering the crippled Fukushima No. 1 nuclear plant, and the utility needs a new plan to address the problem, experts said.

An expert panel with the Nuclear Regulation Authority received a report from TEPCO on the current state of the project on Aug. 18. The experts said the ice wall project, almost in its fifth month, has shown little or no success.

**"The plan to block groundwater with a frozen wall of earth is failing,"** said panel member Yoshinori Kitsutaka, a professor of engineering at Tokyo Metropolitan University. "They need to come up with another solution, even if they keep going forward with the plan."

One big problem hampering work at the nuclear plant, which was hit by the Great East Japan Earthquake and tsunami in 2011, has been the tons of groundwater entering the buildings housing the No. 1 through No. 4 reactors every day.

The water becomes contaminated with radioactive materials within the reactor buildings.

TEPCO's plan was to create a frozen wall of earth around the reactor buildings to divert the groundwater away from the plant and into the ocean.

The company started freezing the ground on March 31, and the project's budget was 34.5 billion yen (\$344 million) in taxpayer money as of the end of May.

But the amount of groundwater pumped from the ocean side of the frozen wall has shown little change from when there was no icy earth wall.

TEPCO's report said 99 percent of thermometer readings on the 820-meter-long stretch showed temperatures of freezing or lower, suggesting the underground wall was frozen solid at those points.

However, **the remaining 1 percent of the readings above freezing were in areas with high levels of groundwater concentration.**

A 99-percent success rate may sound impressive, but much like dams, airlocks and Tupperware, TEPCO's ice wall is failing if it is not 100-percent watertight.

The utility said the unfrozen sections could be reinforced with an injection of concrete.

The panel asked the utility submit calculations estimating the amount of groundwater that can be blocked if water is pumped before it reaches the frozen wall.

August 23, 2016

## 10,000 tons of contaminated water in trenches around reactors

### 10,000 tons of toxic water pools in Fukushima nuclear plant trenches

<http://mainichi.jp/english/articles/20160823/p2g/00m/0dm/074000c>

TOKYO (Kyodo) -- Around 10,000 tons of contaminated water have pooled in underground trenches around the Nos. 1 to 4 reactor buildings of the crippled Fukushima Daiichi nuclear power plant, according to the plant operator Tokyo Electric Power Company Holdings Inc.

- **【Related】** Japan lifts evacuation orders in Fukushima affecting 10,000 people
- **【Related】** TEPCO to reuse tanks holding radioactively contaminated water at Fukushima plant
- **【Related】** TEPCO to extend frozen soil walls to block water leakages at Fukushima plant
- **【Related】** Fukushima population falls by 110,000 after nuclear disaster

Tokyo Electric has no immediate plan to remove the water in the trenches where cables run for the nuclear power complex devastated by the March 2011 earthquake and tsunami disaster.

Water that flew into the trenches in the wake of the huge tsunami is believed to have been mixed with highly radioactive water leaking from the basements of reactor buildings and contaminated rainwater.

"Compared with around 70,000 tons of highly contaminated water that remain in the basements of the reactor buildings, (the water in the trenches) has a low level of concentration and thus poses little threat in terms of radiation exposure and the environment," said an official of the utility known as TEPCO.

TEPCO said in a report issued in July -- based on research conducted in fiscal 2015 -- that it has found around 8,000 tons of toxic water in 17 locations in the trenches that connect with reactor buildings where highly radioactive water accumulates, as well as around 3,000 tons of toxic water at 11 locations in trenches that do not connect with reactor buildings.

Of the water in the trenches around the Nos. 1 to 4 reactor buildings, a removal procedure was completed by June for around 500 tons of water in a pipe that measured the highest level of radioactive cesium at 500,000 becquerels per liter.

The level of radioactive cesium in water at other locations in the trenches was mostly measured at several thousands becquerels or below.

The level in toxic water in the basements of reactor buildings has been measured at around dozens of millions becquerels at maximum.

TEPCO has said it will continue to monitor and measure the level of contamination in water in the trenches regularly and consider taking measures to remove the water in the future. But no concrete plan has been created yet.

The electricity firm has so far removed a total of around 10,000 tons of highly radioactive water at three locations in the trenches running in the seaside of the complex and completed the procedure to fill locations concerned with cement to prevent water leaks.

Still, the level of radioactive cesium remains unchecked at 40 locations in the trenches due to high radioactive levels as well as debris and other objects blocking the research operation.

Around 8,000 tons of contaminated water, including those with an extremely low level of contamination, have also been found in the trenches running around the Nos. 5 and 6 reactor buildings. The two units have lower levels of radiation doses than the Nos. 1 to 4 units as there were no nuclear meltdowns or hydrogen explosions there during the nuclear disaster.

August 30, 2016

## **Typhoon halts work at Daiichi plant**

### **Nearing typhoon halts work at Fukushima Daiichi**

[http://www3.nhk.or.jp/nhkworld/en/news/20160830\\_26/](http://www3.nhk.or.jp/nhkworld/en/news/20160830_26/)

Workers at the troubled Fukushima Daiichi nuclear plant have suspended some of the decommissioning work and are bracing for rain and winds from a powerful typhoon.

Typhoon Lionrock is expected to make landfall along Japan's northeastern coast on Tuesday afternoon, passing off Fukushima Prefecture.

Tokyo Electric Power Company says workers secured electric cables and hoses on the plant compound on Monday.

On Tuesday, the operator suspended work at the plant's port. It also stopped the operation of a crane being used to demolish a temporary cover over one of the reactor buildings. Officials say they are closely watching to make sure the cover is not blown off by the typhoon.

TEPCO says it has also taken measures to prevent contaminated rain water and groundwater from leaking into the ocean.

In past typhoons, it was thought that contaminated rainwater flowed into the ocean through a drainage system. There were also concerns that radioactive groundwater might leak into the ocean as rain could increase the groundwater in the compound.

This time the operator has installed stronger pumps and increased their number.

The utility says as of 11 AM Tuesday, there were no changes in groundwater levels at the plant's site.

Other measures taken earlier include rerouting the drainage system into the plant's port instead of directly into the ocean. TEPCO also raised the barriers around tanks that store tainted water.

See also :

## Decontamination workers preparing for typhoon

[http://www3.nhk.or.jp/nhkworld/en/news/20160829\\_31/](http://www3.nhk.or.jp/nhkworld/en/news/20160829_31/)

People doing decontamination work in areas affected by radioactive fallout from the 2011 Fukushima nuclear accident are preparing for Typhoon Lionrock.

Last year in September, about 400 bags of radioactive soil and waste were swept away when a river in Iitate Village, Fukushima Prefecture, overflowed its banks.

On Monday, Environment Ministry officials instructed local authorities to take measures to prevent such incidents. Workers secured bags of radioactive waste with ropes and covered contaminated soil with vinyl sheets.

The officials plan to suspend clean-up operations for Tuesday, and to send workers to safeguard waste sites.

## Icewall: Japan's "Hail Mary play"

### Japan's 'Hail Mary' at Fukushima Daiichi: An Underground Ice Wall

[http://www.nytimes.com/2016/08/30/science/fukushima-daiichi-nuclear-plant-cleanup-ice-wall.html?emc=edit\\_th\\_20160830&nl=todayshadlines&nid=32427321&r=0](http://www.nytimes.com/2016/08/30/science/fukushima-daiichi-nuclear-plant-cleanup-ice-wall.html?emc=edit_th_20160830&nl=todayshadlines&nid=32427321&r=0)

By MARTIN FACKLERAUG

FUKUSHIMA DAIICHI NUCLEAR POWER STATION — The part above ground doesn't look like much, a few silver pipes running in a straight line, dwarfed by the far more massive, scarred reactor buildings nearby. More impressive is what is taking shape unseen beneath: an underground wall of frozen dirt 100 feet deep and nearly a mile in length, intended to solve a runaway water crisis threatening the devastated Fukushima Daiichi Nuclear Power Station in Japan.

Officially named the Land-Side Impermeable Wall, but better known simply as the ice wall, the project sounds like a fanciful idea from science fiction or a James Bond film. But it is about to become a reality in an ambitious, and controversial, bid to halt an unrelenting flood of groundwater into the damaged reactor buildings since the disaster five years ago when an earthquake and a tsunami caused a triple meltdown. Built by the central government at a cost of 35 billion yen, or some \$320 million, the ice wall is intended to seal off the reactor buildings within a vast, rectangular-shaped barrier of man-made permafrost. If it becomes successfully operational as soon as this autumn, the frozen soil will act as a dam to block new groundwater from entering the buildings. It will also help stop leaks of radioactive water into the nearby Pacific Ocean, which have decreased significantly since the calamity but may be continuing.

However, the ice wall has also been widely criticized as an expensive and overly complex solution that may not even work. Such concerns re-emerged this month after the plant's operator announced that a section that was switched on more than four months ago had yet to fully freeze. Some also warn that the

wall, which is electrically powered, may prove as vulnerable to natural disasters as the plant itself, which lost the ability to cool its reactors after the 45-foot tsunami caused a blackout there.

The reactor buildings are vulnerable to an influx of groundwater because of how the operator, Tokyo Electric Power Co., or Tepco, built the plant in the 1960s, by cutting away a hillside to place it closer to the sea, so the plant could pump in water more easily. That also put the buildings in contact with a deep layer of permeable rock filled with water, mostly rain and melted snow from the nearby Abukuma Mountains, that flows to the Pacific.

The buildings managed to keep the water out until the accident on March 11, 2011. Either the natural disasters themselves, or the explosive meltdowns of three of the plant's six reactors that followed, are believed to have cracked the buildings' basements, allowing groundwater to pour in. Nearly 40,000 gallons of water a day keep flooding into the buildings.

Once inside, the water becomes highly radioactive, impeding efforts to eventually dismantle the plant. During the accident, the uranium fuel grew so hot that some of it is believed to have melted through the reactor's steel floors and possibly into the basement underneath, though no one knows exactly where it lies. The continual flood of radioactive water has prevented engineers from searching for the fuel. Since the accident, five robots sent into the reactor buildings have failed to return because of high radiation levels and obstruction from debris.

The water has also created a waste-management nightmare because Tepco must pump it out into holding tanks as quickly as it enters the buildings, to prevent it from overflowing into the Pacific. The company says that it has built more than 1,000 tanks that now hold more than 800,000 tons of radioactive water, enough to fill more than 320 Olympic-size swimming pools.

On a recent visit to the plant, workers were busily erecting more durable, welded tanks to replace the temporary ones thrown up in a hurry during the early years after the accident, some of which have leaked. Every available patch of space on the sprawling plant grounds now appears to be filled with 95-foot tanks. "We have to escape from this cycle of ever more water building up inside the plant," said Yuichi Okamura, a general manager of Tepco's nuclear power division who guided a reporter through Fukushima Daiichi. About 7,000 workers are employed in the cleanup.

The ice wall is a high-technology bid to break that cycle by installing what might be the world's largest freezer. Pipes almost 100 feet long have been sunk into the ground at roughly three-foot intervals, and filled with a brine solution supercooled to minus 30 degrees Celsius, or minus 22 Fahrenheit. Each pipe is supposed to freeze a column of soil about a foot and a half in radius, large enough to reach the ice column created by its neighboring pipes and form a seamless barrier.

Engineers with the wall's builder, the construction giant Kajima Corp., estimate that it will take about two months for the soil around a pipe to fully freeze. Solidifying the entire wall, which consists of 1,568 such underground pipes, will require 30 large refrigeration units and consume enough electricity to light more than 13,000 Japanese homes for a year.

The technique of using frozen barriers to block groundwater has been used to build tunnels and mines around the world, but not on this scale. And certainly not on the site of a major nuclear disaster. Since the start, the project has attracted its share of skeptics. Some say buried obstacles at the plant, including tunnels that linked the reactor buildings to other structures, will leave holes in the ice wall, making it more like a sieve. Others question why such an exotic solution is necessary when a traditional steel or concrete wall might perform better.

Some call the ice wall a flashy but desperate gambit to tame the water problem, after the government and Tepco were initially slow to address it. Adding to the urgency is the 2020 Olympics, which Prime Minister Shinzo Abe of Japan helped win for Tokyo three years ago by assuring the International Olympic Committee that the water troubles at Fukushima Daiichi were under control.

“It’s a Hail Mary play,” said Azby Brown, a Japan-based researcher for Safecast, an independent radiation-monitoring group. “Tepco underestimated the groundwater problem in the beginning, and now Japan is trying to catch up with a massive technical fix that is very expensive.”

Supporters and skeptics alike will soon learn if that gambit will succeed. After two years of work, Kajima finished installing the pipes and refrigerator units to create the ice wall in February. At the end of March, it switched on part of the ice wall for the first time — roughly half a mile that runs between the reactor buildings and the Pacific. Most of the other, uphill side of the wall was activated in mid-June.

Kajima is freezing the wall in stages under orders from the Nuclear Regulation Authority, Japan’s nuclear watchdog. The authority is concerned that cutting off the groundwater too suddenly might lead to a reversal of flows, causing the radioactive water accumulated inside the reactor buildings to start pouring out into the surrounding soil, possibly reaching the Pacific. It has told Kajima to leave a half-dozen “gateways” in the uphill side that will not be closed until much of the contaminated water is drained from the buildings.

This month, Tepco told the nuclear agency that the seaside segment of the ice wall had frozen about 99 percent solid. It says a few spots have failed to solidify because they contain buried rubble or sand left from the plant’s construction a half-century ago, which now allow groundwater to flow through so quickly that it will not freeze.

Tatsuhiko Yamagishi, a spokesman for Tepco, said the company was trying to plug these holes in the ice wall with quick-drying cement. “We have started to see some progress in temperature decrease,” he said. Even if the cement helps make the ice wall watertight, skeptics question how long it can last. They point out that such frozen barriers are usually temporary against groundwater at construction sites. They say the brine solution used to chill the pipes is highly corrosive, which could make them break or leak. It is also unclear whether the system could break down under the stresses of operating in a high-radiation environment where another earthquake could lead to another power loss.

“Why build such an elaborate and fragile wall when there is a more permanent solution available?” said Sumio Mabuchi, a former construction minister who has called for building a slurry wall, a trench filled with liquid concrete that is commonly used to block water.

Isao Abe, a Kajima engineer overseeing the ice wall, said his company had made the wall more durable by installing underground pipes that are easy to replace if they corrode. He also said the ice wall was self-sealing, meaning that if another earthquake caused cracks, any incoming water would freeze right away, restoring the wall. He also said it would take months for the wall to thaw, giving engineers ample time to restore power even if the plant has another outage.

Mr. Abe said the wall was intended to operate until 2021, giving Tepco five more years to find and plug the holes in the reactor buildings, though skeptics say this difficult task will require more time. Mr. Abe also pointed out that the ice wall was part of a broader strategy for containing the radioactive water. Before installing the ice wall, Kajima also built a conventional steel wall underground along the plant’s border with the Pacific last year.

Tepco says that wall has already stopped all measurable leaks of radioactive materials into the sea.

However, some scientists say that radioactive water may still be seeping through layers of permeable rock

that lie deep below the plant, emptying into the Pacific far offshore. They say the only way to eliminate all leaks would be to repair the buildings once and for all.

Even if the ice wall works, Tepco will face the herculean task of dealing with the huge amounts of contaminated water that have accumulated. The company has installed filtering systems that can remove all nuclear particles but one, a radioactive form of hydrogen known as tritium. The central government and Tepco have yet to figure out what to do with the tritium-laced water; proposals to dilute and dump it into the Pacific have met with resistance from local fishermen, and risk an international backlash. For now, the only visible sign that the freezing has begun are silver-dollar-size patches of ice that have formed on top of the aboveground, silver pipes. At one spot, the No. 4 reactor building loomed, an enormous cube six stories tall with concrete sides that showed large gashes left by the tsunami.

**“The water is here, just three meters beneath our feet,”** said Mr. Okamura, the Tepco general manager, who stood near the pipes wearing a white protective suit, goggles and a surgical mask. **“It still flows into the building, unseen, without stopping.”**

September 2, 2016

## Typhoon makes icewall melt in parts

### Typhoons cause ‘ice wall’ to melt at Fukushima nuclear plant

<http://www.asahi.com/ajw/articles/AJ201609020020.html>

By KOHEI TOMITA/ Staff Writer

Rainfall from recent typhoons caused partial melting of the “ice wall” at the Fukushima No. 1 nuclear plant, allowing highly radioactive water to leak from around the damaged reactor buildings, the plant’s operator said Sept. 1.

Tokyo Electric Power Co. said melting occurred at two sections of the ice wall, which is designed to divert groundwater away from the reactor buildings.

TEPCO officials believe that during the latest typhoon, contaminated water from around the reactor buildings flowed through openings of the ice wall created by the deluge and reached downstream toward the sea.

The groundwater level near a seaside impermeable wall temporarily rose to 28 centimeters below the ground surface when Typhoon No. 10 passed the area on Aug. 30.

Before the typhoon hit, the water level was 35 cm below the surface.

Around 5.5 cm of rainfall a day fell in the area when the typhoon hit.

The groundwater level, however, actually rose by 7 cm, although 740 tons of groundwater was pumped out of the section.

“If there had been an additional 15 cm of rain, (the contaminated water) could have poured out over the ground surface” and spilled into the sea, a TEPCO official said Sept. 1.



The Meteorological Agency's initial forecast said Typhoon No. 10 would bring a maximum 20 cm of rain a day at some locations in the Tohoku region.

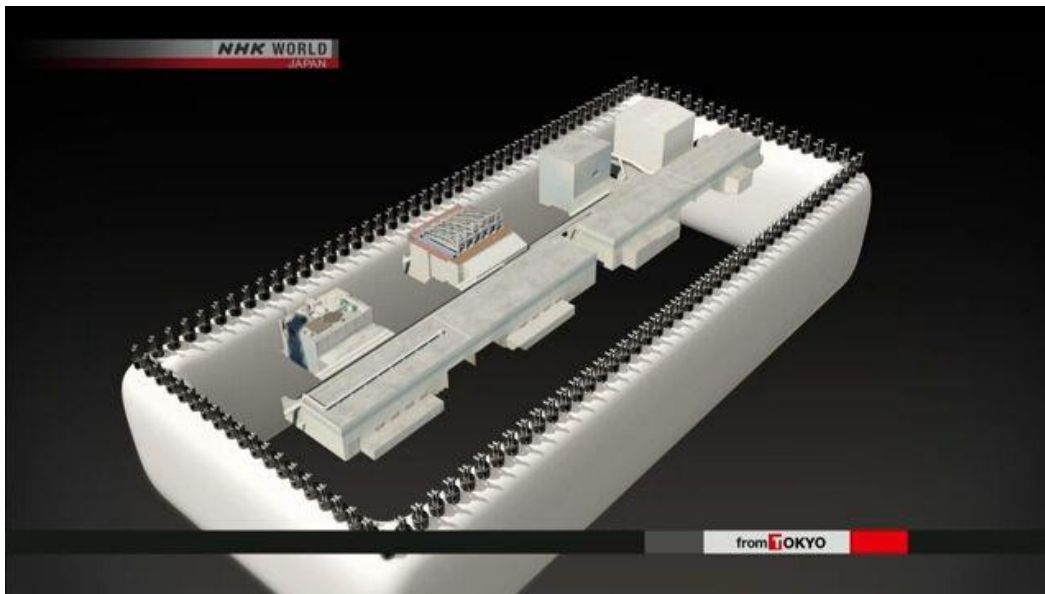
The 34.5-billion-yen (\$335 million) frozen wall was completed in spring to prevent groundwater from entering the reactor buildings and mixing with highly radioactive water.

TEPCO admitted the underground wall of frozen dirt is not working.

The company said the temperatures at the two sections of the frozen wall have climbed above zero since Typhoon No. 7 approached Fukushima Prefecture on Aug. 17.

The company believes that the partial melting was caused by the influx of water brought by the typhoons and heavy rain in between.

TEPCO plans to freeze the wall again by pouring chemicals into pipes that extend underground.



### Temperatures rose in parts of reactor ice wall

[http://www3.nhk.or.jp/nhkworld/en/news/20160902\\_06/](http://www3.nhk.or.jp/nhkworld/en/news/20160902_06/)

The operator of the crippled Fukushima Daiichi nuclear power plant says due to recent heavy rain temperatures rose above zero degrees Celsius in some parts of an underground ice wall.

Tokyo Electric Power Company has been trying to freeze soil around damaged reactors since March. The aim is to cut the volume of contaminated water by reducing the flow of groundwater into damaged reactor buildings.

But the company says a series of storms have been dumping heavy rain in and around the plant since mid-August, pushing up temperatures in some sections of the ice wall.

The utility says wall temperatures to the south of the No.4 reactor rose from minus 5 degrees to plus 1.8 degrees at the highest through Thursday. It adds wall temperatures to the east of the No.3 reactor also went up from minus 1.5 degrees to plus 1.4 degrees.

Temperatures in these sections had been higher than others parts of the wall even before the storms. It's feared that some ice in the sections may have melted as the rain increased groundwater flows.

In response, the firm decided to inject a chemical agent in these 2 places to solidify soil, reduce water flow, and speed up freezing.

Experts point out that the ice wall is not as effective as estimated in decreasing groundwater flows. Discussion on the effectiveness is underway at the Nuclear Regulation Authority.

September 7, 2016

## Icewall "more like a bamboo screen"

### Concern as leaky 'ice wall' around Fukushima nuke plant resembles 'bamboo screen'

<http://mainichi.jp/english/articles/20160907/p2a/00m/0na/011000c>

It has been nearly five and a half years since the meltdowns at Tokyo Electric Power Co. (TEPCO)'s Fukushima No. 1 nuclear plant, and both the utility and the Japanese government remain stymied in their efforts to control the buildup of radioactively contaminated water at the facility.

The problem is simply stated: Groundwater flows down from higher inland elevations towards the Pacific, collecting in the nuclear plant's shattered reactor buildings and becoming contaminated. The plant grounds are packed with (occasionally leaky) storage tanks full of water pumped out of the reactor and turbine building basements, but the water does not stop.

TEPCO has attempted to stop the groundwater from getting into the buildings with a 1.5-kilometer subterranean "ice wall" (actually frozen soil) around the No. 1-No. 4 reactor buildings, but results have been inconclusive. Meanwhile, water decontaminated at the plant remains laced with radioactive tritium, and no storage site has yet been found to put this wastewater. The government is aiming to have all the radioactive water at the Fukushima plant dealt with by the end of 2020, the year Tokyo will host the Summer Olympics, but the way ahead is far from clear.

For one, the ice wall has holes in it.

"Due to heavy rain, the temperature rose above 0 degrees Celsius in two locations (along the wall)," a TEPCO public relations representative told a news conference on Sept. 1, the day after Typhoon Lionrock passed through northeastern Japan. The rainfall that came with the storm had caused a massive increase in the flow of groundwater, which then melted two holes in the ice wall, the official stated.

The freezing operation began in March this year, but part of the perimeter refused to solidify due to local geological features that caused the groundwater to flow particularly quickly. The fact that the typhoon's rains could punch more holes in the wall revealed yet another weak point in the entire project, and experts have begun openly calling it a failure.

TEPCO decided on the ice wall in 2013, to close the spigot on the some 400 tons of radioactively contaminated water being produced daily at the Fukushima plant as groundwater came into contact with the melted fuel from the station's reactor cores. A total of 1,568 pipes were sunk vertically 30 meters into

the earth along a perimeter around the reactor buildings. Then coolant chilled to 30 degrees below zero was circulated through the pipes to freeze the surrounding soil and create an "ice dam."

The project was treated as TEPCO's trump card in its battle against the contaminated water problem, and the utility began the freezing operation along the plant's seaward side in March this year. Freezing commenced on the rest of the wall in June, and TEPCO claimed that as of August, 99 percent of the seaward section and 91 percent of the landward section had been frozen successfully

However, in the five months since the operation began, there has been almost no drop in the amount of radioactive water produced. Experts at an Aug. 18 meeting of the Nuclear Regulation Authority (NRA) asked TEPCO point blank, "When will we see results?" Others commented, "TEPCO's claim that the ice wall is highly effective at blocking the water flow is utterly bankrupt," leaving utility officials fumbling for answers.

"The ice wall isn't really a 'wall' per say, but more like a bamboo screen, which has gaps," Nagoya University professor emeritus Akira Asaoka told the Mainichi Shimbun. "It's obvious that the ice wall's ability to block water is poor. A different type of wall should be considered as soon as possible."

To complicate matters, the ice wall project is tangled up with expectations for the 2020 Tokyo Olympics. The Japanese government decided in September 2013 to commit large sums of public money to the ice wall and other contaminated water countermeasures. Four days later, Prime Minister Shinzo Abe was in Buenos Aires, telling the assembled members of the International Olympic Committee's general session that "the situation (at the Fukushima plant) is under control." He stated that the effects of the radioactive water had been entirely confined to the 0.3 square kilometers of the plant's harbor. Later that day, Tokyo was announced as host of the 2020 Games.

So far, the central government has poured some 34.5 billion yen into the ice wall project. To say that the stupendously expensive initiative had failed would very likely invite scathing public criticism. Minister of Economy, Trade and Industry Hiroshige Seko told a news conference last month that "it's true the ice wall is a difficult project, but the freezing is progressing." And yet, no results have been forthcoming. Solving the Fukushima No. 1 plant's contaminated water problem by 2020 is inscribed in the reactor decommissioning schedule set by the government and TEPCO. If the ice is a failure, it would not just throw the work schedule off kilter; it would violate a publicly stated commitment to the international community.

To boost the ice wall's effectiveness, in June TEPCO began injecting a specialized cement into parts of the perimeter that remained stubbornly unfrozen, and instituted supplementary projects to make the ground easier to freeze. TEPCO plans to freeze every side of the perimeter, but it remains to be seen if the utility will have anything to show for its work.

September 12, 2016

## **TEPCO delays removal of No1. temporary cover**

### **TEPCO postpones cover removing work**

[http://www3.nhk.or.jp/nhkworld/en/news/20160912\\_12/](http://www3.nhk.or.jp/nhkworld/en/news/20160912_12/)

The operator of the Fukushima Daiichi nuclear power plant has postponed work to remove a temporary cover from a damaged reactor building **due to strong winds**.

Tokyo Electric Power Company installed the cover on the partially collapsed **No. 1 reactor** building after the 2011 nuclear accident to prevent the spread of radioactive materials.

TEPCO spent 3 months from July of last year removing the top part of the cover. It then surveyed the upper sections of the building in preparation for the retrieval of spent nuclear fuel from a storage pool on the top floor.

The utility initially planned to begin removing the sides of the cover on Monday, but it now hopes to begin on Tuesday or later.

**TEPCO officials say they expect the work to be completed by late November.**

They say **workers are spraying chemical agents and taking other steps to prevent the spread of radioactive dust.**

TEPCO intends to conduct an inspection of the debris piled on the top floor and then start retrieving spent nuclear fuel in 2020.

It plans to begin removing the molten fuel at the No. 1 to No. 3 reactors by 2021.

September 13, 2016

## **90% frozen**

### **Fukushima ice wall is 90% frozen, more work needed**

[http://www3.nhk.or.jp/nhkworld/en/news/20160913\\_18/](http://www3.nhk.or.jp/nhkworld/en/news/20160913_18/)

The operator of the Fukushima Daiichi nuclear power plant made public on Monday a facility to monitor the condition of an ice wall built to keep groundwater from entering the reactor buildings.

Tokyo Electric Power Company is using a 1.5 kilometer-long underground barrier of frozen earth to prevent water from flowing through the damaged reactors and becoming contaminated.

The freezing process started at the end of March.

Monitors show frozen areas of the wall in blue and sections with high temperatures in red.

Government officials say 99 percent of the wall closest to the ocean has been frozen, but the ratio remains

at 92 percent on the landward side.

The officials say **it is difficult to freeze further as there is a risk of contaminated water leaking out from the reactor buildings if groundwater levels are not kept constant.**

Additional work is underway to step up the freezing of some areas where the temperature doesn't drop so easily.

TEPCO also has to deal with the aftermath of recent heavy rains, which have raised temperatures in some sections of the wall.

## **TEPCO resumes removal of No.1 cover**

### **TEPCO resumes removal of Fukushima plant cover**

[http://www3.nhk.or.jp/nhkworld/en/news/20160913\\_28/](http://www3.nhk.or.jp/nhkworld/en/news/20160913_28/)

The operator of the Fukushima Daiichi nuclear power plant has resumed work to remove a temporary cover from a damaged reactor building.

Tokyo Electric Power Company had covered the partially collapsed No. 1 reactor building to prevent radioactive materials generated by the 2011 accident from spreading.

It started the removal process in July last year, the first step in the retrieval of spent nuclear fuel from a storage pool in the building.

The operation was suspended after sheets from the roof area were removed to assess the building's condition.

On Tuesday, cranes were used to detach the panels from the side of the building, and the debris inside was exposed for the first time in 5 years. Each panel is 23 by 17 meters and weighs 20 tons.

TEPCO officials say they will spray chemicals to ensure that radioactive substances do not disperse even in strong winds.

They say they plan to complete the operation by the end of November, so that the debris can be removed. The removal of spent fuel is due to begin in 2021.

Industry ministry official Masato Kino who monitored the progress at the scene said difficult procedures will continue, but the first step has been taken. He said he hopes to carefully and safely proceed.

## No.1 reactor exposed



The outer layer of the crippled No. 1 reactor building at the Fukushima No. 1 nuclear power plant is exposed as Tokyo Electric Power Co. removes one of the panels covering the facility at 6:22 a.m. on Sept. 13. (Pool)

### Fukushima plant building exposed as TEPCO opens old wounds

<http://www.asahi.com/ajw/articles/AJ201609130070.html>

By CHIKAKO KAWAHARA/ Staff Writer

The devastated outer layer of Fukushima No. 1 nuclear power plant's No. 1 reactor building has been exposed for the first time in almost five years in the painstaking reactor decommissioning process.

Plant operator Tokyo Electric Power Co. began removing on Sept. 13 the exterior walls of the cover installed around the structure to prevent the dispersal of radioactive materials on Sept. 13.

Shortly past 6 a.m., a large crane began removing a massive piece of the cover installed around the reactor building. The panel dismantled that day measured 23 by 17 meters and weighed 20 tons.

The cover was installed in October 2011 as a temporary measure after a nuclear meltdown occurred following the Great East Japan Earthquake and tsunami in March that year. The meltdown caused a hydrogen explosion, blowing the walls off the building.

**Once the cover is dismantled, the operator can assess the state of the building's interiors and remove the debris fallen onto the spent fuel pool inside.**

"Steady progress is necessary in reconstruction, but we hope they will carry on the procedure with safety as the No. 1 priority," said a Fukushima prefectural government official.

TEPCO said that it plans to remove the remaining 17 panels of the covering by the end of the year. The portion covering the roof has already been removed.

Once the cover is removed, the utility will begin drawing up plans to remove the 392 fuel assemblies from the spent fuel pool and melted nuclear fuel from inside the building.

The plant operator said that it plans to be extra careful during the procedure. It will shroud the building in tarpaulins once the cover is removed as a precautionary measure against dust and other materials containing radioactive materials from being carried aloft by the wind.

The utility and central government's joint schedule for the decommissioning process of the reactor states that the removal of the fuel rods from the pool will start in fiscal 2020.

### Sampling of water in Units 1-2 exhaust stack

[http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2016/images/handouts\\_160913\\_02-e.pdf](http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2016/images/handouts_160913_02-e.pdf)

### Analysis of water level in the *drain sump pit* of Units 1-2 exhaust stack at Fukushima Daiichi Nuclear Power Station

water level : approx 60 cm (in the 100 cm deep pit)

### Analysis of water quality in the pit (September 9, 2016)

**Beta radiation :  $6.0 \times 10^7$  Bq/L [60.000.000]**

**cesium 134:  $8,3 \times 10^6$  Bq/L**

**cesium 137:  $5,2 \times 10^7$  Bq/L**

September 20, 2016

## TEPCO wants more help from Govt.

### Panel to examine options for wrecked Fukushima plant

<http://www.japantimes.co.jp/news/2016/09/20/business/panel-examine-options-wrecked-fukushima-plant/#.V-DkJzVdeos>

Kyodo

A panel of experts will discuss reforms at Tokyo Electric Power Company Holdings Inc., including the costly plans to scrap its Fukushima No. 1 nuclear power plant, Industry minister Hiroshige Seko said Tuesday.

The costs of decommissioning the plant, ravaged by the 2011 triple meltdown, is **expected to far exceed the initial estimate of ¥2 trillion**, prompting the government to review its financial aid to the utility with the help of the private sector.

The government-appointed panel will meet for the first time in early October and draft proposals by year-end, Seko said, as Tepco plans to revise its business plan, compiled in 2014, possibly early next year. Members of the panel include Akio Mimura, head of the Japan Chamber of Commerce and Industry, and other senior officials of major business groups. Tepco President Naomi Hirose will also join as an observer.

The utility's business has been pressured by the **costs of cleaning up contaminated areas and compensating those affected by the accident.**

The **growing costs of scrapping the plant as well as increased competition in the sector** led the company to seek fresh government assistance in July.

September 21, 2016

## Typhoon raises groundwater to surface

### TEPCO pumping groundwater from Fukushima plant

[http://www3.nhk.or.jp/nhkworld/en/news/20160921\\_09/](http://www3.nhk.or.jp/nhkworld/en/news/20160921_09/)

The operator of the Fukushima Daiichi nuclear power station says it is pumping groundwater from under the plant **to prevent contaminated water from leaking into the adjacent port.**

Tokyo Electric Power Company says the heavy rains brought by Typhoon Malakas have raised the underground water levels around the plant's embankments.

TEPCO officials say they added pumps to prevent the groundwater from rising further. They say **the water rose nearly to the surface** shortly before 10 PM on Tuesday.

The officials say **this has prevented rain from permeating the ground and increased the risk that the rainwater could become contaminated and flow into the port.**

The utility says that while it is pumping the groundwater to prevent leakage, it will measure the radioactive substances in the water.

### Typhoon rain raises tainted Fukushima plant groundwater to surface

<http://www.japantimes.co.jp/news/2016/09/21/national/typhoon-rain-raises-tainted-fukushima-plant-groundwater-near-surface/#.V-lvYDVdeos>

Staff Report, JII



Heavy rain brought by Typhoon Malakas caused contaminated groundwater to rise to ground level at the radiation-hit Fukushima No. 1 nuclear plant Tuesday night, raising fears of tainted water flooding out to the plant's port area, its operator said.

Tokyo Electric Power Company Holdings Inc. said in a press release that plant workers are doing their utmost to pump up tainted groundwater at the Fukushima compound, while trying to measure the level of radioactive substances contained in the water.

Under normal circumstances, groundwater taken from wells around the damaged reactor buildings at the Fukushima plant is filtered and stored in numerous tanks built on the compound.

Shortly before 10 p.m. Tuesday, groundwater reached the surface level at an observation well near the seawall at the power plant's port, and at 11:30 p.m. Tuesday, groundwater stood at 3 cm above the surface level, Tepco said.

The well has a far higher wall and the ground around it is paved, the company said, playing down the possibility that any water flowed out of the well.

By 9 a.m. Wednesday, the water level had dropped to 3 cm below the surface.

Meanwhile, some rainwater may have flowed directly into the port before seeping underground, according to the company.

Tepco will continue pumping groundwater around the seawall, located near the damaged No. 1 to No. 4 reactors, and carry out close examinations of water inside the port, the company said.

In order to curb the flow of groundwater into the sea, the company has covered the seawall with water shields and carries out groundwater pumping operations.

Typhoon Malakas itself was downgraded to an extratropical depression at around 9 p.m. Tuesday as it moved along the coast of the Tokai region and swayed toward the Pacific. It was initially forecast to hit the Kanto region in the early hours of Wednesday.

The previous typhoon, Lionrock, earlier this month killed at least 17 people. Before Lionrock, two typhoons had claimed at least two lives in the northeast.

## What about that leak?

### **TEPCO: Possible water leak at Fukushima plant during typhoon**

<http://www.asahi.com/ajw/articles/AJ201609210047.html>

By KOHEI TOMIDA/ Staff Writer

Tokyo Electric Power Co. said Sept. 21 it will check for radiation contamination in seawater near its crippled Fukushima nuclear plant after heavy rain from Typhoon No. 16 brought tainted groundwater to the surface.

The water reached the top of wells at the Fukushima No. 1 nuclear power plant, and there is a possibility that some of it spilled into the sea.

“We will analyze the seawater because we cannot determine whether groundwater containing radioactive materials has actually leaked,” a TEPCO official said.

The official added that the company believes most of the water that may have poured into the sea was rainwater that had not seeped into the ground.

The utility constantly monitors groundwater levels in wells around the reactor buildings at the plant to prevent overflows.

TEPCO said groundwater in wells on the seaside area of the nuclear complex reached the surface around 10 p.m. on Sept. 20 amid the heavy rain brought by the approaching typhoon. The water kept rising despite workers’ efforts to lower the level using makeshift pumps and septic tank trucks.

The groundwater level remained the same as of 7 a.m. on Sept. 21 before it finally dropped to about 3 centimeters from the surface two hours later, the company said.

According to TEPCO, about 575 millimeters of rain fell in the area of the nuclear plant from Aug. 1 to Sept. 20.

September 28, 2016

## Pumping radioactive water and then what?

### TEPCO to begin removing tainted water at Fukushima plant

<http://www.asahi.com/ajw/articles/AJ201609290050.html>

Tokyo Electric Power Co. intends to begin pumping up highly contaminated water accumulating in the basements of buildings at its wrecked Fukushima No. 1 nuclear power plant by the end of March.

TEPCO disclosed its strategy Sept. 28 at a review meeting with the Nuclear Regulation Authority, the government’s nuclear watchdog.

In response, the NRA urged the utility to provide a detailed road map for the project.

Removing the huge volume of radioactive water in the reactor, turbine and other buildings has posed an urgent challenge for TEPCO.

**The NRA pressed it to take action as soon as possible, pointing out that the contaminated water in the buildings’ basements is a likely reason flowing groundwater also gets polluted.**

The NRA is also concerned that the contaminated water in the basements might leak into the sea if the nuclear complex is struck by another powerful tsunami.

TEPCO estimates that **68,000 tons of tainted water** exists below the reactor and turbine buildings, as well as other structures.

**Particularly worrisome is the estimated 2,000 tons of highly radioactive water in the condensers of the No. 1 through No. 3 turbine buildings**, which accounts for 80 percent of the radioactive materials in all of the tainted water.

The contaminated water was transferred to the condensers in the immediate aftermath of the March 2011 triple meltdown.

TEPCO plans to finish transferring the water in the condensers by the first half of the next fiscal year and all of the contaminated water in the basements by 2020.

September 29, 2016

## Not so sure about icewall

### Heavy rains stall assessment of frozen wall at Fukushima plant

By KOHEI TOMIDA/ Staff Writer

<http://www.asahi.com/ajw/articles/AJ201609290073.html>

Tokyo Electric Power Co. reported a delay in the underground ice wall project at its Fukushima No. 1 nuclear power plant, citing the stalled assessment of the structure due to heavy rains from a recent typhoon.

The utility reported the delay at a review meeting with the Nuclear Regulation Authority, the government's nuclear watchdog, on Sept. 28. TEPCO initially planned to assess the effectiveness of the ice wall by the end of this month.

According to TEPCO, the volume of groundwater pumped up in areas on the sea side of the facility was supposed to have dropped by now if the ice wall functioned properly.

But the company acknowledged this had not happened.

TEPCO had sought NRA approval to freeze a section of the ice wall facing the mountainside to enhance the effect of blocking groundwater, but it did not get the go-ahead.

"It does not make sense that the company sought approval to freeze the area facing the mountainside, just because the ice wall on the sea side did not go well," said Toyoshi Fuketa, a commissioner of the NRA, told the meeting.

The groundwater level in the sea side portion outside the ice wall reached the surface on and off between Sept. 20 and Sept. 23 when the plant was struck by torrential rain as a result of Typhoon No. 16.

TEPCO said rainwater flowed into the sea, rather than seeping into the ground, because of the higher groundwater level.

Radioactive cesium in samples taken from the sea nearby measured a record high 95 becquerels per 1 liter.

According to the company, 0.8 percent of 5,800 or so observation spots set up on the sea side section of the ice wall showed that the soil has not been entirely frozen.

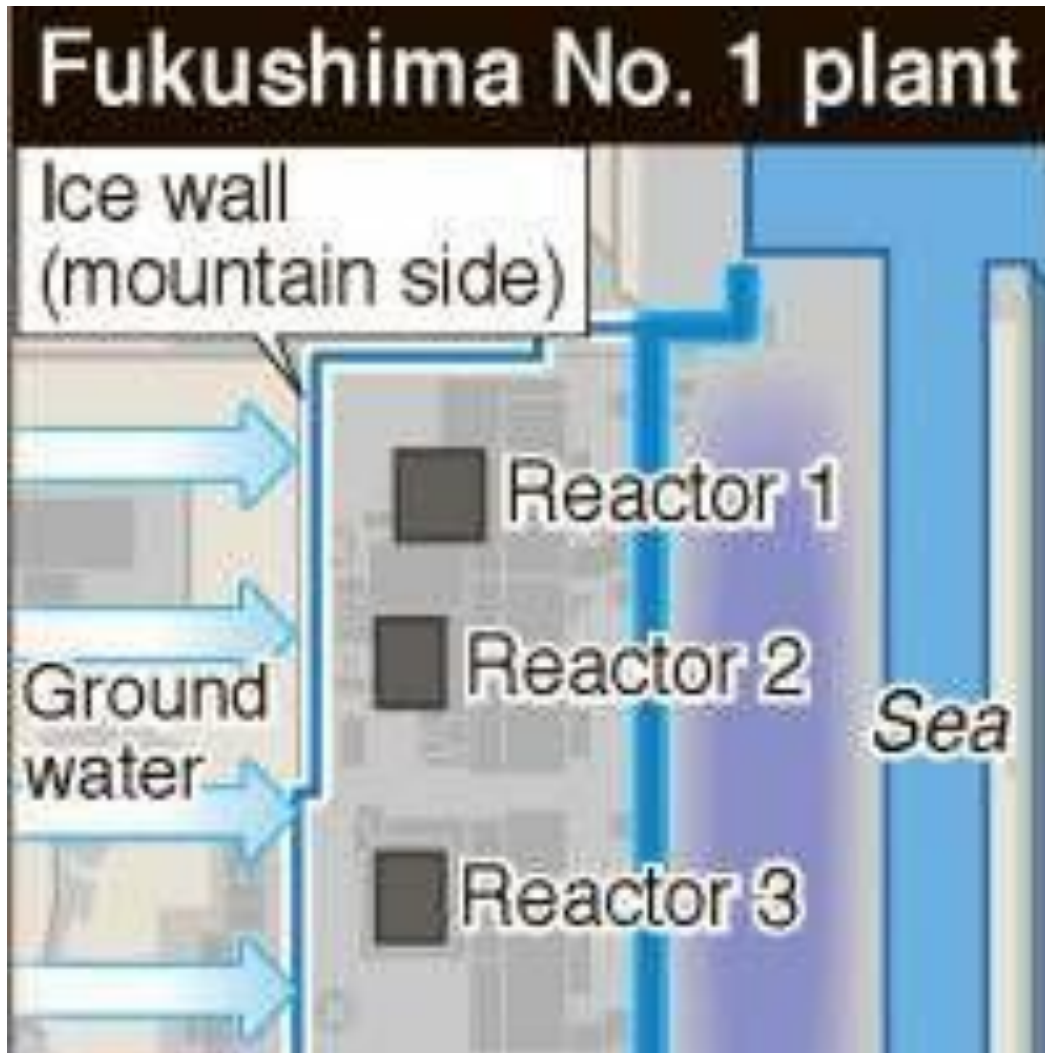
TEPCO officials believe that groundwater penetrated gaps in the ice wall before pushing up the groundwater level in the area downstream near the sea.

The frozen soil wall was built around the No. 1 through No. 4 reactor buildings. The government poured 35 billion yen (\$350 million) into the project.

The objective was to block groundwater from mixing with contaminated water in the basements of the reactor and other buildings.

TEPCO started freezing soil in late March, but not all of the soil turned into ice, allowing a huge volume of groundwater to accumulate.

September 30, 2016



### **Tepco admits success of Fukushima ice wall still unknown**

<http://www.japantimes.co.jp/news/2016/09/30/national/tepco-admits-success-fukushima-ice-wall-still-unknown/#.V--cRsldeos>

**by** Kazuaki Nagata  
Staff Writer

Tokyo Electric Power Holdings Inc. and the government bet big on an underground ice wall as a key measure to battle the tainted water issue at the crippled Fukushima No. 1 nuclear plant. But whether the ¥35 billion gambit funded by the government is working to block the inflow of groundwater remains unclear even six months after the utility started freezing an area of underground soil.

Tepco said it needs more time to judge whether the system is working. But the Nuclear Regulation Authority, Japan's nuclear watchdog, appears skeptical on the effectiveness of the 1.5-km-long wall that encircles reactor buildings 1 to 4, asking Tepco to deal with the issue but without counting on it. So far Tepco has finished freezing the east side of the ice wall — albeit with delays caused by severe typhoon-driven rains — and 95 percent of the west side but has yet to get the NRA's approval to freeze the 100 percent of it.

"It's really unfortunate and I am very sorry" for not being able to provide an assessment of the ice wall, Naohiro Masuda, who heads Tepco's decommissioning project, told a news conference Thursday.

Masuda said in August that Tepco would be able to provide an assessment of the effectiveness of the ice wall in September, and that the utility would have finished freezing the east side by then.

But Masuda said unexpected heavy rain during recent typhoons melted some parts of the structure.

Masuda said workers have since repaired the damage and finished freezing the east side 100 percent. But he declined to say when the assessment will be released.

The purpose of the ice wall is to block groundwater before it can enter the reactor buildings, which are located between nearby mountains and the ocean.

To do this, Tepco pumps groundwater that has flowed west to east toward five wells near the ocean, back into the reactors to cool them.

If the wall succeeds, the water being pumped from the ocean wells should reduce to about 70 tons each day, from hundreds of tons, according to Tepco. The daily level was between 600-1,200 tons in September, which Tepco attributed to heavy rains.

About 180 tons of groundwater a day seeps into the reactor buildings through cracks or holes and is mixed with contaminated water inside, causing the amount of tainted water at the plant to increase daily. Currently, about 68,000 tons of tainted water is stored there but the risk remains that it could leak if another powerful quake hits near the facility.

For Tepco, the success of the ice wall is fundamental to achieve its next major goal of removing the contaminated water flooding the basement floors of the reactor buildings.

The utility plans to remove the water by 2020, but believes it can speed up the process by two years if the underground wall works.

The NRA, however, remains unconvinced.

"(Tepco) needs to come up with measures that do not rely on the ice wall and complete the removal of the tainted water from the building by 2020," Toyoshi Fuketa, deputy NRA chairman, told Tepco officials at a panel meeting Wednesday.

During the meeting, Tepco expressed its intention to freeze the entire west side of the wall.

But Fuketa said, "That's out of discussion," since it was still unclear whether the east side was effectively blocking groundwater.

Among the NRA's concerns is that completely blocking the groundwater on the west side might reduce the groundwater level below the tainted flooded water line in the reactor buildings, which would allow tainted water to leak out.

But as the wall appears to have done little to reduce the amount of groundwater pumped daily, the NRA ordered Tepco to come up with alternative measures.

The NRA has suggested that Tepco strengthen the pumping capability of wells around the reactor buildings to collect the groundwater before it can seep inside.

Tepco said at the Wednesday meeting that it will still be able to finish the removal of tainted water in the buildings by 2020 without the icewall.

October 7, 2016

## Flange-type storage tank leaks again

### Radioactive water leaks from storage tank at Fukushima plant

<http://www.asahi.com/ajw/articles/AJ201610070036.html>

**Up to 32 liters of radioactive water** leaked from a storage tank at the crippled Fukushima No. 1 nuclear plant, but the contaminated liquid has been contained, Tokyo Electric Power Co. said Oct. 6.

The leaked water is currently within barriers surrounding the tank that are designed to block the flow of fluids, TEPCO, the plant's operator, said.

The liquid contained water that had been treated to remove radioactive strontium and other substances, as well as highly contaminated water from the bottom of the tank that was stored shortly after the nuclear accident started in 2011.

**A radioactivity level of 590,000 becquerels of beta ray-emitting materials was detected per liter of the leaked water.**

The water seeped out of a tank with bolted seams on its sides, which are more prone to leaks than those with welded walls.

**TEPCO continues to use the bolted containers despite the risk because production of welded tanks cannot keep pace with the buildup of contaminated water**, mainly from groundwater entering the damaged reactor buildings, at the nuclear plant.

## Storage tank leaks at Fukushima Daiichi plant

[http://www3.nhk.or.jp/nhkworld/en/news/20161007\\_02/](http://www3.nhk.or.jp/nhkworld/en/news/20161007_02/)

Workers at the crippled Fukushima Daiichi nuclear plant have found a leak of highly radioactive water from a waste water tank.

Its operator, Tokyo Electric Power Company, says the water likely leaked from a seam of the tank.

The leaked water was spotted on Wednesday on the side of one of an array of steel tanks holding contaminated water that is continuously generated at the site.

TEPCO's analysis found 590,000 becquerel per liter of beta-emitting radioactive materials in the water.

Tokyo Electric estimates that 32 liters of such highly radioactive water had trickled out, mixed with rainwater, and remained within a barrier around the tank.

Workers moved water in the tank to another one to lower the water level enough to halt the leak.

The leaking cylindrical tank is made by splicing steel plates with bolts. But they have had waste water leaks in the past from seams.

The operator has been replacing these leak-prone tanks with new seamless ones. But the increasing volume of waste water makes it difficult for the utility to completely do away with the old ones.

October 17, 2016

## Get to the bottom of Fukushima disaster before restarting plants

### Niigata governor-elect calls for Fukushima nuclear crisis investigation

<http://mainichi.jp/english/articles/20161017/p2a/00m/0na/008000c>

NIIGATA -- Governor-elect Ryuichi Yoneyama has called for getting to the bottom of the Fukushima nuclear crisis before debating the pros and cons of restarting the local atomic power station.

- **【Related】** Anti-nuclear candidate wins Niigata governor race
- **【Related】** TEPCO suffers blow with anti-nuclear candidate's win in Niigata governor race
- **【Editorial】** Gov't, TEPCO should take Niigata gubernatorial election results seriously

Yoneyama, 49, told reporters on the morning of Oct. 17, "We can't approve a restart as long as the lives and livelihoods of prefectural residents can't be protected."

During his campaigning, Yoneyama had said discussions on the issue "can't be started without clarifying the cause of the accident at the Fukushima No. 1 Nuclear Power Plant."

At the same time, he said he is prepared to have dialogue with the central government and Tokyo Electric Power Co. (TEPCO) instead of confronting these entities. TEPCO is the operator of both the idled Kashiwazaki-Kariwa Nuclear Power Plant in Niigata Prefecture and the tsunami-hit Fukushima plant.

Yoneyama said he is prepared to cooperate with an investigation being conducted by a panel comprised of the prefectural government and TEPCO into an incident in which the utility had concealed that meltdowns occurred at the Fukushima No. 1 nuclear complex.

"We'd like to get to the bottom of the case by not just confronting but cooperating with TEPCO," he told reporters.

The governor-elect stopped short of ruling out the possibility that the power plant will be restarted if necessary conditions are met.

"I don't think we should rule out the possibility. We can't have discussions with each other unless there is room for compromise with each other," he said.

Yoneyama successfully ran in the Oct. 16 Niigata gubernatorial election with the backing of the opposition Japanese Communist Party, Liberal Party and Social Democratic Party. However, the Liberal Democratic Party, the ruling party in the National Diet, has a majority in the prefectural assembly.

"We've agreed to place priority on dialogue over confrontation, and on bringing benefits to prefectural residents," he said.

October 21, 2016

## **“Temporary” storage sites yet another concern for residents**

### **Study: Possible water problem at storage sites in Fukushima**

<http://www.asahi.com/ajw/articles/AJ201610210044.html>

THE ASAHI SHIMBUN

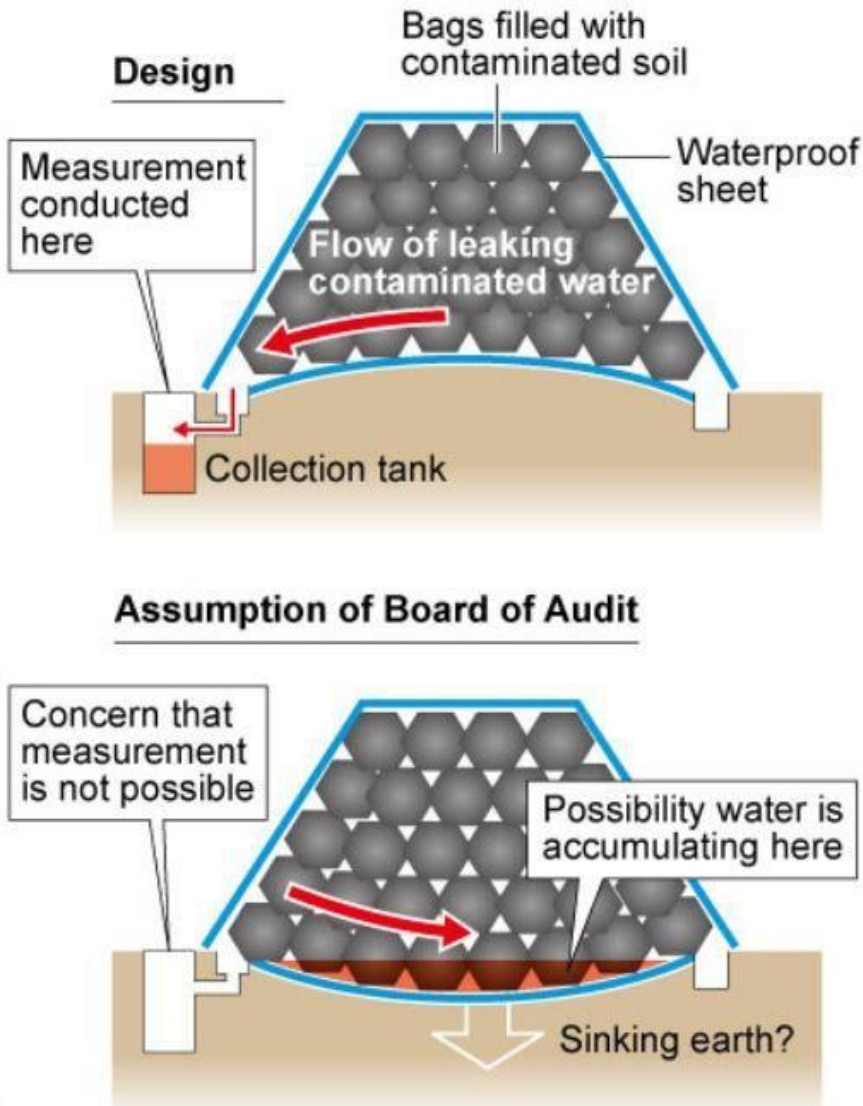


It might be difficult to measure radiation levels in water at this temporary storage site for contaminated soil in Fukushima Prefecture. (Kenji Izawa)

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## Basic structure of temporary storage site for contaminated soil



Bags of radiation-contaminated soil could be sinking into the ground at temporary storage sites in Fukushima Prefecture, allowing water to accumulate within instead of flowing to outside tanks for testing, the Board of Audit said.

No confirmation has been made that the ground at the sites is actually sinking or if contaminated water has pooled inside. But Board of Audit officials are asking the Environment Ministry to consider additional safety measures if signs indicate that this is actually occurring.

The board's study focused on 34 of the 106 temporary storage sites that the Environment Ministry set up for soil removed through decontamination work after the disaster in March 2011 unfolded at the Fukushima No. 1 nuclear power plant.

Construction of the storage sites started in 2012, and the transfer of contaminated soil to these facilities was completed in 2015.

The temporary storage sites were designed to have a slight mound on the ground in the center to allow water from the bags to flow down into surrounding collection tanks for periodic measurements of radiation levels.

Internal Environment Ministry guidelines called for this setup at storage sites containing bags that are not waterproof.

The Board of Audit studied 34 temporary storage sites where the bags are not waterproof. These bags were piled five deep or higher at those sites.

The study showed that **at 31 of the sites, the weight of the bags may have not only flattened the mound in the center, but it also could have created an indent in the ground where the leaking water could accumulate.**

If the water does not flow to the tanks, it will be difficult to determine the radiation levels.

The study also noted that the foundations at the sites were soft to begin with and may be unable to support the bags of soil. **The sinking phenomenon could worsen as time passes.**

The Environment Ministry played down the risk of the water contaminating areas around the storage facilities.

“Even if the ground has sunk, the structure is designed so water does not leak outside the site,” a ministry official said. “Eventually, the water should collect in the tanks. We will make every effort to oversee the sites as well as use waterproof bags as much as possible.”

A total of 4.16 billion yen (\$40 million) was spent to construct the 31 temporary storage sites.

**The Environment Ministry designed the temporary storage sites under the precondition they would be used for only three years and then removed. For that reason, measures were not taken to strengthen the foundations to prevent the ground from sinking, even if soft farmland was chosen for a site.**

The plan is to eventually return the land where the temporary storage sites have been built to its original state and return it to the landowners

However, the Board of Audit’s study adds another concern for residents, many of whom had opposed construction of the temporary storage sites in their neighborhoods.

Toshio Sato, 68, has evacuated to Fukushima city from his home in Iitate village, where four of the possible problem storage sites are located.

“There are some people who want to resume growing rice once they return home,” Sato said. “If water is accumulating, there is the possibility it could unexpectedly overflow into surrounding areas. The concerns just seem to emerge one after another.”

The government plans to lift the evacuation order for a large part of Iitate in March 2017.

(This article was compiled from reports by Kosuke Tauchi, Shoko Rikimaru, Kenji Izawa and Akifumi Nagahashi.)

## Fukushima update by G. Edwards

By Gordon Edwards (ccnr.ca)

**FUKUSHIMA UPDATE -- OCTOBER 2016:**

***The government of Shinzo Abe has passed draconian legislation to prevent ongoing information about the Fukushima Daiichi nuclear disaster from leaking out to the world at large. Ordinary***

*citizens, and even professional journalists, can be imprisoned for reporting on conditions that the government deems to be contrary to the public interest -- as defined by the government.*

*Nevertheless, some information does seep through the seemingly impregnable wall of governmental-industrial secrecy.*

#### **DECOMMISSIONING COSTS MORE THAN DOUBLE**

*(1) The cost of dealing with the triple meltdown, previously estimated at about 800 million dollars per year, and expected to take 40 years or more, has now been recognized as massively underestimated. It appears that the desperate cleanup measures will cost several billion dollars per year if any real progress is to be made. This alarming state of affairs was documented by Japan's Ministry of Economy, Trade and Industry, in presentations made before a panel struggling to devise a viable financial plan for TEPCO, the electric utility that owns the Fukushima Daiichi nuclear power plant, according to an article that appeared in the South China Morning Post on October 25 2016.*

*See <http://www.scmp.com/news/asia/east-asia/article/2039929/cost-scrap-fukushima-nuclear-plant-massively-underestimated>.*

#### **ICE WALL PARTIALLY COLLAPSES**

*(2) The Fukushima Daichi nuclear power plant was constructed over a major aquifer. When the three reactor cores melted down five and a half years ago, the slow inexorable flow of groundwater beneath the crippled reactors flushed out radioactive materials from the molten cores, delivering hundreds of tonnes of radioactively contaminated water into the Pacific Ocean every day. The Abe government promised to invest hundreds of million of dollars to install and maintain an enormous underground ice wall surrounding the entire nuclear site to divert groundwater away from the molten reactor cores, thereby reducing the rate of contamination of the Ocean waters. On September 2, 2016, an article in the Asahi Shimbun reported that drenching rain from the recent typhoons melted at least two sections of the ice wall and allowed highly contaminated water from around the damaged reactor cores to migrate, still underground, but downstream towards the sea. A TEPCO official admitted that the underground ice wall of frozen dirt is not working. If there had been another 15 cm. of rain, he said, the highly radioactive water would have reached the surface and flowed overland directly into the sea.*

*See <http://www.asahi.com/ajw/articles/AJ201609020020.html>*

November 2, 2016

## **Checking icewall's effectiveness**

## Ice wall at Fukushima plant to be examined

[http://www3.nhk.or.jp/nhkworld/en/news/20161102\\_27/](http://www3.nhk.or.jp/nhkworld/en/news/20161102_27/)

Japanese government officials and the operator of the crippled Fukushima Daiichi nuclear plant say they plan to dig and check the ground around reactors. They want to see if an ice wall installed there is working as intended.

The underground ice wall is meant to prevent groundwater from getting into the damaged reactor buildings and becoming contaminated.

Tokyo Electric Power Company has been creating a 1.5 kilometer-long barrier of frozen earth since March. The ice wall is formed by circulating coolant in pipes buried around the reactor site.

**Engineers believe that except for an area on the plant's hillside, the freezing work has been completed.**

Government and TEPCO officials have relied on thermometers in the ground to determine if the soil is frozen. But Japan's nuclear regulator has urged them to more precisely check the conditions underground and the ice wall's effectiveness.

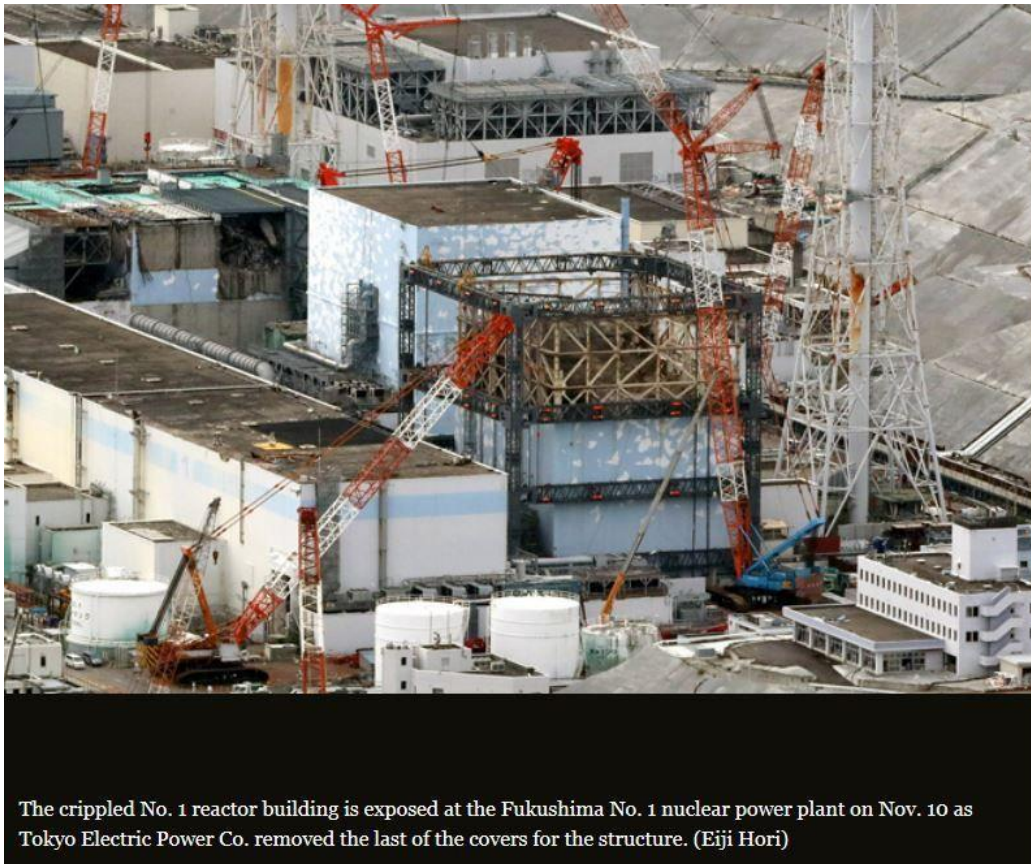
**This month, workers will dig several meters into the ground south of the Number 4 reactor to directly check the condition of the frozen wall. The area was chosen due to its relatively low radiation level.**

Later this month, officials from a government task-force will inspect the site.

TEPCO's decommissioning roadmap calls for most of the contaminated water to be removed from the reactor buildings in 2018. To achieve this, the ice wall needs to be completed and effectively preventing groundwater from flowing into the reactor buildings.

November 10, 2016

## Tarpaulins to prevent stirring up radioactive substances



The crippled No. 1 reactor building is exposed at the Fukushima No. 1 nuclear power plant on Nov. 10 as Tokyo Electric Power Co. removed the last of the covers for the structure. (Eiji Hori)

## Last cover removed from crippled reactor in Fukushima

<http://www.asahi.com/ajw/articles/AJ201611100041.html>

By KOHEI TOMIDA/ Staff Writer

The No. 1 reactor at the Fukushima No. 1 nuclear power plant is completely exposed for the first time in five years after the last of the temporary protective covers for the crippled structure was removed Nov. 10.

The next step will be to extract nuclear fuel inside the reactor building, which was wrecked by a hydrogen explosion in the early stages of the March 2011 nuclear disaster.

The covers were installed the following October as a temporary measure against the spread of radioactive substances after the triple meltdown triggered by the Great East Japan Earthquake and tsunami.

A large crane lifted off the 20-ton cover, the last of the 18 panels installed, around 6 a.m. on Nov. 10.

Plant operator Tokyo Electric Power Co. began removing the covers one by one in September.

The 392 fuel assemblies are stored in the spent nuclear fuel pool inside the building. Melted fuel also remains inside the reactor.

TEPCO will assess the state of the reactor building's interior in efforts to remove debris from the collapse of a roof over the spent nuclear fuel pool.

It will take precautions to prevent dust containing radioactive substances from being stirred up by **shrouding the reactor building with tarpaulins.**

November 15, 2016

## All's well

### **Tepco Completes Dismantling Of Wall Panels At Fukushima-Daiichi-1**

<http://www.nucnet.org/all-the-news/2016/11/15/tepco-completes-dismantling-of-walls-at-fukushima-daiichi-1>

#### Security & Safety

15 Nov (NucNet): Tokyo Electric Power Company (Tepco) has completed dismantling all 18 outer wall panels at the Fukushima-Daiichi Unit 1 building, a statement by Japan Atomic Industrial Forum (Jaif) said. This is a major step towards the removal of spent fuel from the spent fuel pool at Unit 1, Jaif said. Tepco began dismantling the outer wall panels in September 2016. Jaif said no significant change in the concentration of radioactive materials has been detected during the operation. Each of the four damaged reactor units at Fukushima-Daiichi has its own spent fuel pool. Removing fuel assemblies has been a major objective within the larger decommissioning process. According to Jaif, it will take two years for debris to be removed from the upper part of the operating floor at Unit 1 and for a fuel-removal cover and fuel-handling machine to be installed. Fuel removal from the Unit 1 spent fuel pool is scheduled to begin around March 2021. Jaif said Tepco is still carrying out an investigation on the state of debris beneath the collapsed roof of Unit 1 in anticipation of the removal. A camera and a dust-sampling device, both hung from a crane at the upper part of the reactor building, are recording conditions and gathering data on the concentration of radioactive materials in the air, Jaif said.

#### **Related reports in the NucNet database (available to subscribers):**

- Tepco Launches Global Site For Help With Fukushima Decommissioning (News in Brief No.215, 31 October 2016)

November 16, 201

## Fukushima Memory and Future App

### **Free app to show visitors Fukushima recovery efforts**

<http://mainichi.jp/english/articles/20161116/p2a/00m/0na/006000c>

A scene from reconstruction work is displayed on a tablet screen while using the "Fukushima Memory and Future Experiential App," in this picture taken at the Fukushima Prefectural Government office on Oct. 31, 2016. (Mainichi)

FUKUSHIMA -- Prefectural authorities here have released a smartphone and tablet app showing the recovery steps the area has taken since the 2011 Great East Japan Earthquake and tsunami, in hopes to remind visitors of the disaster and attract more tourists there.

The app -- called "Fukushima Memory and Future Experiential App" -- employs augmented reality (AR) functions and can display movies and still images of scenes such as tsunami that hit local beaches and the sight of reconstruction work when people visit 27 locations in Minamisoma and two other municipalities in the prefecture.

One part of the footage shown by the app portrays fishermen affected by the Fukushima nuclear disaster struggling to resume operations through the test fishing of whitebait.

"We want to let visitors know about Fukushima people's efforts in overcoming the quake disaster and looking toward the future," said a prefectural government official.

The free app can be downloaded from App Store or Google Play by entering the words "Fukushima taiken" in Japanese ("Fukushima" in hiragana and "taiken" (experience) in kanji).

(Related link)

<http://www.pref.fukushima.lg.jp/site/portal/arfukushimakiokutomiraitaikenn.html>

November 19, 2016

## **Fukushima students visit plant**

### **Fukushima students see crippled nuclear plant firsthand**

By CHIKAKO KAWAHARA/ Staff Writer



Students from Fukushima High School view the stricken Fukushima No. 1 nuclear power plant during a tour aboard a bus on Nov. 18. The No. 1 reactor building is in the background. (Chikako Kawahara)

<http://www.asahi.com/ajw/articles/AJ201611190023.html>

OKUMA, Fukushima Prefecture--It was no ordinary outing for the 13 students from Fukushima High School.

The teenagers toured the site of the crippled Fukushima No. 1 nuclear power plant by bus on Nov. 18 to get a firsthand look at work to decommission the reactors following the triple meltdown in 2011.

It was the first tour by youngsters since the disaster as plant operator Tokyo Electric Power Co. had deemed the radiation risk was too high.

Through bus windows, the students observed the damaged reactor buildings, rows of storage tanks holding contaminated water and other facilities on the sprawling nuclear complex.

"The tour made me realize that we should arm ourselves with accurate information if we want to change people's perceptions of Fukushima as a scary place," said Keika Kobiyama, a first-year student in the group. "For starters, I want to tell my fellow high school students 'We went to the plant to see for ourselves what was going on there.'"

TEPCO had previously refused to allow tours by those under the age of 18.

But the company gave the green light to this request as an exception on grounds that radiation levels had dropped significantly.

The students were each given a dosimeter as they boarded the bus for the two-hour tour. The trip was held after their parents agreed to the visit.

The students themselves had been releasing updates on the disaster for Japanese and foreign audiences by monitoring radiation levels in the prefecture and studying the decommissioning process.

### **High school takes students to see Fukushima nuclear reactor decommissioning**

<http://mainichi.jp/english/articles/20161119/p2a/00m/0na/008000c>



...Following the Labor Standards Act, which forbids employing people younger than 18 from working in places with harmful radiation, **TEPCO generally only allows people 18 or older to enter the plant.** From the time of the disaster through June of this year, TEPCO admitted around 23,000 visitors, but this was the first time it has done so for high school students. **According to TEPCO, the radiation exposure during the students' visit was at the most 10 microsieverts.** ...

November 21, 2016

### **NHK video: New option for radioactive water**

<http://www3.nhk.or.jp/nhkworld/en/news/videos/20161121161923683/>

### **Let it evaporate (this idea has already been used after the accident at Three Mile Island)**

although some critics say environmental consequences are unclear

Japan needs the help of the international community (US, France, Britain and Russia).

November 22, 2016

## **Fukushima plants: "No abnormalities", says TEPCO**

### **FUKUSHIMA EARTHQUAKE: Tepco Says 'No Abnormalities' At Nuclear Stations**

<http://www.nucnet.org/all-the-news/2016/11/22/tepcosaysnoabnormalitiesatfukushima-nuclear-stations-after-earthquake>

Japanese Nuclear operator Tokyo Electric Power Corporation (Tepco) said there are no abnormalities at either the Fukushima-Daiichi or Fukushima-Daini nuclear stations following a 7.4 magnitude earthquake off the coast of the prefecture early on 22 November 2016 local time.

**The company said on its social media feeds that no abnormalities had been found, no radiation level changes detected, and no injuries reported after the earthquake.**

Tepco said the cooling function of the Fukushima-Daini Unit 3 spent fuel pool resumed at 07:47 local time after cooling water supply stopped at 06:10 due to the earthquake.

Tepco said the stoppage was caused by the tremor and "strong acceleration" at the power plant. Unconfirmed reports said that at 06.38, the Fukushima-Daiichi and Daini stations had a tsunami wave about 1m high.

Coastal residents in Japan were ordered to move to higher ground after the earthquake struck off the coast of Fukushima prefecture.

The Japan Meteorological Agency issued a tsunami warning for waves of up to 3m in Fukushima and Miyagi prefectures, and a tsunami advisory for much of the rest of northeast Japan's Pacific coast.

Tsunamis of 1.4 metres and 90 centimetres were reported in Sendai and Soma about an hour after the earthquake, and the tsunami warning area was widened later in the morning.

Fukushima prefecture is home to the Fukushima-Daiichi and Fukushima-Daini nuclear power stations where seven reactors in operation at the time were destroyed by a huge tsunami following an offshore earthquake in March 2011.

The Japan Meteorological Agency put the quake at 7.4 magnitude while the United States Geological Survey said it was 6.9 magnitude. It struck at a shallow depth of seven miles) shortly before 06.00 local time on Tuesday (2100 GMT on Monday) in the Pacific off Fukushima.

**Related reports in the NucNet database (available to subscribers):**

- IAEA Confirms 'Further Progress' Towards Full Operation Of Fukushima Frozen Wall (News in Brief No.230, 21 November 2016)

## **Check Fukuleaks website for updates on Fukushima recent quake**

<http://www.fukuleaks.org/web/?p=15836>  
check fukuleaks for updates

## **TEPCO unable to check for possible leaks**

### **TEPCO: Leak of radioactive water unlikely at Fukushima plant**

Tokyo Electric Power Co. said radioactive water likely did not leak from its stricken Fukushima No. 1 nuclear plant following the morning earthquake that spawned a tsunami on Nov. 22.

TEPCO officials said the company manually shut down equipment that was transferring contaminated water from reactor buildings after the magnitude-7.4 earthquake struck off the coast of Fukushima Prefecture.

The measure was taken because water being transferred could have spilled out if a pipe in the system was fractured in the quake, they said.

"It may be the first time that we suspended a facility of our Fukushima No. 1, Fukushima No. 2 or Kashiwazaki-Kariwa nuclear power plants due to a quake since the Great East Japan Earthquake and tsunami (in March 2011)," said Naohiro Masuda, president of Fukushima Daiichi Decontamination & Decommissioning Engineering Co., TEPCO's in-house organization.

He made the remark at a news conference at the utility's head office in Tokyo.

Groundwater mixing with contaminated water in damaged reactor buildings has been a serious problem at the plant since the nuclear disaster unfolded in 2011.

"The biggest risk is a tsunami causing contaminated water that has accumulated (in the reactor buildings) to leak and pollute the environment," said Masuda, explaining why the company halted operations of the water transfer facility.

After the Japan Meteorological Agency issued a tsunami warning at 6:02 a.m., the company ordered workers in lower areas of the plant to evacuate to higher ground. They have been unable to check for possible leaks around the reactor buildings and the turbine buildings near the sea.

"It is a bit inappropriate that we've been unable to do so," Masuda said. "That's why we suspended the transfer facility. We think that no water will leak now."

TEPCO also reported that pumps to cool water in the spent nuclear fuel pool at the No. 3 reactor building of the Fukushima No. 2 nuclear power plant shut down after the quake. The company said this was an automatic mechanism that kicked in after the water level changed in the tank that adjusts water conditions in the pool.

"It is a result of the fact that the automatic suspension device worked normally," Masuda said. The pumps were later restarted.

## **Radiation monitor down at Fukushima port**

### **Marine radiation monitoring post down after M7.4**

<http://fukushima-diary.com/2016/11/marine-radiation-monitoring-post-down-after-m7-4/>

In the evening of 11/22/2016, Tepco announced the radiation monitoring post in the sea has been suspended due to the quake. The post is situated at the end of the breakwater of Fukushima plant port. They cannot monitor the radioactive substance spreading to the Pacific with this monitoring post out of order.

They also admitted the underwater fence was damaged, and also the coolant water got out of the common spent fuel pool due to the quake. It reportedly spread over 2m \* 3m but the exact volume is not announced.

About 40 minutes after the quake, Tepco announced they found no abnormality in Fukushima plant however 1m high tsunami was observed reaching the plant port.

## **Icewall examined...before quake**



A Natural Resources and Energy Agency official explains the state of the ice wall meant to surround the reactor buildings at the Fukushima No. 1 Nuclear Power Plant, on Nov. 21, 2016. (Pool photo)

## Ice wall at Fukushima nuclear plant revealed for first time

FUKUSHIMA -- The Economy, Trade and Industry Ministry on Nov. 21 showed the media for the first time the visual inspections conducted on the condition of the subterranean ice wall around the nuclear reactors at the stricken Fukushima No. 1 Nuclear Power Plant to block groundwater from flowing into the plant buildings.

The ice wall project calls for freezing the soil around the No. 1 to No. 4 reactor buildings that stretches some 1.5 kilometers to a depth of about 30 meters to create a solid barrier by hammering in equidistant cooling pipes and circulating coolant chilled to minus 30 degrees Celsius.

The industry ministry on Nov. 21 dug a part of the ice wall to approximately 1.2 meters in depth on the mountain side of the No. 4 reactor building. The soil temperature around the cooling pipes 40 centimeters deep was about minus 10.3 degrees, while an area of 1.5 meters in radius around the cooling pipes was frozen at a depth of 1.2 meters.

While plant operator Tokyo Electric Power Co. claims that the ice wall could reduce the amount of groundwater flowing into the reactor buildings from some 400 metric tons a day to 100 tons or less, the Nuclear Regulation Authority cast doubt on the project during an August meeting, with a member saying that the plan was a failure.

## Ice wall at Fukushima plant examined

[http://www3.nhk.or.jp/nhkworld/en/news/20161121\\_22/](http://www3.nhk.or.jp/nhkworld/en/news/20161121_22/)

Government officials have examined an underground ice wall built around Japan's crippled Fukushima Daiichi nuclear plant to confirm whether the soil has frozen.

Work is ongoing to build a 1.5 kilometer barrier of frozen soil encircling reactor buildings. The goal is to prevent underground water from seeping into the plant premises, resulting in more tainted water.

Coolants are being circulated from pipes buried around the reactor site.

Work to build an ice wall began in March, and is almost completed.

State minister for industry, Yosuke Takagi and others on Monday looked at an exposed section of the ice wall.

They said the ice wall had hardened enough to withstand being hit with a hammer.

Officials say prior to construction of the ice wall, workers collected some 350 tons of underground water on a daily basis. The amount has shrunk to about 200 tons.

Japan's nuclear regulator is also planning to assess the effectiveness of the ice wall installment.

December 5, 2016

## No.3 cooling out for a while

### **Fukushima reactor briefly loses cooling during inspection**

<http://mainichi.jp/english/articles/20161205/p2g/00m/0dm/079000c>

TOKYO (AP) -- One of the melted reactors at the tsunami-hit Fukushima nuclear power plant had a temporary loss of cooling Monday when a worker accidentally bumped a switch while passing through a narrow aisle of switch panels during an inspection and turned off the pumping system.

The plant's operator, Tokyo Electric Power Co., said cooling for the No. 3 reactor, one of the three that melted following the 2011 earthquake and tsunami, was out for nearly an hour before a backup pump kicked in.

The reactor had enough water left inside and there was no temperature increase or radiation leak from the incident, TEPCO spokesman Yuichi Okamura said at a news conference.

Even though there was no radiation leak or overheating of the core, or any injuries, the incident was a reminder that Fukushima's decommissioning work is running on a very fragile system.

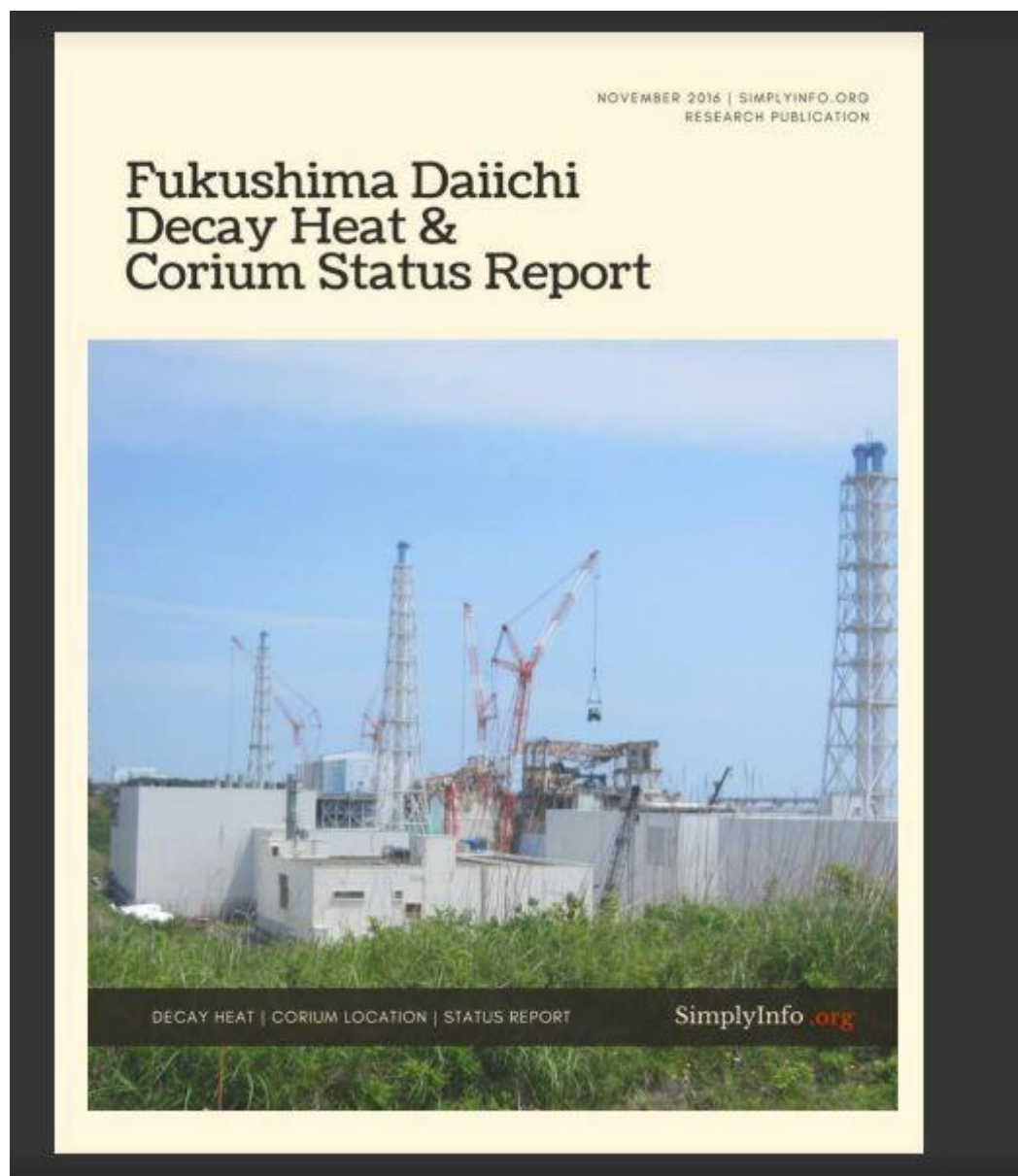
The plant was largely running on makeshift pipes, wiring and other equipment in the first two to three years following the 2011 disasters, suffering a series of minor blackouts -- including those caused by rats chewing cables -- cooling stoppages and other problems.

The plant has since largely stabilized, but it remains vulnerable to unanticipated incidents as it continues to struggle with decommissioning work, which is expected to last decades.

Monday's incident occurred when the worker was passing by a dimly lit aisle that was only 85 centimeters (2.8 feet) wide, flanked by tall switch panels on both sides, Okamura said. With radiation levels still high, the worker was wearing a full-face mask and hazmat suit when he lost his balance while carrying equipment. His elbow jammed into the switch, breaking off its safety cover and inadvertently turning the lever to turn off the water injection pump to the No. 3 reactor.

Okamura acknowledged the lack of space at the site and said that the plant will seek ways to eliminate human errors like one on Monday.

## Corium Status Report



## Fukushima Daiichi Decay Heat & Corium Status Report

[http://www.fukuleaks.org/web/?page\\_id=15924](http://www.fukuleaks.org/web/?page_id=15924)

This report by the SimplyInfo.org research team explores the post-meltdown conditions at Fukushima Daiichi. The potential locations for the melted fuel and the ongoing generation of decay heat are discussed. Scroll down to read the report.

Download to read offline (PDF)

Larger versions of the illustrations and graphs can be found here

December 23, 2016

### No.3 fuel retrieval postponed

#### Fuel removal at Fukushima reactor again faces delay

<http://www.asahi.com/ajw/articles/AJ201612230043.html>



Steel frames are transported at the Fukushima No. 1 nuclear power plant on Dec. 20 to prepare for work to retrieve spent nuclear fuel from the storage pool of the damaged No. 3 reactor building. (Pool)

Work to retrieve spent nuclear fuel in the No. 3 reactor building storage pool of the crippled Fukushima No. 1 nuclear power plant will again be postponed **due to a delay in clearing radioactive debris at the site.**

TEPCO planned to begin removing 566 spent nuclear fuel assemblies in the storage pool in January 2018. However, the government and the plant operator, Tokyo Electric Power Co., decided on the postponement, sources said on Dec. 22. They will decide on a new timetable in a few weeks.

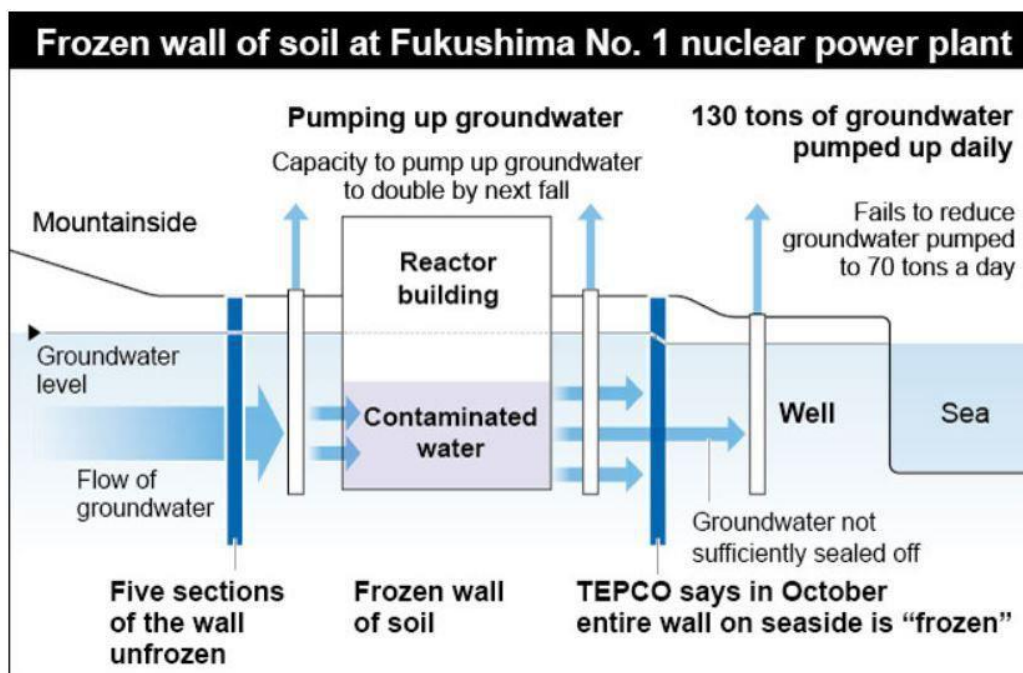
The work was initially scheduled for fiscal 2015, but had been pushed back because of high radiation readings in and around the No. 3 reactor building. The building was heavily damaged by a hydrogen explosion in the days following the disaster, triggered by the 2011 Great East Japan Earthquake and tsunami.

TEPCO had attempted to lower radiation levels by clearing the radioactive debris remaining at the site. But the clearing work took longer than expected due to contamination being more widespread than previously thought, forcing TEPCO and the government to again put off the retrieval.

Radiation levels have now dropped as almost all of wreckage at the site has been cleared, TEPCO said. The government and TEPCO have said fuel retrieval at the No. 1 and No. 2 reactor buildings will start in fiscal 2020 or later.

December 27, 2016

## Ice wall: Results "limited at best", says NRA



The Asahi Shimbun

## NRA: Ice wall effects 'limited' at Fukushima nuclear plant

By KOHEI TOMIDA/ Staff Writer



Citing “limited, if any effects,” the Nuclear Regulation Authority said a highly touted “frozen soil wall” should be relegated to a secondary role in reducing contaminated groundwater at the Fukushima No. 1 nuclear plant.

The government spent 34.5 billion yen (\$292 million) to build the underground ice wall to prevent groundwater from mixing with radioactive water in four reactor buildings at the crippled plant. But the NRA, Japan’s nuclear watchdog, concluded on Dec. 26 that the wall has been ineffective in diverting the water away from the buildings. It said that despite the low rainfall over the past several months, the amount of groundwater pumped up through wells outside the frozen wall on the seaside is still well above the reduction target.

It urged the plant operator, Tokyo Electric Power Co., to tackle the groundwater problem primarily with pumps, not the ice wall.

In response, TEPCO at the meeting said that by next autumn, it will double its capacity to pump up groundwater from the current 800 tons a day.

About 400 tons of groundwater enters the damaged reactor buildings each day and mixes with highly radioactive water used to cool melted nuclear fuel.

The ice wall project, compiled by the industry ministry in May 2013, was seen as a fundamental solution to this problem that has hampered TEPCO’s cleanup efforts since the triple meltdown in March 2011. Some 1,568 frozen ducts were inserted 30 meters deep into the ground to circulate a liquid at 30 degrees below zero. The freezing process was supposed to have created a solid wall of ice that could block the groundwater.

TEPCO began freezing the wall on the seaside in March. It announced in the middle of October that the temperature at all measuring points in that area was below zero.

Before the frozen wall project, TEPCO had to pump up about 300 tons of contaminated water a day. The daily volume dropped to about 130 tons in recent weeks, but it was still well beyond the target of 70 tons. Still, TEPCO boasted about the effectiveness of the ice wall at the meeting with the NRA on Dec. 26, saying, “We are seeing certain results.”

**The NRA, however, said the results are limited at best.**

Toyoshi Fuketa, an NRA commissioner, already warned TEPCO in October that it cannot expect the ice wall to be highly effective in containing the groundwater.

“Pumping up groundwater through wells should be the main player because it can reliably control the groundwater level,” Fuketa said at that time. “The ice wall will play a supporting role.”

That sentiment was echoed at the Dec. 26 meeting.

However, the NRA approved the utility’s plan to begin freezing dirt for a wall on the mountain side of the nuclear plant.

The NRA was previously concerned about risks posed by the new ice wall. If it totally blocked groundwater from the mountain side, the water level within the frozen soil near the reactors could become too low, allowing highly contaminated water inside the reactor buildings to flow out more rapidly. The NRA urged TEPCO to delay work on the mountain side until the ice wall on the seaside portion proved effective.

But it reversed its stance, saying a sharp drop in the groundwater level is unlikely based on the ineffectiveness of the existing ice wall.

“The frozen wall on the mountain side will not be able to block groundwater because the wall on the seaside was also unable to do so,” Fuketa said. “It will not be very dangerous to freeze the wall on the mountain side as long as the work is carried out carefully.”

TEPCO will start the work to freeze the ducts at five sections as early as next year.

Masashi Kamon, professor emeritus of geotechniques at Kyoto University, expressed skepticism about continuing the ice wall project without a full scrutiny of the underground conditions.

“Soil around the tunnels for underground pipes must be hard to freeze,” he said. “TEPCO should find out the conditions of the very bottom of the ice wall by drilling at least one section. **It is questionable to continue with the project without a review.**”

## All under control, says TEPCO

### Video: "The current situation at Fukushima Daiichi NPS"

-From 3.11 toward the future- (ver, Jan. 2017)

<http://www.tepco.co.jp/en/decommision/index-e.html>

Fukushima Daiichi Nuclear Power Station was attacked by a huge tsunami caused by Tohoku Pacific Ocean earthquake on March 11 2011.

We would like to show you the latest situation of Fukushima Daiichi, looking back the time of the accident.

[http://www.tepco.co.jp/en/news/library/archive-e.html?video\\_uuid=o6iw41m6&catid=61795](http://www.tepco.co.jp/en/news/library/archive-e.html?video_uuid=o6iw41m6&catid=61795)

January 24, 2017

## Camera get stuck trying to get into No.2 containment vessel

### Fukushima camera probe hits a snag

[https://www3.nhk.or.jp/nhkworld/en/news/20170124\\_22/](https://www3.nhk.or.jp/nhkworld/en/news/20170124_22/)

Workers attempting to get a better look inside a damaged reactor at the Fukushima Daiichi nuclear power plant have encountered a problem.

On Tuesday they inserted a camera in a pipe leading into the container vessel of the No. 2 reactor, with the aim of capturing footage of molten fuel inside.

But plant operator Tokyo Electric Power Company says the camera, which is marginally smaller than the pipe, quickly became stuck.

TEPCO says a simulated trial run went off without a hitch. The utility will investigate what went wrong before deciding whether to try again.

**Workers need a clearer picture of the debris to determine how best to remove it**, an important step in the decommissioning process for the 3 reactors that suffered meltdowns.

## Inside reactor No.2



## TEPCO starts full survey inside Fukushima No. 2 reactor vessel

See also video footage here:

<http://www.asahi.com/ajw/articles/AJ201701270073.html>

Tokyo Electric Power Co. sent a camera into the containment vessel of the No. 2 reactor at the Fukushima No. 1 nuclear power plant on Jan. 26 as it started a full-scale survey of the damage inside. The probe is being conducted in advance of plans to send a robot into the heavily contaminated vessel in February to determine the locations of the melted nuclear fuel.

Nearly six years have passed since the Great East Japan Earthquake and tsunami in March 2011 triggered the Fukushima nuclear accident. However, the precise locations of the melted fuel inside the No. 2 reactor are unknown.

If those sites are confirmed, they will serve as valuable data in decommissioning the reactor.

On Jan. 26, TEPCO inserted a camera-installed pipe into the containment vessel through a hole that had been made for the survey robot “Sasori” to pass through.

The radiation level around the hole was eight sieverts per hour, a deadly exposure level for humans.

Workers were forced to perform their tasks while taking cover behind a wall, which was located about two meters from the hole.

According to TEPCO, video footage taken by the camera inside the containment vessel showed that there were no obstacles around the area where Sasori is expected to pass through.

Next week, TEPCO plans to send the camera probe deeper and shoot images of the area just below the nuclear reactor. Utility officials said there is a possibility that melted fuel can be seen.

If data on the locations and conditions of the melted nuclear fuel are obtained, TEPCO and the International Research Institute for Nuclear Decommissioning (IRID) will utilize them when they study the removal method for the fuel, expected to be decided in fiscal 2018 at the earliest.

TEPCO hopes that it will start to take out the melted fuel as early as 2021.

To date, the utility has examined the inside of the containment vessel of the No. 2 reactor with an industrial endoscope three times. However, it has been unsuccessful in confirming the locations of the melted fuel.

(This article was written by Kohei Tomida and Takashi Sugimoto.)

February 10, 2017

## Fukushima Daiichi NPS Prompt Report 2017

### Fukushima Daiichi NPS Prompt Report (Feb 10,2017) Recent Topics: PROGRESS AT UNITS 1 AND 3, AND ‘ICE WALL’ UPDATE HIGHLIGHT LATEST NUCLEAR SAFETY PROGRESS REPORT

[http://www.tepco.co.jp/en/press/corp-com/release/2017/1375451\\_10469.html](http://www.tepco.co.jp/en/press/corp-com/release/2017/1375451_10469.html)

#### ***Work in Units 1 and 3 are preparations for removal of fuel assemblies from the spent fuel pools***

TOKYO, Feb. 10-Preparations at Fukushima Daiichi Units 1 and 3 for the eventual removal of fuel assemblies, together with progress in freezing the “ice wall,” are the highlights of the latest quarterly report on progress in TEPCO Holdings’ implementation of its Nuclear Safety Reform Plan.

Also reported is continuing work to ensure that the Kashiwazaki-Kariwa Nuclear Power Station is getting ready for safe operation based on the Nuclear Regulation Authority’s requirements, and a summary of the company’s self-assessment effort. The report covers the third quarter of TEPCO Holdings’ current fiscal year, October-December 2016.

#### ***Preparations for Spent Fuel Removal***

In Unit 1, temporary wall panels that had been put in place after the March 2011 accident were being carefully removed so that rubble scattered on the reactor's top floor can be removed to conduct the future fuel extractions. The panel removals were completed in November, and the goal is to begin fuel removal operations during FY2020.

In Unit 3, additional shielding has been put in place on the top floor to protect employees and contractors who will need to work there during preparation for the fuel removal from the spent fuel pool. Other work to support fuel removal equipment was performed in the unit, and the plan is to begin removing fuel in FY 2018.

### ***"Ice Wall" (the landside impermeable wall)***

The report also summarizes developments during the quarter in the freezing of the "ice wall" - actually a frozen soil barrier designed to isolate the four damaged reactor buildings from groundwater flows. It reports that the frozen state of the soil is being maintained, and that the amount of water pumped up daily has declined from 400 cubic meters to 140 cubic meters.

### ***Self-Assessment***

The report briefly summarized TEPCO Holdings' major self-assessment activity. The self-assessment's findings, it said, "revealed the need to enhance organizational governance and human resource cultivation. In response to these findings, we are sharing information on basic plans and priorities and quickly implementing necessary reforms, and a management model is being established and developed as a governance enhancement measure to promote follow-ups by management." (A more detailed report including action plans and actions being implemented was provided to the Nuclear Reform Monitoring Committee in January, after the close of the quarter, and is available on TEPCO Holdings' website at [http://www.tepco.co.jp/en/press/corp-com/release/2017/1368951\\_10469.html](http://www.tepco.co.jp/en/press/corp-com/release/2017/1368951_10469.html).)

The report also discusses progress at Kashiwazaki-Kariwa, and in the overall implementation of the Nuclear Safety Reform Plan, including better communication and various management reforms. An English-language summary of the quarterly progress report may be seen at [http://www.tepco.co.jp/en/press/corp-com/release/betu17\\_e/images/170210e0101.pdf](http://www.tepco.co.jp/en/press/corp-com/release/betu17_e/images/170210e0101.pdf).

The full report is available (currently only in Japanese) at <http://www.tepco.co.jp/press/release/2017/pdf1/170210j0102.pdf>.

### **About TEPCO Group**

Tokyo Electric Power Company Holdings, Inc. (TEPCO Holdings) is Japan's largest power company group, holding three independent business entities: TEPCO Fuel & Power, Inc., TEPCO Power Grid, Inc., and TEPCO Energy Partner, Inc. As a group, it generates, distributes, and sells electricity and other types of energy principally to the Kanto metropolitan area, which includes Japan's two most populous cities, Tokyo and Yokohama. Its 33,000 employees are committed to providing safe, reliable power to its 29 million customers as well as fulfilling its responsibilities to the communities of Fukushima. (As of April 1, 2016)  
TEPCO Website:

<http://www.tepco.co.jp/en/index-e.html>TEPCO Facebook page:

<https://www.facebook.com/OfficialTEPCOen>TEPCO Twitter page: [https://twitter.com/TEPCO\\_English](https://twitter.com/TEPCO_English)

February 13, 2017

## Inside damage doesn't show

### Six years on, signs of progress seen in visit to Fukushima plant

<http://www.asahi.com/ajw/articles/AJ201702130029.html>

By HISASHI HATTORI/ Senior Staff Writer

A recent tour of the Fukushima No. 1 nuclear power plant shows not only the damage to the reactors, but also the progress that has been made in improving the working environment for those preparing the site for decommissioning. (Video footage by Hisashi Hattori)

On visiting the crippled Fukushima No. 1 nuclear power plant in 2013, journalists had to don full facial masks and bulky protective clothing because of the high radiation levels.

But on a tour on Feb. 6, except for a face mask and vest containing a dosimeter, **normal clothing was all that was necessary to enter the site.**

While conditions on the grounds of the plant may have improved in the six years since the catastrophic triple meltdown, there are many signs that the decommissioning of the reactors will be drawn out.

A group of reporters from Japan National Press Club member organizations were given a tour on Feb. 6 of the plant site by officials of Tokyo Electric Power Co., the plant operator.

The latest visit was the fifth for the writer since the March 2011 nuclear accident triggered by the Great East Japan Earthquake and tsunami.

A bus carrying the journalists stopped on a hill overlooking the four crippled reactor buildings. The No. 1 reactor building stood about 80 meters away. The dosimeter held by the TEPCO official accompanying the group recorded a reading of 0.149 millisieverts per hour.

The No. 1 reactor building was once covered to prevent the spewing of radioactive materials because the roof had been blown off in a hydrogen explosion in the early days of the accident. However, that cover was removed in November 2016.

"The ceiling remains collapsed," the TEPCO official said.

The rubble remains untouched on the upper part of the building, and the metal skeleton was clearly visible.

At the No. 3 reactor, work continues to remove spent nuclear fuel from the storage pool located at the upper part of the reactor building. The bent metal parts that looked like a bird's nest have been removed, but cracks remain along the thick concrete side walls of the building, exposing the metal reinforcement. The exterior of the No. 2 reactor building is largely unchanged from before the accident, mainly because the building was not hit by an explosion.

However, images from the interior painted a different picture. In January, what appeared to be a lump of melted nuclear fuel that flowed out of the pressure vessel was captured on camera. An analysis of the images led to the estimation that a maximum radiation level of 530 sieverts per hour existed in the containment vessel.

On Feb. 9, another robot was forced to abort its operations and the estimate was made that the radiation level was 650 sieverts per hour.

**Experts now believe that an unexpectedly large amount of melted nuclear fuel has likely spread throughout the reactor.**

The exponentially large level of radiation is apparent when a comparison is made with the 1999 accident at the JCO uranium reprocessing facility at Tokai, Ibaraki Prefecture, when a criticality accident led to the deaths of two workers. At that time, the radiation level for the individual exposed to the lower level was between six to 10 sieverts.

The bus took the group close to the No. 2 and No. 3 reactors.

Approaching within a few meters of the No. 3 reactor building, the TEPCO official said that the radiation level on the dosimeter was 0.245 millisieverts per hour.

While that may seem infinitesimal next to the No. 2 reactor containment vessel, exposure to it for five hours would be equivalent to the annual limit of 1 millisievert considered safe for humans.

Rubble in the area is being removed by remotely controlled cranes and other heavy equipment. Robots are used for indoor work, but progress is hampered by the high radiation levels.

**The plant site at one time included an abundance of forested area, but that has been cut down.**

In its place are rows upon rows of tanks up to three floors high holding radiation-contaminated water. There are a total of about 1,000 such tanks on the plant grounds.

From immediately after the nuclear accident, water continued to be pumped into the three reactors to cool the melted nuclear fuel. In addition, groundwater flows into the reactor building basements at a rate of about 150 tons a day. While the volume of water flowing in has decreased, it still becomes contaminated by radiation.

**No decision has yet been made on what to do about the approximately 960,000 tons of contaminated water on the plant site.**

On the other hand, noticeable steps have been taken to improve the working environment of those preparing the reactors for decommissioning.

At one time, radioactive materials that had spewed out of the reactor buildings fell on large areas of the plant site. Those areas have been largely covered with mortar, reducing the areas of the plant grounds where workers must wear full face masks and protective clothing to prevent inhaling or swallowing radioactive materials.

"Workers can move around in light clothing at about 90 percent of the plant site," said Shunji Uchida, the head of the Fukushima No. 1 plant.

A nine-floor facility that can accommodate 1,200 workers has been constructed where workers can take a break and rest. A new headquarters building has also been constructed with an atrium.

February 25, 2017

**"A forest of containers" and nowhere to go**



Workers bring in a new water tank, right, as a replacement for an old contaminated water tank at TEPCO's No. 1 nuclear power plant in the town of Okuma in Fukushima Prefecture on Feb. 24, 2017. (Mainichi)

## Fukushima nuclear plant still plagued by tainted water 6 years after meltdowns

<http://mainichi.jp/english/articles/20170225/p2a/00m/0na/010000c>

OKUMA, Fukushima -- With two weeks to go until the sixth anniversary of the disaster at Tokyo Electric Power Co. (TEPCO)'s Fukushima No. 1 Nuclear Power Plant here, the Mainichi Shimbun visited the plant on Feb. 24, obtaining a first-hand view of working conditions and the persisting problem of tainted water. The number of areas on the plant site requiring full face masks has decreased considerably, and the overall working environment has improved greatly. However, the issue of having to replace the tanks that hold radioactively contaminated water lingers.

Dealing with contaminated water requires significant manpower. According to TEPCO, **about half of the approximately 6,000 people working daily at the No. 1 nuclear power plant are involved in handling contaminated water.**

There are roughly 1,000 tanks of contaminated water inside the No. 1 plant site, forming a forest of containers with nowhere else to go.

During the immediate aftermath of the nuclear disaster in 2011, a considerable number of tanks known as flanges were placed within the site. However, as concerns continue to grow about contaminated water leaking from these tanks due to dilapidation, TEPCO has taken action and is working on dismantling them. Although covering the ground at the No. 1 plant with concrete has made it possible to work in about 90 percent of the site without a protective uniform, all those working near the old tanks must wear full face masks and Tyvek suits as the tanks once held highly contaminated water. Wearing this kind of protective clothing makes the work much harder to perform -- as it can be difficult to breathe -- and it is physically exhausting, even in the middle of winter.

Hiroshi Abe, 55, of Shimizu Corp. -- the company overseeing the dismantling work -- states, "As we work toward recovery from the disaster, we want to ensure that all workers are protected from radiation exposure and injuries."



Presently, the level of radiation in the vicinity of the buildings housing the No. 1, No. 2, and No. 3 reactors is high. During the Mainichi Shimbun's visit to the site on Feb. 24, the radiation level near the No. 3 reactor was found to be more than 300 microsieverts per hour, and near the No. 2 reactor building, it was discovered to be 137.6 microsieverts per hour.

Furthermore, an "ice wall," which was built to restrict the flow of contaminated water underground, has not been as effective as initially expected.

A spokesman for TEPCO, Takahiro Kimoto, who accompanied the Mainichi Shimbun on this visit, said, "Nearly six years have passed since the disaster. Our decommissioning work is now about to enter the main stage of extracting melted fuel."

However, with TEPCO and the government's decommissioning work set to continue until around 2041-2051, there is still a long way to go until they can reach the "main stage."

### In photos: Inside the Fukushima No.1 nuclear plant



### In photos: Inside the Fukushima No.1 nuclear plant

<http://mainichi.jp/english/graphs/20170225/hpe/00m/0na/001000g/1>

February 27, 2017

## Robots like humans "still feeling around the dark"

### Robots' limitations exposed in search for melted nuclear fuel in Fukushima

<http://mainichi.jp/english/articles/20170227/p2a/00m/0na/016000c>

OKUMA, Fukushima -- In an attempt to minimize the risk to humans during the search for melted nuclear fuel at the Fukushima No. 1 Nuclear Power Plant, robots have also been deployed to help out with the task.

- **【Related】** Search for melted nuclear fuel at Fukushima plant's No. 2 reactor faces obstacles
- **【Related】** Proud workers at Fukushima No. 1 nuke plant risk deadly radiation danger
- **【Related】** Editorial: Time to transform Japan's nuclear plant inspection system

However, the robots have also encountered some problems. For instance, a Toshiba Corp. robot that was sent in to clear away deposited material inside the containment vessel of the No. 2 reactor failed to clear away much material, and within approximately two hours, its camera had broken.

According to Takahiro Kimoto of plant operator Tokyo Electric Power Co. (TEPCO), "The radiation inside the containment vessel was so intense that the images transmitted back from a camera attached to the robot were pitch black." This was somewhat disappointing for the team working at the No. 2 reactor because by losing their robotic "eye" inside the containment vessel, they were unable to make the progress they were hoping for.

On Feb. 16, a "scorpion robot" was sent into the containment vessel. The intention of the mission was to locate melted nuclear fuel. However, deposited materials inside the vessel meant that the robot became stuck and was unable to move any further.

In the end, images from directly underneath the nuclear reactor were obtained not from the robot, but by "human means," on Jan. 30. By using a pipe and a camera, the team was able to confirm the presence of holes in the platform. They also discovered brown and black deposited material, which appeared to be melted nuclear fuel. Therefore, some might say that "human methods" are more effective than robots in a mission of this nature.

According to TEPCO, "This was the first probe of its kind in the world. We were able to collect sufficient data." However, critics would argue that six years have passed since the outbreak of the Fukushima nuclear disaster in 2011, and yet the exact situation regarding melted nuclear fuel at the site is still unclear.

Looking ahead, further difficulties are anticipated at both the No. 1 and No. 3 reactors, where in the past, there have been hydrogen explosions. This is mainly because there are several meters of contaminated water underneath the containment vessels, and the radiation levels are stronger than at the No. 2 reactor. There are plans to insert a robot inside the No. 1 reactor in March, but a date has not yet been set for the No. 3 reactor. Satoshi Okada of the nuclear power plant maker Hitachi-GE Nuclear Energy, which oversees the search at the No. 1 reactor, states, "In order to deal with the problem of melted nuclear fuel, we must first ascertain exactly how and where the melted fuel has been scattered inside the reactors."

In summer 2017, TEPCO and the government will look into ways of withdrawing the melted nuclear fuel from the site, with the aim of commencing extraction work in 2021 -- exactly 10 years after the initial disaster.

The Three Mile Island Disaster in the U.S. in 1979 will provide some kind of reference for TEPCO and the government, because in that particular case, the removal of melted nuclear fuel started 11 years after the

initial accident. However, the situation at Fukushima appears to be more complicated than at Three Mile Island, because in the case of the latter accident, melted nuclear fuel was retained within pressure containers. Conversely, in the case of Fukushima, some of the material has seeped through the pressure containers.

With regard to the government and TEPCO's decommissioning work, Nuclear Regulation Authority Chairman Shunichi Tanaka states, "It is still early to talk in such an optimistic way. At the moment, we are still feeling around in the dark."

Time will tell as to whether the current plan for removing melted nuclear fuel from the No. 1 power plant is a realistic possibility or just a pipe dream.

## **Search for melted nuclear fuel at Fukushima plant's No. 2 reactor faces obstacles**

<http://mainichi.jp/english/articles/20170227/p2a/00m/0na/011000c>

Although nearly six years have passed since the nuclear disaster at the Fukushima No. 1 Nuclear Power Plant in 2011, the search for the melted nuclear fuel inside the plant continues.

- **【Related】 Proud workers at Fukushima No. 1 nuke plant risk deadly radiation danger**

**The operators of the plant, Tokyo Electric Power Co. (TEPCO), deployed over 800 workers inside the No. 2 reactor at the No. 1 plant between December 2016 and February 2017 -- but so far, they have been unable to identify the location of the melted nuclear fuel.**

TEPCO also plans to conduct studies inside the No. 1 and No. 3 reactors, but they are surely headed for a rough road as the search for the melted nuclear fuel continues to be extremely difficult. It is likely that struggles in that search will have a negative effect on the government and TEPCO's target of completing the Fukushima decommissioning work between 2041 and 2051.

Apart from humans, robots have also been involved in the search. In the case of the No. 2 reactor for example, robots have been used in the following way.

The mission to get a good look inside the No. 2 reactor containment vessel had four steps; first, workers would drill a hole measuring 11.5 centimeters in diameter into the containment vessel wall, allowing robots to enter the vessel; then workers would insert a pipe with a camera into the hole so that the situation inside the vessel could be observed; a cleaning robot would then be sent inside the vessel to clear away any sediment in the way for the next robot; and finally a self-propelled, scorpion-shaped robot would travel to the area directly below the nuclear reactor, in search of the melted fuel. However, a number of unexpected problems emerged along the way.

Heavy machinery giant IHI Corp.'s Keizo Imahori, 38, who oversaw the mechanical boring of the containment vessel in December 2016, explains that, "A number of unexpected dents were found on the floor of the nuclear reactor building." This was a surprising discovery for Imahori and his team. The presence of the dents meant that it would be difficult for machines to get sufficiently close to the necessary areas to drill a hole, which in turn has a detrimental effect on the entire search for melted nuclear fuel.

As an emergency measure, 1-meter by 1-meter iron sheets were used to cover the dents, but workers involved in laying the sheets were exposed to extra radiation because of this additional work.

In addition to the dents, the No. 1 to No. 3 reactors at the Fukushima plant, which first started operating in the 1970s, had many parts that have undergone repair work not reflected in their original construction plans. It was impossible to check such changes in the structure beforehand due to high levels of radiation. There was another problem -- the machines could not be attached to the side of the containment vessel, which meant workers were unable to carry out drilling work. This was caused by the containment vessel's paint peeling away. The problem was solved after workers peeled off the paint by hand, but this also caused them to be exposed to more radiation.

The hole-boring process at the No. 2 reactor took approximately 20 days to complete -- during which, workers involved in the project were exposed to approximately 4.5 millisieverts of radiation on average. Based on national guidelines, many companies involved in decommissioning work set the annual upper radiation dose at 20 millisieverts for their workers. Therefore, workers can only be involved in this project up to five times before their level of radiation exposure exceeds the limit. However, as Imahori points out, "We have no way of knowing the situation unless we actually go in there."

Nevertheless, in order to ensure that highly-skilled professionals with expert knowledge in nuclear power plants continue to be involved in the search for the melted nuclear fuel, it is necessary to use robots as much as possible to reduce the amount of radiation to which humans are exposed.

At the same time, with the Fukushima No. 1 Nuclear Power Plant being somewhat like a "burning house," manpower is also required to make effective progress with the search. Yasuo Hirose, of IHI Corp., states, "If we completely rely on robots for the decommissioning work, they will not be able to deal with any unexpected problems. The decommissioning process is likely to be a very long task." (Mirai Nagira, Science & Environment News Department)

March 9, 2017

## Fukushima Daiichi after 6 years

### Fukushima Daiichi 6 Years On

<https://www3.nhk.or.jp/nhkworld/nhknewslines/33/fukushimadaiichi6yearson>

NHK World's Ayako Sasa joins anchor Miki Yamamoto in the studio.

**Yamamoto:** The Fukushima Daiichi nuclear plant, on the Pacific coast more than 200 kilometers northeast of Tokyo, suffered one of the worst nuclear accidents in history after the March 2011 earthquake and tsunami. Workers are still struggling to contain the high levels of radiation and contaminated water there. Ayako, can you bring us up to speed on what's gone on at the plant since the disaster?

**Sasa:** The nuclear power plant is facing the ocean, and when the tsunami hit it caused massive damage to 4 reactor buildings and facilities. Three of them were damaged by hydrogen explosions, and reactors 1, 2 and 3 suffered meltdowns. To cool the reactors, water needed to be pumped in. They're still pumping water in today, and when it goes inside, it gets contaminated.

That water is then processed and is kept in storage tanks. There are around 1,000 of them. But what to do with all that contaminated water has not been decided. What's more, there's also underground water

coming down from mountains in this direction and getting inside. Tokyo Electric Power Company is trying to prevent that water from getting in.

**Yamamoto:** This is where the ice wall comes in isn't it?

**Sasa:** That's right. Water runs down from the mountains to the ocean. It seeps through cracks in the buildings and it becomes contaminated -- tons of water floods into the buildings each day. The Japanese government and TEPCO decided to build an underground ice wall to block the water. They put long pipes into the ground and filled them with liquid coolant, which in turn freezes the soil between the pipes. The operation began last year and still isn't completed. The final part of the process needs approval and the nuclear watchdog is still studying what they think will happen when the wall is complete.

**Yamamoto:** The goal is to decommission the crippled plant. Can you talk about that process?

**Sasa:** Yes, when the meltdowns happened, nuclear fuel rods inside the reactors melted. TEPCO needs to find out what happened to that molten fuel and how much there is in order to figure out how to remove it. But here's the problem -- radiation levels are still too high for workers to get inside to see the damage for themselves. Because of this, they've sent in cameras and robots instead. Last month, the latest robot was sent in to measure the temperature, radiation and take pictures. It broke down and TEPCO gave up on it.

**Yamamoto:** Although research and development continue to get the answer, they still haven't found the exact location of the melted fuel rods and this is after 6 years. What's the timeline looking like for TEPCO?

**Sasa:** Decommissioning the Daiichi plant will take decades. And, the process is not only long but also complicated. The government and TEPCO are expected to decide this year on a broad outline for how to remove the melted fuel rods in. Their aim is to start removing it from one of the reactors in 2021, the whole process 30 to 40 years.

As for cost, the government says we can expect the price tag to quadruple from earlier estimates. That will bring things to about 70 billion dollars. The reason? The difficulty of the task and the lengthy period of time needed to do it. A project of this scale has never been done before.

## March 11, 2017

### 6 years

#### Japan marks 6 years since 3/11 disaster

[https://www3.nhk.or.jp/nhkworld/en/news/20170311\\_03/](https://www3.nhk.or.jp/nhkworld/en/news/20170311_03/)

Saturday marks 6 years since the massive earthquake and tsunami hit northeastern Japan, triggering the Fukushima Daiichi nuclear accident.

Reconstruction efforts in disaster-hit areas have been delayed, and over 120,000 people are still living in temporary and other housing as evacuees.

The magnitude-9.0 quake struck in the Pacific off the coast of northeastern Japan at around 2:46 PM on March 11th, 2011. It generated a tsunami more than 10 meters high. Areas around the quake's focal zone still experience tremors more frequently than before the disaster.

The National Police Agency says that, as of Friday, the number of deaths stands at 15,893 in 12 prefectures. It says 2,553 remain missing in 6 prefectures.

The Reconstruction Agency says at least 3,523 people died in 10 prefectures due to health problems and other reasons related to their lives as evacuees.

The agency adds that as of February 13th, more than 123,000 people were living in temporary, rental, or other housing as evacuees.

The agency says 23,393 housing units for disaster survivors who cannot afford to rebuild their homes had been completed by the end of January. That's 78 percent of over 30,000 such units the authorities plan to build.

The Japanese government will lift evacuation orders for many areas in Fukushima Prefecture by early April, except for no-entry zones with high radiation levels. But many residents say they won't return home due to concern over radiation and delays in rebuilding infrastructure.

NHK has learned, based on a national census, that the population in 14 coastal municipalities in the prefectures of Iwate, Miyagi, and Fukushima decreased by more than 10 percent over the period between March 1, 2011, and February 1 of this year.

3 reactors at the Fukushima Daiichi nuclear power plant suffered meltdowns following the earthquake and tsunami.

The operator, Tokyo Electric Power Company, or TEPCO, is trying to figure out a way to remove fuel debris, a mixture of molten fuel and reactor parts. The removal work is regarded as the toughest task in the process of decommissioning the reactors.

But high radiation levels make it difficult to determine the exact location of the debris.

In February, the utility sent a robot into the containment vessel of the plant's No.2 reactor and detected an extremely high radiation level of 210 sieverts per hour.

The robot could not reach a central area under the reactor's core, failing to confirm facts about the fuel debris.

TEPCO plans to conduct a robotic survey inside the No.1 reactor, starting on March 14th.

The utility is also tackling the problem of radioactive water at the plant.

The utility has finished 98 percent of the work to freeze soil around the No.1 to No.4 reactor buildings to block the inflow of groundwater.

Nearly 940,000 tons of contaminated water are stored in about 900 tanks at the plant. No substantive plans have been made to dispose of the water.

March 13, 2017

## Safety equipment testing and training badly needs reviewing

### Fukushima Daiichi reactor cooling system untested

[https://www3.nhk.or.jp/nhkworld/en/news/20170312\\_21/](https://www3.nhk.or.jp/nhkworld/en/news/20170312_21/)

An emergency cooling system for the No.1 reactor at the Fukushima Daiichi nuclear plant was set at a mode that was difficult to start for nearly 30 years until 2010.

The No.1 reactor was the first of the 3 reactors at the plant to melt down in the 2011 accident.

The isolation condenser system was automatically activated after the massive earthquake 6 years ago, and operators used it to cool down the reactor.

However, they failed to make full use of it, and misjudged its operating status after power was lost in the tsunami.

The subsequent meltdown of the No.1 reactor caused a hydrogen explosion.

NHK interviewed officials from Tokyo Electric Power Company and requested the disclosure of information. NHK found that **the setting of the emergency cooling system was changed in 1981 to make it difficult to start.**

**The isolation condenser is supposed to switch on automatically when the pressure inside the reactor rises for some reason. But its settings were altered so that another device for reducing internal pressure would start first.**

**There is no record of the isolation condenser being used for nearly 30 years, even when problems occurred.**

**Safety measures were reviewed the year before the 2011 accident, and the cooling system was reset to make it easy to start.**

**However, it was never actually tested before the 2011 accident.**

The utility says it cannot confirm why the setting was changed in 1981 as there are **no records**, and it was not tested because there was a risk of a radioactive leak if the system became damaged.

The company says employees were told about the isolation condenser in their training courses.

**Hosei University Professor Hiroshi Miyano says people cannot use such a device without**

experience, and this may have been a factor behind the scale of the accident. He says safety equipment testing and training should be reviewed at other nuclear plants.

## What about all this radioactive waste?



Tanks for storing contaminated water, with Reactors 1 and 2 in the background at the Fukushima Daiichi Nuclear Power Station in Fukushima, Japan, Feb. 21, 2017. Japanese officials wrestle with what to do with the ever-growing pile of radioactive waste at the nuclear power station, six years after the accident there. (Ko Sasaki/ © 2017 The New York Times)

## Nuclear Waste's Toll And Challenge in Japan, Six Years After Disaster

<http://www.asahi.com/ajw/articles/SDI201703131091.html>

By MOTOKO RICH/ © 2017 The New York Times

FUKUSHIMA DAIICHI NUCLEAR POWER STATION--Six years after the largest nuclear disaster in a quarter-century, Japanese officials have still not solved a basic problem: what to do with an ever-growing pile of radioactive waste. Each form of waste at the Fukushima Daiichi Nuclear Power Station, where three reactors melted down after an earthquake and a tsunami on March 11, 2011, presents its own challenges.

### **400 Tons of Contaminated Water Per Day**

The Tokyo Electric Power Co. is pumping water nonstop through the three reactors to cool melted fuel that remains too hot and radioactive to remove. About 400 tons of water pass through the reactors every day, including groundwater that seeps in. The water picks up radiation in the reactors and then is diverted into a decontamination facility.

But the decontamination filters cannot remove all the radioactive material. So for now, all this water is being stored in 1,000 gray, blue and white tanks on the grounds. The tanks already hold 962,000 tons of contaminated water, and Tokyo Electric is installing more tanks. It is also trying to slow the flow of groundwater through the reactors by building an underground ice wall.



Within a few years, though, and no one is sure exactly when, the plant may run out of room to store the contaminated water. "We cannot continue to build tanks forever," said Shigenori Hata, an official at the Ministry of Economy, Trade and Industry.

Authorities are debating whether it might be acceptable, given the relatively low radioactive levels in the water, to dilute the contaminated water and then dump it into the ocean. But local fishermen are vehemently opposed. Many people still do not trust Tokyo Electric because of its bungled response to the disaster, the worst nuclear accident since Chernobyl.

### **3,519 Containers of Radioactive Sludge**

The process of decontaminating the water leaves radioactive sludge trapped in filters, which are being held in thousands of containers of different sizes.

Tokyo Electric says it cannot quantify the amount of radioactive sludge being generated. But it says it is experimenting with what to do with it, including mixing it with cement or iron. Then it will have to decide how to store it.

### **64,700 Cubic Meters of Discarded Protective Clothing**

The estimated 6,000 cleanup workers at the site put on new protective gear every day. These hazmat suits, face masks, rubber gloves and shoe coverings are thrown out at the end of each shift. The clothing is compressed and stored in 1,000 steel boxes stacked around the site.

To date, more than 64,700 cubic meters of gear has been discarded, the equivalent of 17 million 1-gallon containers. Tokyo Electric says it will eventually incinerate all this contaminated clothing to reduce the space needed to store it.

### **Branches and Logs From 220 Acres of Deforested Land**

The plant's grounds were once dotted with trees, and a portion was even designated as a bird sanctuary. But workers have cleared about 220 acres of trees since the meltdown spewed radiation over them. Now, piles of branches and tree trunks are stacked all over the site. Officials say there are about 80,000 cubic meters of this waste, and all of it will have to be incinerated and stored someday.

### **200,400 Cubic Meters of Radioactive Rubble**

Explosions during the meltdown filled the reactors with rubble. Workers and robots are slowly and carefully trying to remove this tangled mass of crushed concrete, pipes, hoses and metal.

Tokyo Electric estimates that more than 200,400 cubic meters of rubble--all of it radioactive--have been removed so far and stored in custom-made steel boxes. That is the equivalent of about 3,000 standard 40-foot shipping containers.

### **3.5 Billion Gallons of Soil**

Thousands of plastic garbage bags sit in neat rows in the fields and abandoned towns surrounding the Fukushima plant. They contain soil that was scraped from land that was exposed to radiation in the days after the accident.

Japan's Ministry of the Environment estimates that it has bagged 3.5 billion gallons of soil, and plans to collect much more. It will eventually incinerate some of the soil, but that will only reduce the volume of the radioactive waste, not eliminate it.

The ministry has begun building a massive, interim storage facility in Fukushima prefecture and negotiating with 2,360 landowners for the thousands of acres needed to complete it. And that is not even a long-term solution: The government says that after 30 years it will need another site--or sites--to store radioactive waste.

### **1,573 Nuclear Fuel Rods**

The ultimate goal of the cleanup is to cool and, if possible, remove the uranium and plutonium fuel that was inside the three reactors at the time of the disaster.

Hundreds of spent fuel rods are in cooling pools inside the reactors, and the company hopes to have cleared away enough rubble to begin removing them next year. The much bigger challenge will be removing the fuel that was in use in the reactor core at the time of the meltdown.

The condition and location of this molten fuel debris are still largely unknown. In one reactor where a robot was sent in January, much of the melted fuel is believed to have burned through the bottom of the inner reactor vessel and burrowed into the thick concrete foundation of the containment structure.

The plan is to completely seal the containment vessels, fill them with water and use robots to find and remove the molten fuel debris. But the rubble, the lethal levels of radiation and the risk of letting radiation escape make this an exceedingly difficult task.

In January, the robot sent into one of the reactors discovered radiation levels high enough to kill a person in less than a minute. Another had to be abandoned last month after debris blocked its path and radiation disabled it.

Tokyo Electric hopes to begin removing fuel debris from the reactor cores in 2021. The entire effort could take decades. Some say the radioactive material may prove impossible to remove safely and have suggested leaving it and entombing Fukushima under a concrete and steel sarcophagus like the one used at Chernobyl.

But the Japanese government and Tokyo Electric say they are committed to removing all the waste and cleaning the site, estimated at a cost of \$188.6 billion.

“We want to return it to a safe state,” said Yuichi Okamura, general manager of the company’s nuclear power and plant siting division. “We promised the local people that we would recover the site and make it a safe ground again.”

(March 11, 2017)

March 20, 2017

**Should be easier this time...**



A robot on March 18 took this image of a valve and a pipe in cooling water at the bottom of the containment vessel of the No. 1 reactor at the Fukushima No. 1 nuclear power plant. (Provided by the International Research Institute for Nuclear Decommissioning)

### **Clearer water should help find melted fuel at Fukushima plant**

<http://www.asahi.com/ajw/articles/AJ201703200028.html>

Cooling water in the No. 1 reactor of the Fukushima No. 1 nuclear plant has improved in transparency, which should make it easier to pinpoint the location of melted nuclear fuel, the plant's operator said. The improved transparency, compared with the level two years ago, was confirmed on March 18, when a research robot took an image that clearly showed a valve and a pipe in the water at the bottom of the reactor's containment vessel, Tokyo Electric Power Co. said March 19.

Devices on the robot measured radiation levels of 7.8 sieverts per hour on a metal stage for workers and 1.5 sieverts per hour in the water.

The research robot on March 20 and 21 will study areas where the melted nuclear fuel could exist.

March 22, 2017

### **Another failed mission?**

### **Robot can't find melted fuel at No. 1 reactor of Fukushima plant**

<http://www.asahi.com/ajw/articles/AJ201703220046.html>



What appears to be sand has piled up on a pipe at the bottom of the containment vessel of the No. 1 reactor at the Fukushima No. 1 nuclear power plant. This image was taken by a survey robot on March 20. (Provided by the International Research Institute for Nuclear Decommissioning)

Tokyo Electric Power Co. (TEPCO) extended the mission of a survey robot after it failed to locate melted nuclear fuel at the No. 1 reactor of the Fukushima No. 1 nuclear power plant. The robot on March 20 was sent into the reactor's containment vessel, where the melted fuel is believed to have landed at the bottom, but pipes blocked its view, TEPCO said March 21. The utility lengthened the period of research from four days to five days until March 22 to check other areas with high probabilities of melted fuel. According to estimates, some of the melted nuclear fuel may have fallen into a cylinder-shaped structure that supports the pressure vessel, flowed out from the structure through a door for workers, and then spread at the bottom of the containment vessel. The bottom of the containment vessel is covered with accumulated cooling water. The survey on March 20 took place in an area about 1 meter from the door. The robot's measurement device, equipped with a camera and a dosimeter, was hung from a stage for workers and lowered into the water below. Although the pipes blocked the view of the conditions at the bottom of the containment vessel, the camera took pictures of what appears to be sand piling up on the pipes. The radiation level around the area in the water was 6.3 sieverts per hour. "Judging from the radiation level, there is a high possibility that what is piling up on the pipes is not nuclear fuel," a TEPCO official said.

### **Robot probe of No.1 reactor to continue until Wed.**

[https://www3.nhk.or.jp/nhkworld/en/news/20170321\\_33/](https://www3.nhk.or.jp/nhkworld/en/news/20170321_33/)

The operator of the crippled Fukushima Daiichi nuclear power plant says a robotic survey of fuel debris at the No. 1 reactor is being hampered by plumbing and other structures. The utility says it will extend the

probe by one day, until Wednesday.

So far engineers have detected strong radiation of about 11 sieverts per hour in the water inside the containment vessel.

Tokyo Electric Power Company on Saturday started sending a remote-controlled robot into the reactor's containment vessel to look at the state of debris -- a mixture of melted fuel and reactor parts. The robot is equipped with a camera and a dosimeter.

The melted fuel is believed to still be at the bottom of the vessel, where about 2 meters of contaminated water accumulates.

TEPCO released the results of the ongoing survey on Tuesday. It said the robot moved to a location believed to be just above the debris and lowered the camera and dosimeter into the accumulated water.

The dosimeter detected radiation of 6 sieverts per hour one meter from the bottom. But piping prevented the device from reaching deeper, and it has yet to confirm the debris.

TEPCO also said the robot recorded about 11 sieverts of radiation per hour about 30 centimeters from the vessel's bottom at another location. Officials believe the radiation may be coming from contaminated fragments that fell to the bottom, as they expected no debris there.

Through the extended probe, TEPCO hopes to collect more data on conditions inside the vessel.

## TEPCO welcomes the challenge

This is what TEPCO was writing on Feb. 15, 2017

### **Fukushima Daiichi NPS Prompt Report 2017**

[http://www.tepco.co.jp/en/press/corp-com/release/2017/1377951\\_10469.html](http://www.tepco.co.jp/en/press/corp-com/release/2017/1377951_10469.html)

### **Fukushima Daiichi NPS Prompt Report (Feb 15,2017)NEW CHALLENGE: TEPCO will send "SCORPION" robot into Fukushima Daiichi Unit 2 PCV for further investigation.**

Following up on a telescopic probe and obstacle removal robot, TEPCO will insert a new robot which looks like a scorpion to further investigate inside the Unit 2 PCV. This is a new challenge for TEPCO that the robot will try to obtain information on the reactor by getting visual image and measuring temperature and radiation level.

Ideally, TEPCO needs to identify where the melted fuels are located inside the reactor in order to research and develop the technology to remove the fuels. And this will also welcome more progressively on international collaboration and partnerships.

Scorpion shaped robot is a "symbol" of new challenge that TEPCO is going to face for the decommissioning the site. The information which will be obtained from its cameras will allow TEPCO to further understand

the condition of the Unit 2.

In addition, investigation will be held in a safe manner that robot will be inserted inside the PCV and the radiation will remain at the same area.

**Every step is a new challenge for TEPCO but TEPCO welcomes the challenge. There are lessons to be learned every day.** But "technology" such as robots are constantly evolving. And TEPCO will keep moving forward.

March 24, 2017

## Robot can't find fuel debris

### Robot probe into reactor failed to find debris

[https://www3.nhk.or.jp/nhkworld/en/news/20170324\\_02/\\*](https://www3.nhk.or.jp/nhkworld/en/news/20170324_02/*)

The operator of the crippled Fukushima Daiichi nuclear plant says a robot probe into the No.1 reactor failed to locate where the fuel debris is.

It says it will work to find it by analyzing radiation data obtained by the probe.

Tokyo Electric Power Company, or TEPCO, did a 5-day robotic investigation through Wednesday inside the reactor's containment vessel. It measured radiation and tried to take images of fuel debris -- a mixture of melted nuclear fuel and reactor parts.

TEPCO says the probe didn't get any images of the debris, but that at 10 locations under water, it measured radiation levels at various heights.

Officials say that at one of the points where they were expecting debris to be, at 90 centimeters from the floor, the radiation was 9.4 sieverts an hour. That is very strong. They say at that location the levels remained high even as the dosimeter got further away from the floor.

At another point the radiation was 11 sieverts an hour at 30 centimeters from the floor. But the radiation levels got lower further away from the floor.

TEPCO engineers plan to use the data and images to analyze the spread of debris, which is essential to decommission the reactor.

See also : <http://www.japantimes.co.jp/news/2017/03/24/national/tepc-robot-failed-capture-images-melted-fuel-reactor-1/>

May 4, 2017

## **Fukuleaks on investigations of Unit 1 refueling floor**

### **Fukushima Unit 1 Refueling Floor Inspection Results**

Nancy Foust

<http://www.fukuleaks.org/web/?p=16279>

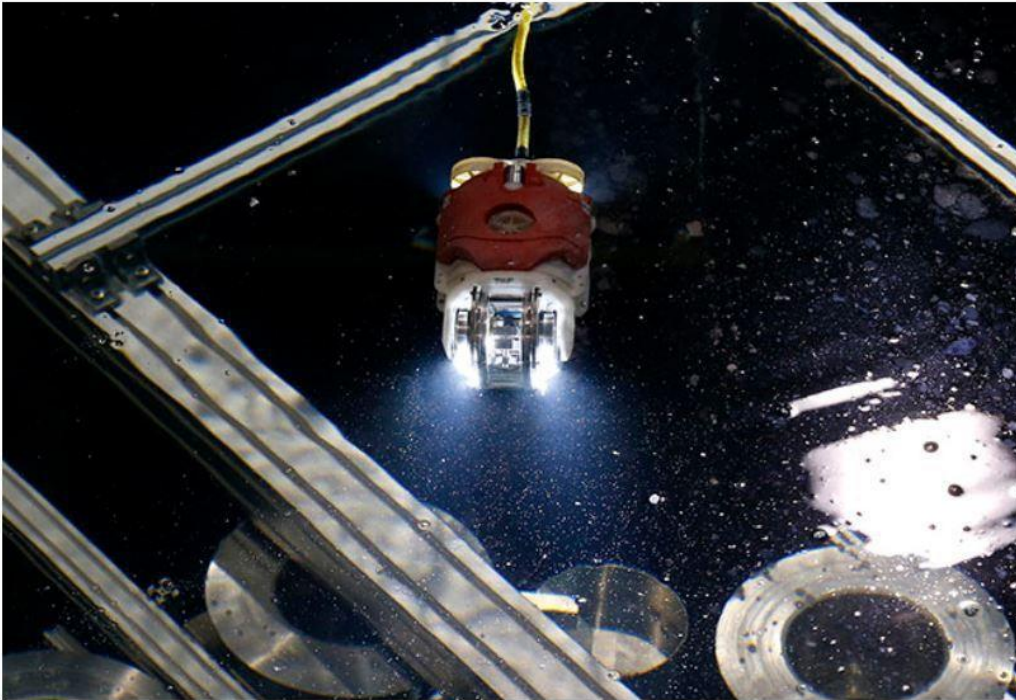
Investigations of the unit 1 refueling floor area took place between November 2016 and February 2017. This area has been of interest to determine if the containment cap leaked and also the conditions of the spent fuel in the pool. Diagrams are machine translated, please refer to the original Japanese document if there is any question.

The concrete and steel roof fell onto the refueling floor during the 2011 meltdowns. This has complicated efforts to characterize the conditions in the area. A scope was used to look under the roof panel. Findings from this and earlier efforts to view the refueling floor discovered that the concrete reactor well cover sections were pushed up and sideways out of the well. These new inspections found they were more dislodged than initially thought.

[...]

June 15, 2017

## **Sunfish robot for Fukushima plant**



A new robot for underwater investigation of a Fukushima damaged reactor moves through the water at a test facility in Yokosuka near Tokyo on June 15. (AP Photo)

## Swimming robot to probe damage at Fukushima nuclear plant

<http://www.asahi.com/ajw/articles/AJ201706150057.html>

THE ASSOCIATED PRESS

YOKOSUKA, Kanagawa Prefecture--A Japanese industrial group unveiled Thursday a swimming robot designed for underwater probes of damage from meltdowns at the Fukushima No. 1 nuclear power plant after the March 2011 earthquake and tsunami.

Remote controlled robots are key to the decades-long decommissioning process for the plant. But super-high radiation and structural damage inside the reactors hampered earlier attempts to inspect areas close to the reactors' cores.

The developers say they plan to send the probe into the primary containment vessel of reactor No. 3 at Fukushima in July to study the extent of damage and locate parts of melted fuel thought to have fallen to the bottom of the chamber, submerged by highly radioactive water.

The robot, nicknamed the "mini manbo," or little sunfish, is about the size of a loaf of bread. It is equipped with lights, maneuvers with tail propellers and collects data using two cameras and a dosimeter.

During Thursday's demonstration at a test facility near Tokyo, the probe slowly slid down from a rail and moved across the water. A team operated it remotely, with one guiding the robot while another adjusted a cable that transmits data and serves as its lifeline. The probe entered a mock-up of a containment vessel, its lights glowing in the murky water.



Officials hope the probe can swim deep into the reactor to illuminate the area underneath the reactor's core.

Japan hopes to locate and start removing fuel from the reactors after Tokyo's 2020 Olympics.

Earlier, snake and scorpion-shaped robots became stuck inside two reactors. The scorpion robot's crawling function failed and it was left inside the plant's reactor No. 2 containment vessel. The other, designed for cleaning debris for the "scorpion" probe, was called back after two hours when two of its cameras stopped working after its total radiation exposure reached 1,000 sieverts--a level that would kill a human within seconds. The plan had been to use the robot for 10 hours at an exposure level of 100 sieverts per hour.

The swimming robot shown was co-developed by electronics and energy giant Toshiba and the government's International Research Institute for Nuclear Decommissioning.

Scientists need to know the melted nuclear fuel's exact location and understand structural damage in each of the three wrecked reactors to work out the optimum, safest way to remove the fuel.

"The fuel debris will be a challenge," said Dale Klein, a former U.S. Nuclear Regulatory Commission chief, who now serves as an outside adviser to the Tokyo Electric Power Co., the plant's operator. He said it could take six months to a year to obtain necessary data and decide on how to remove the fuel.

"They will have to identify where it is, then they will have to develop capability to remove it. No one in the world has ever had to remove material like this before. So this is something new and it would have to be done carefully and accurately," Klein said.

Japanese officials say they want to determine preliminary removal methods this summer and start work in 2021. The decommissioning technology developers IRID and its partners have designed other basic robots, including a "muscle" arm robot made by Hitachi-GE Nuclear Energy, and a different arm robot made by Mitsubishi Heavy Industries, that are designed to approach the debris from the sides of the reactors.

TEPCO is struggling with the plant's decommissioning, which is now expected to cost 8 trillion yen (\$70 billion), four times an earlier estimate. Part of that cost will be included in Japanese utility bills.

The 2011 meltdown forced tens of thousands of nearby residents to evacuate their homes. Many are still unable to return due to high radiation levels.

See also : <https://mainichi.jp/english/articles/20170616/p2g/00m/0dm/003000c>

and

<http://www.japantimes.co.jp/news/2017/06/15/national/toshiba-unveils-submersible-video-robot-probe-reactor-3-fukushima-no-1-plant/>

## **Ocean sunfish robot at Fukushima plant**

[https://www3.nhk.or.jp/nhkworld/en/news/20170615\\_34/](https://www3.nhk.or.jp/nhkworld/en/news/20170615_34/)

Tokyo Electric Power Company has debuted a new underwater robot to help in the removal of melted fuel at a crippled nuclear reactor in Fukushima.

On Thursday, a test of the robot was disclosed to the public in Yokosuka City, Kanagawa Prefecture, near Tokyo.

The robot travels by rotating a screw operated by remote control. As it moves slowly at 4 centimeters per second, it resembles an ocean sunfish.

The robot is 30 centimeters long and 13 centimeters wide. Cameras are attached at the front and back of its body. The robot is also equipped with a dosimeter.

TEPCO plans to film the inside of the containment vessel, which holds water that's more than 6 meters deep.

Use of the robot at Fukushima may come as early as next month.

In the 2011 accident, nuclear fuel in the No.3 reactor is believed to have melted and fallen to the bottom of the containment vessel that covers the reactor. The nuclear fuel is thought to lie within the water injected for cooling.

Removal of nuclear fuel is considered the most difficult part of decommissioning the Fukushima Daiichi nuclear plant. TEPCO plans to decide how to go about it around the summer of this year. No full-scale examination has been done so far at the No.3 reactor.

June 24, 2017

## Testing a new method to stop water leakage

### Test to stop water leakage conducted in Fukushima

[https://www3.nhk.or.jp/nhkworld/en/news/20170624\\_16/](https://www3.nhk.or.jp/nhkworld/en/news/20170624_16/)

A research institute working on decommissioning the Fukushima Nuclear Power Plant has started testing a method to stop leakage of highly contaminated water.

Nuclear fuels in reactors No. 1 through No. 3 melted during the 2011 accident. This caused highly contaminated water to flow into the containment vessels outside the reactors.

**It's believed the water is leaking inside the buildings through cracks in equipment that link the reactor with the containment vessel.**

**The International Research Institute for Nuclear Decommissioning is developing a method to fill the equipment with concrete.**

The institute has started testing the new method at its facility in Naraha Town, Fukushima Prefecture.

Mock equipment containing water was set up in a building at the facility.

Concrete was poured into it through pipes and hoses.

The test is being remotely controlled, with the height of the accumulating concrete measured every 10 minutes.

About 200 cubic meters, or 4,800 tons of concrete will be infused over an 8-hour period.

Researchers at the institute say they will see if the concrete will solidify and stop the water leakage.

June 27, 2017

## Finish the icewall?



### TEPCO aims to complete Fukushima ice wall

[https://www3.nhk.or.jp/nhkworld/en/news/20170627\\_01](https://www3.nhk.or.jp/nhkworld/en/news/20170627_01)

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The operator of the crippled nuclear power plant in Fukushima has applied for permission to freeze the remaining part of an ice wall that is being built to keep groundwater from entering the reactor buildings.

Tokyo Electric Power Company submitted the application to the Nuclear Regulation Authority on Monday, in order to gain permission to freeze the 7 meter-wide section on the mountain side.

Workers started circulating coolant in buried pipes to form the 1.5 kilometer-long wall in March of last

year. They hope to keep groundwater from entering the crippled buildings and being contaminated with radioactive substances.

The utility company has been taking a cautious approach, expanding the frozen area little by little to gradually reduce the groundwater inflow.

That's because of the regulator's concern that freezing the entire area could lead to a sharp drop in the groundwater level outside the reactor buildings, which could cause the tainted water to leak out.

But company officials now say they are sure that water will not leak out. And they say the barrier is already working to decrease the flow of water. The daily amount of groundwater flowing into the buildings is now 100 tons. When the project started, it was 400 tons.

The officials say that the completion of the ice wall will further reduce the amount.

July 5, 2017

## How to extract fuel debris



### **Fuel debris extraction plan for crippled Fukushima reactors to be revealed soon:**

#### **sources**

<http://www.japantimes.co.jp/news/2017/07/05/national/group-mulls-fukushima-no-1-melted-fuel-debris-extraction-without-filling-containment-vessels-water/#.WV0-elFpyos>

Kyodo

A state-backed entity is close to completing a plan for decommissioning the crisis-hit Fukushima nuclear power plant, detailing for the first time how it hopes to extract fuel debris from three reactors, sources said.

The Nuclear Damage Compensation and Decommissioning Facilitation Corp., tasked with providing technical support for decommissioning the complex, may propose a method to remove nuclear debris without completely filling the reactor containment vessels with water, the sources said Tuesday.

The plan means the debris inside reactors 1, 2 and 3 at the crippled Fukushima No. 1 complex is likely to be shaved off gradually with a drill or laser equipment as a shower of water is poured remotely, the sources said.

Filling reactor containment vessels with water before removing the debris is seen as effective in blocking the spread of radiation, but the entity decided not to adopt the approach because they fear water may leak from the damaged structures, the sources said.

In the method currently being weighed, some debris would remain in the air during the operation, posing a major challenge in efforts to block radiation and prevent debris from flying off, the sources said.

While debris has yet to be directly confirmed and information on exact locations and conditions is limited, the extraction work — the most difficult part of the decommissioning project — is expected to proceed in stages from the side of the bottom part of each reactor containment vessel, the sources said.

Based on the plan, the government and the plant operator, Tokyo Electric Power Company Holdings Inc., are expected to determine a course of action for each reactor building this summer, possibly reviewing a road map for decommissioning the entire complex as well, the sources added.

Decommissioning the crippled reactors is expected to take at least 30 to 40 years.

The current road map calls for a debris-extraction plan for each reactor by this summer, with a detailed plan for at least one of the units ready in the first half of fiscal 2018. Extraction work would begin in 2021. Following a magnitude 9.0 earthquake in March 2011, tsunami waves inundated the six-reactor plant, located on ground 10 meters above sea level, flooding power supply facilities. Reactor cooling systems were crippled and reactors 1, 2 and 3 suffered fuel meltdowns, while hydrogen explosions damaged the buildings housing reactors 1, 3 and 4.

At least 150,000 people in Fukushima were forced to live as evacuees amid radiation fears. While some have returned to their homes, Tepco and the government face enormous challenges in scrapping the reactors.

The Nuclear Damage Compensation and Decommissioning Facilitation entity was established after the crisis, the worst nuclear disaster since Chernobyl, to help the utility pay damages. The state-backed entity holds a majority stake in Tepco.

July 14, 2017

## Cleanup requires release of (contaminated) water into sea

### TEPCO chair: Treated water must be released into sea

<http://www.asahi.com/ajw/articles/AJ201707140020.html>

THE ASSOCIATED PRESS

The new chairman of Tokyo Electric Power Co. says the utility needs to stop dragging its feet on plans to dump massive amounts of treated but contaminated water into the sea and to make more money if it's

ever going to succeed in cleaning up the mess left by meltdowns more than six years ago at the tsunami-hit Fukushima No. 1 nuclear power plant.

Takashi Kawamura, an engineer-turned-business leader who previously headed Hitachi's transformation into a global conglomerate, is in charge of reviving TEPCO and leading the cleanup at the Fukushima No. 1 plant. In an interview Thursday with selected media, Kawamura said despite the massive costs of the cleanup and meeting tighter safety requirements, nuclear power is still vital for Japan's national security. Below are highlights from the interview, where Kawamura spoke in Japanese:

#### **CLEANUP REQUIRES RELEASE OF WATER**

Massive amounts of radiation-contaminated water that has been processed and stored in hundreds of tanks at the plant are hindering decommissioning work and pose a safety risk in case another massive quake or tsunami strikes. TEPCO needs to release the water--which contains radioactive tritium that is not removable but considered not harmful in small amounts--into the Pacific Ocean, Kawamura said. The method is favored by experts at the International Atomic Energy Agency and Japan's Nuclear Regulation Authority as the only realistic option. Earlier, TEPCO had balked at calls by NRA chairman Shunichi Tanaka for controlled release of the water, now exceeding 770,000 metric tons, into the sea, fearing a public backlash. "Technically, we fully support the chairman's proposal," he said, adding that there is still strong resistance from local residents, especially fishermen. "I think we should have acted sooner. ... We should start moving faster."

#### **PROFITS NEEDED**

Kawamura says TEPCO must become more profitable to manage to cover the gargantuan costs of cleaning up Fukushima No. 1 after it suffered multiple meltdowns due to the massive March 11, 2011, earthquake and tsunami. TEPCO'S longtime status as a regional monopoly undermined its profit-making incentive, hobbling its ability to cover most of the 21.5 trillion yen (about \$190 billion) price tag for decommissioning the plant and compensating dislocated residents. "To reconstruct Fukushima, we must make more profit, and I know we should not be taking about just money, but I think that is important," he said.

#### **DECOMMISSIONING IS THE FUTURE**

**TEPCO's main mission now is decommissioning Fukushima No. 1, an unprecedented challenge that experts say could take decades and will take still more research and development. "That's our main activity and gaining new expertise in the decommissioning is far more important. But I believe there will be a time when decommissioning becomes an important business," Kawamura said. "Decommissioning is a process which takes time, not only for accident-hit reactors but ordinary retired reactors," he said. "I plan to coordinate with those who are studying the possibility of properly turning decommissioning of ordinary reactors into a viable business."**

#### **JAPAN NEEDS NUKES**

**Kawamura says he believes nuclear power is still a viable business and one that will continue to be vital for Japan's energy security, despite the extra costs from stricter post-Fukushima safety requirements and the cost of processing spent fuel and waste. TEPCO is reviewing its business strategy, but based on rough estimates, "I still believe that nuclear is still superior for Japan, which is really a resource-poor country," he said. "Even if we take severe accident measures and factor in spent fuel processing and other costs, I think there are some reactors that can still be profitable." He said nuclear power includes a wide range of technologies that Japan should not abandon, for national security reasons, as China continues to build nuclear plants.**

#### **TEPCO'S OTHER REACTORS**

**Kawamura said TEPCO hopes to restart the utility's Kashiwazaki-Kariwa nuclear plant in northern Japan, even while the decommissioning at Fukushima No. 1 is under way, so the operable plant can be a major source of revenue for the company. He said a decision on whether to resume operation of the Fukushima No. 2 plant, near Fukushima No. 1, will depend on a financial review. He said he regrets TEPCO's slowness in making a decision and acknowledged calls from local authorities and residents to decommission the second Fukushima plant, which was also hit by the tsunami but avoided a meltdown.**

July 15, 2017

## **777 000 tons of contaminated water stored on Fukushima Daiichi site**



The Fukushima No. 1 plant and hundreds of tanks containing tritiated water are viewed from the air in February. | KYODO

## **TEPCO backpedals after disaster reconstruction chief knocks plan to dump tritiated water into sea**

<http://www.japantimes.co.jp/news/2017/07/15/national/tepc-backpedals-disaster-reconstruction-chief-knocks-plan-dump-tritiated-water-sea/#.WWo0qIFpyos>

Kyodo

**Tokyo Electric backed off its tritium-dumping decision Friday after disaster reconstruction minister Masayoshi Yoshino said it would cause problems for struggling fishermen trying to recover in Fukushima Prefecture.**

The remarks made Friday by the Fukushima native came shortly after the chairman of Tokyo Electric Power Company Holdings Inc. was quoted as saying that the decision to discharge tritium-tainted water from the Fukushima No. 1 power plant into the sea had “already been made.”

After Tepco Chairman Takashi Kawamura’s remarks were widely reported, the utility scrambled to make a clarification the same day.

According to Tepco’s clarification, Kawamura meant to say that there was “no problem” with the dumping plan, based on government guidelines and “scientific and technological standards.” The statement also said that **no final decision had been made.**

A government panel is still debating how to deal with the massive amount of tainted water stored in tanks at the atomic plant, where three reactor cores melted after a huge earthquake in March 2011 spawned tsunami that devastated the region and knocked out all power at the plant.

Tritium typically poses little risk to human health unless ingested in high amounts. It remains in filtered water as it is difficult to extract on an industrial basis. Ocean discharges of diluted volumes of tritium-tainted water are a routine part of nuclear power plant operations.

At a news conference, Yoshino said there would “certainly be damage due to unfounded rumors” if the tainted water were dumped into the sea. He urged those pushing for the release “not to create fresh concerns for fishermen and those running fishing operations in Fukushima Prefecture.” He also asked them to take care not to drive fishermen “further toward the edge.”

Yoshino, who is not directly involved in the decision-making process for handling the water, was alluding to local concerns about how people’s livelihoods will be affected if people think marine products from Fukushima are contaminated with radiation. He added that **while he is aware that many in the scientific community say the diluted water can be safely released, he remains opposed.**

“As I am also a native of Fukushima Prefecture, I fully understand the sentiment of the people,” the minister said.

Water injected to perpetually cool the damaged reactors becomes tainted in the process. **A high-tech filtering apparatus set up at the plant can remove 62 types of radioactive material but not tritium. As a result, tritiated water is building up continuously at the plant. As of July 6, about 777,000 tons were stored in about 580 tanks on the premises.**

On March 11, 2011, tsunami inundated the six-reactor plant, which is situated 10 meters above sea level, and crippled its power supply, causing a station-wide blackout. The failure of the cooling systems in reactors 1, 2 and 3 then led to a triple core meltdown that became the world’s worst nuclear disaster since Chernobyl in 1986.

July 19, 2017

## **Tepco deploys new robot into Fukushima No. 1 reactor to locate fuel debris**

<http://www.japantimes.co.jp/news/2017/07/19/national/tepco-sends-new-type-robot-fukushima-no-1-reactor-search-fuel-debris/#.WXBnElFpyos>



KAZUAKI, NAGATA – Tokyo Electric Wednesday sent a submersible robot into the primary containment vessel of the No. 3 reactor at the Fukushima No. 1 nuclear plant to probe for the exact location of melted fuel debris.

The first day of the operation, which lasted for about three hours, failed to find the fuel. Still, engineers and technicians learned the inside of the structure was quite damaged, Tokyo Electric Power Company Holdings Inc. said in an evening news conference.

“This was the first time that a robot has entered the containment vessel of reactor 3,” said Takahiro Kimoto, a Tepco spokesman. “We think this is a big step.”

He said the first day’s mission was to see what conditions were like and whether it was possible for the robot to move deeper into the vessel’s waters, where the company believes the fuel debris has fallen.

Video recorded by the robot showed scattered debris inside the structure. The utility also said steel gratings in the vessel designed to work as a scaffolding under regular circumstance were not where they should have been, which engineers could not explain.

Still, the company is hopeful the robot will be able to travel to deeper levels in the next phase of the probe scheduled for Friday, said Kimoto. The water level inside the No. 3 containment vessel is about 6 meters deep.

The cylindrical 30-cm robot, which was developed by Toshiba Corp., is equipped with a 180 degree-capable camera whose angle can be controlled and another fixed camera on its rear. Toshiba has been heavily involved with the Fukushima decommissioning process.

The mega-earthquake and massive tsunami on March 11, 2011 knocked out power in Fukushima, causing core meltdowns in the No. 1, No. 2 and No. 3 reactors. The heated fuel rods melted and then penetrated their pressure vessels to apparently fall to the bottom of the surrounding containment vessels.

Tepco deployed different robot types to investigate inside the containment vessels at the No. 1 and No. 2 reactors in January and March, respectively. But they failed to find any fuel debris.

Locating the exact location of the fuel is a crucial step to devise a way to remove debris and ultimately to scrap the crippled Fukushima plant.

July 20, 2017

## **New robot deployed at No.3 reactor**

### **Robot Probes Nuclear Reactor (NHK video)**

<https://www3.nhk.or.jp/nhkworld/en/news/videos/20170720150021660/>

## **No.3 reactor: Metal grating is missing**

## Scaffolding at No.3 Fukushima reactor missing

[https://www3.nhk.or.jp/nhkworld/en/news/20170720\\_01/](https://www3.nhk.or.jp/nhkworld/en/news/20170720_01/)

The operator of the Fukushima Daiichi Nuclear Power Plant says the metal scaffolding right below the damaged No.3 reactor appears to have gone missing after the 2011 disaster.

Tokyo Electric Power Company, or TEPCO, started a full-scale robotic probe into the containment vessel on Wednesday.

In the 2011 accident, most of the nuclear fuel in the No.3 reactor is believed to have melted and fallen to the bottom of the containment vessel that covers the reactor. **The nuclear fuel is thought to lie within 6-meter-deep water that was injected for cooling.**

TEPCO and the Japanese government plan to remove the nuclear fuel debris as part of decommissioning of the reactor. They are **trying to locate the debris.**

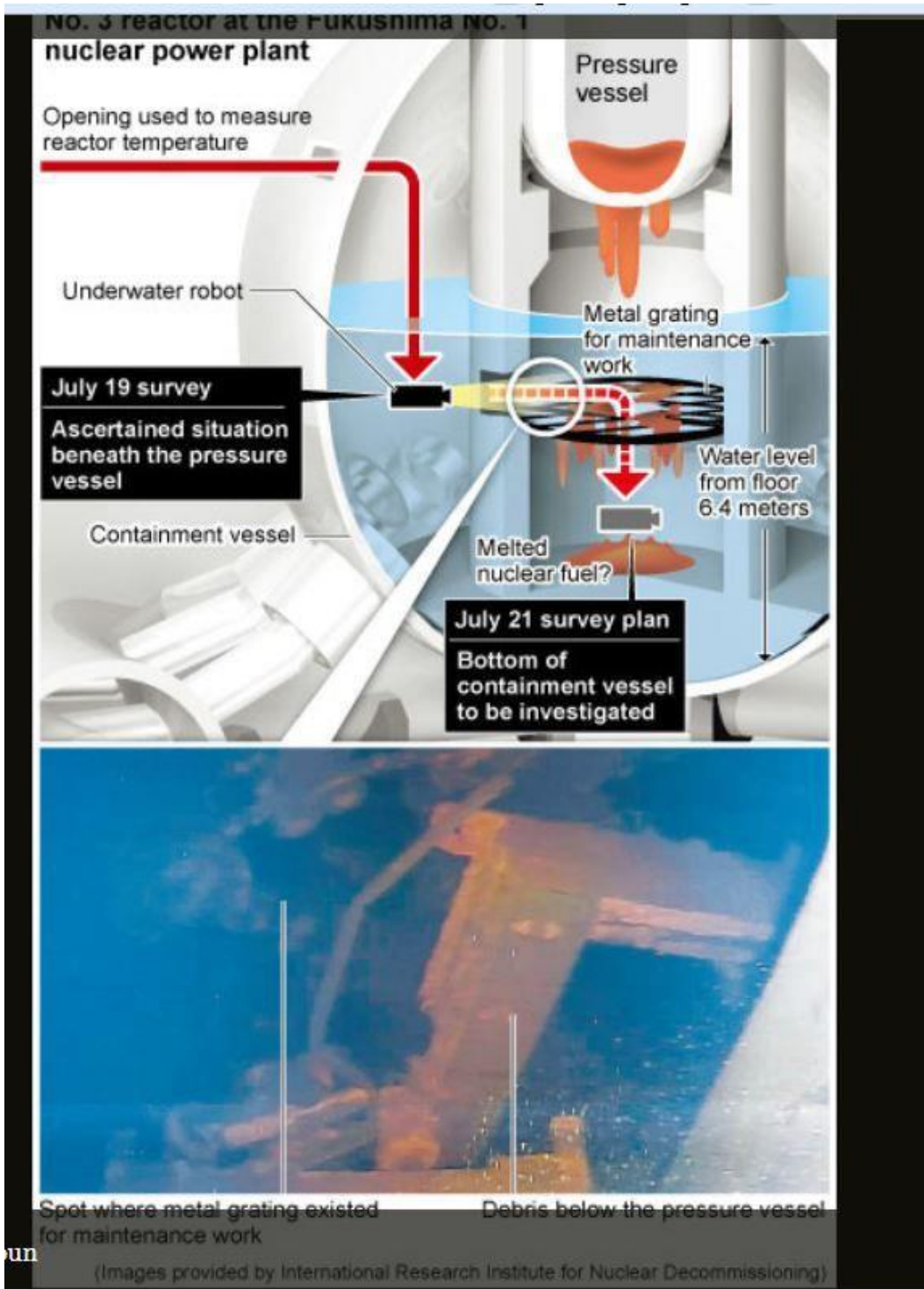
They used a new underwater robot equipped with cameras for Wednesday's probe. It is 30 centimeters long and 13 centimeters wide.

The robot was unable to obtain an image of the metal grating which was right below the reactor before the disaster.

TEPCO officials say the grating apparently fell along with the molten fuel.

They told reporters that **they could not determine where the nuclear fuel debris is. But they said they could identify a path that might lead to areas where the debris is believed to lie.**

## Collapsed scaffolding in No.3 reactor



**Fukushima robot reveals collapsed scaffolding in nuclear reactor**

<http://www.asahi.com/ajw/articles/AJ201707200046.html>

By KOHEI TOMIDA/ Staff Writer

New images of inside the Fukushima No. 1 nuclear power plant taken by a swimming robot reveal previously unseen damage from the meltdown that followed the March 2011 earthquake and tsunami. The images show the collapsed state of metal scaffolding that had been installed for maintenance work beneath a pressure vessel that sits within a containment vessel inside the plant's No. 3 reactor. It is highly likely that melted nuclear fuel fell through the pressure vessel and weakened the scaffolding, leading to its collapse.

Almost all of the nuclear fuel in the No. 3 reactor likely melted and dropped from the pressure vessel and accumulated at the bottom of the containment vessel, according to analysis by Tokyo Electric Power Co., the crippled plant's operator.

Coolant water in the containment vessel is about 6.4 meters deep. TEPCO sent the robot, specially designed for underwater probes, inside the No. 3 reactor on July 19 and released the pictures that day. The camera-equipped robot captured images of the collapsed scaffolding after moving forward to the opening of a tube-shaped concrete object that supports the pressure vessel.

Metal parts to support devices at the bottom of the pressure vessel had also vanished.

TEPCO plans to collect images of the melted nuclear fuel that is believed to have accumulated at the bottom of the containment vessel on July 21.

In light of damage to the scaffolding and other parts that was identified by the July 19 survey, TEPCO planned to examine the route for the robot to enter the vessel on July 20.

The investigations follow robot probes in the plant's No. 1 and No. 2 reactors, which were conducted from January to March.

TEPCO and the government plan to decide how to remove the nuclear fuel as early as this summer in accordance with results of the robot probes on all three reactors.

## **Swimming robot probes Fukushima reactor to find melted fuel**

<https://mainichi.jp/english/articles/20170720/p2g/00m/0dm/032000c>

TOKYO (AP) -- An underwater robot entered a badly damaged reactor at Japan's crippled Fukushima nuclear plant Wednesday, capturing images of the harsh impact of its meltdown, including key structures that were torn and knocked out of place.

Plant operator Tokyo Electric Power Co. said the robot, nicknamed "the Little Sunfish," successfully completed the day's work inside the primary containment vessel of the Unit 3 reactor at Fukushima, which was destroyed by a massive March 2011 earthquake and tsunami.

TEPCO spokesman Takahiro Kimoto praised the work, saying the robot captured views of the underwater damage that had not been previously seen. However, the images contained no obvious sign of the melted nuclear fuel that researchers hope to locate, he said.

The robot was left inside the reactor near a structure called the pedestal, and is expected to go deeper inside for a fuller investigation Friday in hopes of finding the melted fuel.

"The damage to the structures was caused by the melted fuel or its heat," Kimoto told a late-night news conference held nine hours after the probe ended its exploration earlier in the day.

The robot, about the size of a loaf of bread, is equipped with lights, maneuvers with five propellers and collects data with two cameras and a dosimeter. It is controlled remotely by a group of four operators.

The robot was co-developed by Toshiba Corp., the electronics and energy company charged with helping clean up the plant, and the International Research Institute for Nuclear Decommissioning, a government-funded consortium.

It was on a mission to study the damage and find the fuel that experts say has melted, breached the core and mostly fallen to the bottom of the primary containment chamber, where it has been submerged by highly radioactive water as deep as 6 meters (20 feet).

The robot discovered that a grate platform that is supposed to be below the reactor core was missing and apparently was knocked down by melted fuel and other materials that fell from above, and that parts of a safety system called a control rod drive were also missing.

Remote-controlled robots are key to the decades-long decommissioning of the damaged plant, but super-high levels of radiation and structural damage have hampered earlier probes at two other reactors at the plant.

Japanese officials say they want to determine preliminary methods for removing the melted nuclear fuel this summer and start work in 2021.

Scientists need to know the fuel's exact location and understand the structural damage in each of the three wrecked reactors to work out the safest and most efficient ways to remove the fuel.

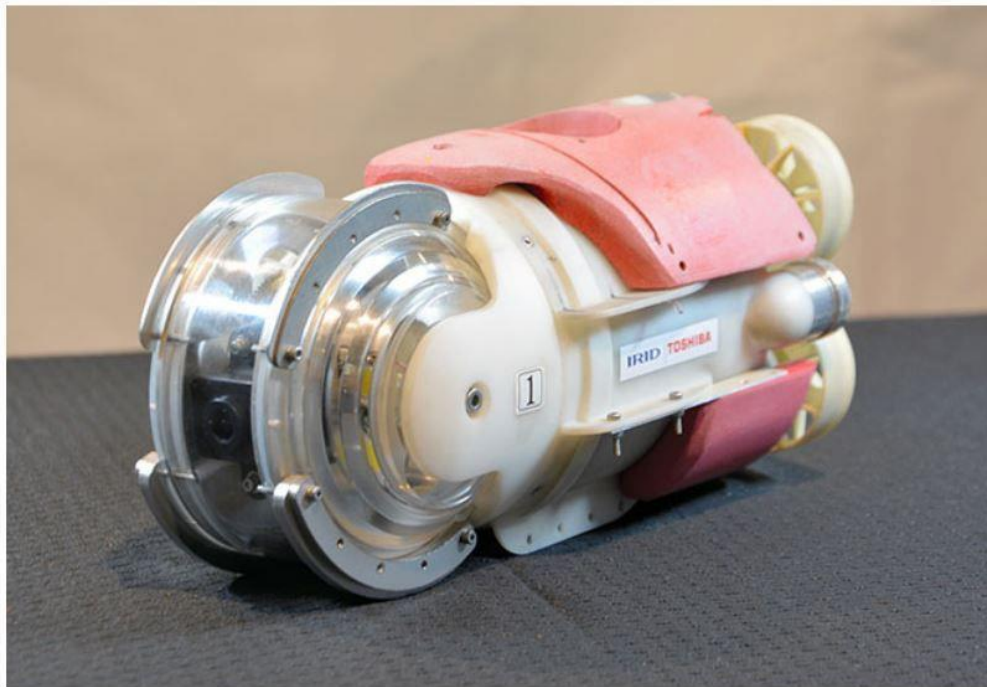
Robots tested earlier became stuck inside the two other reactors. A scorpion-shaped robot's crawling function failed and it was left inside the plant's Unit 2 containment vessel. A snake-shaped robot designed to clear debris for the scorpion probe was removed after two hours when its cameras failed due to radiation levels five times higher than anticipated.

The robot used Wednesday was designed to tolerate radiation of up to 200 sieverts -- a level that can kill humans instantly.

Kimoto said the robot showed that the Unit 3 reactor chamber was "clearly more severely damaged" than Unit 2, which was explored by the scorpion probe.

July 21, 2017

## Potential fuel debris hanging as icicles



An underwater robot surveying the No. 3 reactor of the Fukushima No. 1 nuclear power plant (The Asahi Shimbun)

### Possible 'icicle' of melted fuel spotted at Fukushima plant

<http://www.asahi.com/ajw/articles/AJ201707210036.html>

An icicle that appears to be melted nuclear fuel has been seen hanging from the bottom of the pressure vessel of the No. 3 reactor at the crippled Fukushima No. 1 nuclear power plant, sources said.

Tokyo Electric Power Co., the plant's operator, confirmed the presence of what is believed to be fuel debris on July 21 with an underwater robot equipped with a camera, the sources said.

If the icicle is confirmed to be fuel debris, it will become valuable data in the investigation to determine the cause of the accident, triggered by the March 2011 Great East Japan Earthquake and tsunami, and efforts to decommission the reactor.

The survey of the No. 3 reactor conducted so far has found that most of the nuclear fuel apparently melted and fell through a hole at the bottom of the pressure vessel.

On July 21, TEPCO deployed the underwater robot into the No. 3 reactor's containment vessel, which holds the pressure vessel, from early in the morning to look into the area below the pressure vessel.

When the robot entered the area, its camera showed what seems to be fuel debris hanging like an icicle from a hole at the bottom of the pressure vessel.

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## **Fukushima robot finds potential fuel debris hanging like icicles in reactor 3**

<http://www.japantimes.co.jp/news/2017/07/21/national/fukushima-robot-finds-potential-fuel-debris-hanging-like-icicles-reactor-3/#.WXNFQFFpyos>

Staff Report, Bloomberg

Tokyo Electric has said that a remotely controlled robot investigating the inside of reactor 3 at the Fukushima No. 1 power plant has finally spotted objects that could be fuel debris — a potential milestone in the effort to clean up one of the worst atomic disasters in history.

This is the first time Tepco has found something likely to be melted fuel. When the utility sent a different robot into reactor 2 in January, it found black lumps sticking to the grating in the primary containment vessel but said they were difficult to identify.

The objects spotted this time look like icicles hanging around a control rod drive attached to the bottom of the pressure vessel, which holds the core, Tokyo Electric Power Company Holdings Inc. said at an evening news conference Friday.

Enclosed by the huge primary containment vessel, the pressure vessel originally contained the fuel rod assemblies. But the rods melted into a puddle and burned through its bottom once the plant lost power after being swamped by the monstrous tsunami of March 11, 2011.

The robot also captured images of lumps of material that appear to have melted and resolidified near the wall of the pedestal, a concrete structure that supports the pressure vessel.

“From the pictures taken today, it is obvious that some melted objects came out of the reactor. This means something of high temperature melted some structural objects and came out. So it is natural to think that melted fuel rods are mixed with them,” said Takahiro Kimoto, a Tepco spokesman.

“In that sense, it is possible that the melted objects found this time are melted fuel debris or probably around it,” he said, adding the utility will think about how they can be analyzed to determine if they are the former fuel rods.

Fuel from a nuclear meltdown is known as corium, a mixture of fuel rods and other structural materials.

“It is important to know the exact locations and the physical, chemical, radiological forms of the corium to develop the necessary engineering defueling plans for the safe removal of the radioactive materials,” said Lake Barrett, a former official at the U.S. Nuclear Regulatory Commission who was involved with the cleanup at the Three Mile Island nuclear power plant in the U.S. “The recent investigation results are significant early signs of progress on the long road ahead.”

Because of the high radioactivity in the reactor, only specially designed robots can probe the unit. And the unprecedented nature of the Fukushima disaster means that Tepco is pinning its efforts on technology not yet invented to get the melted fuel out of the reactors.

The utility aims to decide on the procedure for removing the melted fuel from each unit as soon as this summer. And it will confirm the procedure for the first reactor during fiscal 2018 ending in March 2019, with removal slated to begin in 2021.

Decommissioning the reactors will cost ¥8 trillion (\$72 billion), according to an estimate in December from the Ministry of Economy, Trade and Industry. Removing the fuel is one of the most important steps in the cleanup, which may take as long as 40 years.

The significance of Friday's finding "might be evidence that the robots used by Tepco can now deal with the higher radiation levels, at least for periods of time that allow them to search parts of the reactor that are more likely to contain fuel debris," M.V. Ramana, professor at the Liu Institute for Global Issues at the University of British Columbia, said by email.

"If some of these fragments can be brought out of the reactor and studied, it would allow nuclear engineers and scientists to better model what happened during the accident," Ramana said.

The utility began probing reactor 3 on Wednesday. Since the PCV has 6 meters of water in it, which is higher than in reactors 1 and 2, the 30-cm robot will have to go deep under water. The robot has two cameras — one on the front that can pivot 180 degrees vertically, and another on its back.

July 22, 2017

## First step of decommissioning?





Material that appears to be nuclear fuel debris hangs like an icicle from the bottom of the pressure vessel of the No. 3 reactor at the Fukushima No. 1 nuclear power plant. (Provided by the International Research Institute for Nuclear Decommissioning)

## **Images of fuel debris 1st step in deactivating Fukushima plant**

<http://www.asahi.com/ajw/articles/AJ201707220018.html>

The discovery of apparent icicle-shaped melted nuclear fuel within a reactor at the stricken Fukushima No. 1 nuclear power plant could be an important first step toward decommissioning the facility. Images taken July 21 by a submersible robot that was remotely controlled to a position directly under the pressure vessel of the No. 3 reactor showed what appeared to be fuel debris that had melted through the vessel and later solidified, hanging like an icicle from the bottom of the pressure vessel.

Another pile of solidified material had also accumulated like lava on a structure below the vessel. The material was orange and gray.

The images provided the first confirmation of sizable amounts of solidified material although robots have been sent into three reactors at the No. 1 plant. In other "expeditions," high radiation levels crippled the robot activity and prevented further study.

Operator Tokyo Electric Power Co. said the manner in which the solidified material was found within the No. 3 reactor suggested the material is fuel debris.

"It clearly appears to be something that solidified after melting out of the pressure vessel," said one official. "We believe the material emerged after nuclear fuel mixed with structural matter within the pressure vessel."

Past analysis of the No. 3 reactor led to the assumption that almost all the nuclear fuel had dropped through the pressure vessel after burning a hole in the bottom and dripping down. The latest robot survey confirms that is what likely happened.

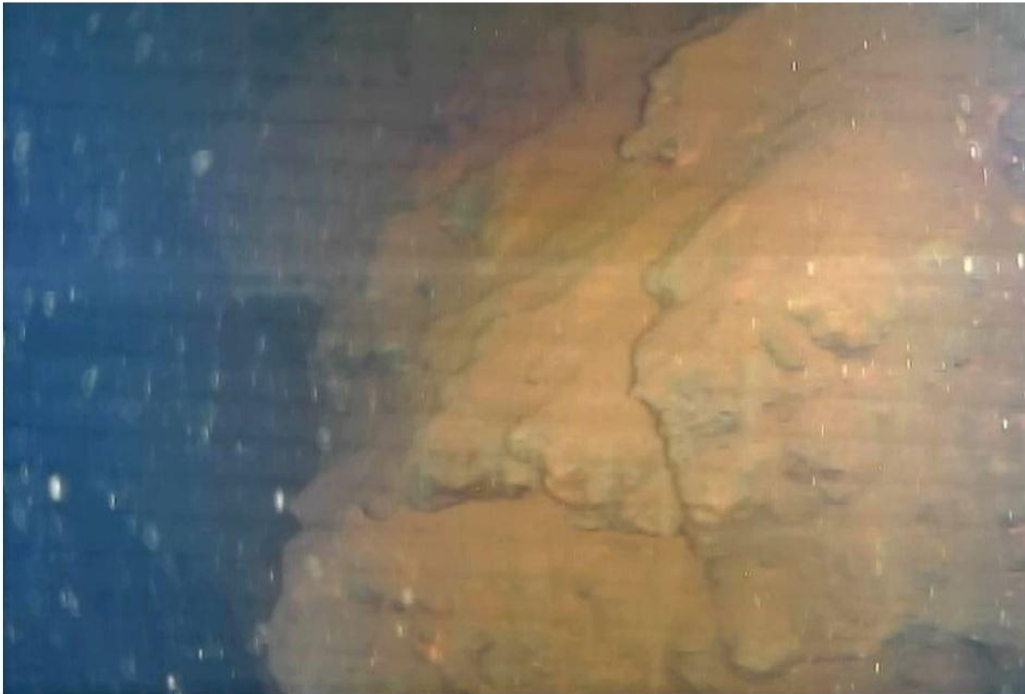
TEPCO officials plan to deploy the submersible robot July 22 to an even greater depth within the containment vessel that holds the pressure vessel. It aims to ascertain the amount of fuel debris that has spread at the bottom of the containment vessel.

Images taken by the robot over the two days of study will be analyzed, along with other data, to gain a firmer understanding of what the material is.

That could prove important in deciding how to proceed with decommissioning.

### **Possible melted fuel seen for first time at Fukushima plant**

[https://mainichi.jp/english/articles/20170722/p2g/00m/0dm/003000c#cxrecs\\_s](https://mainichi.jp/english/articles/20170722/p2g/00m/0dm/003000c#cxrecs_s)



This image captured by an underwater robot provided by International Research Institute for Nuclear Decommissioning shows lava-like lumps believed to contain melted fuel inside the Unit 3 reactor at Fukushima Dai-ichi nuclear plant in Okuma town, northeastern Japan, on July 21, 2017. (International Research Institute for Nuclear Decommissioning via AP)

TOKYO (AP) -- An underwater robot captured images of solidified lava-like rocks Friday inside a damaged reactor at Japan's crippled Fukushima nuclear plant, spotting for the first time what is believed to be nuclear fuel that melted six years ago.

Plant operator Tokyo Electric Power Co. said the robot found large amounts of lava-like debris apparently containing fuel that had flowed out of the core into the primary containment vessel of the Unit 3 reactor at Fukushima. The plant was destroyed by a massive earthquake and tsunami in March 2011.

Cameras mounted on the robot showed extensive damage caused by the core meltdown, with fuel debris mixed with broken reactor parts, suggesting the difficult challenges ahead in the decades-long decommissioning of the destroyed plant.

Experts have said the fuel melted and much of it fell to the chamber's bottom and is now covered by radioactive water as deep as 6 meters (20 feet). The fuel, during meltdown, also likely melted its casing and other metal structures inside the reactor, forming rocks as it cooled.

TEPCO spokesman Takahiro Kimoto said it was the first time a robot camera has captured what is believed to be the melted fuel.

"That debris has apparently fallen from somewhere higher above. We believe it is highly likely to be melted fuel or something mixed with it," Kimoto said. He said it would take time to analyze which portions of the rocks were fuel.

In an earlier survey Wednesday, the robot found severe damage in the vessel, including key structures that were broken and knocked out of place.

The robot, nicknamed "the Little Sunfish," on Friday went inside a structure called the pedestal for a closer look. TEPCO plans to send the robot farther down on Saturday in hopes of finding more melted fuel and debris.

Experts have said the melted fuel is most likely to have landed inside the pedestal after breaching the core. Kimoto said the robot probe in its two missions has captured a great deal of useful information and images showing the damage inside the reactor, which will help experts eventually determine a way to remove the melted fuel, a process expected to begin sometime after the 2020 Tokyo Olympics.

"It's still just the beginning of the (decades-long) decommissioning. There is still a long way to go, including developing the necessary technology," he said. "But it's a big step forward."

Locating and analyzing the fuel debris and damage in each of the three wrecked reactors is crucial for decommissioning the plant. The search for melted fuel in the two other reactors has so far been unsuccessful because of damage and extremely high radiation levels.

The submersible robot, about the size of a loaf of bread, is equipped with lights, maneuvers with five propellers and collects data with two cameras and a dosimeter. It is controlled remotely by a group of four operators. It was co-developed by Toshiba Corp., the electronics, nuclear and energy company charged with helping clean up the plant, and the International Research Institute for Nuclear Decommissioning, a government-funded consortium.

## **Images show possible fuel debris**

[https://www3.nhk.or.jp/nhkworld/en/news/20170722\\_04/](https://www3.nhk.or.jp/nhkworld/en/news/20170722_04/)

Engineers at the Fukushima Daiichi nuclear power plant are working to scrap the facility's damaged reactors. For the first time, they've found what's likely to be fuel debris in one of them.

The engineers have been trying to locate molten fuel in the No.3 reactor. The fuel is thought to have melted and fallen to the bottom of the containment vessel.

They lowered a submersible robot into the 6-meter-deep cooling water in the vessel. The image sent back by the robot shows an orange substance on a device that operates the fuel control rods. Objects shaped like icicles are also visible.

The engineers plan to use the robot to look for fuel debris at the bottom of the containment vessel.

**Removing the molten fuel from the reactors is the biggest hurdle to decommissioning them.**

July 25, 2017

## TEPCO releases new footage

### TEPCO releases video of 'nuclear debris' at Fukushima plant

<http://www.asahi.com/ajw/articles/AJ201707250039.html>

By KOHEI TOMIDA/ Staff Writer

Footage released by Tokyo Electric Power Co. on July 24 shows what is believed to be nuclear fuel debris. The lumps are scattered at the bottom of the containment vessel of the No. 3 reactor at the Fukushima No. 1 nuclear power plant. (Video provided by the International Research Institute for Nuclear Decommissioning)

What is believed to be nuclear fuel debris scattered inside a reactor of the crippled Fukushima No. 1 nuclear power plant can be clearly seen in video footage released by Tokyo Electric Power Co. on July 24. The four-minute video shows nuclear fuel debris dispersed in an area measuring about 5 meters in diameter directly beneath the No. 3 reactor's pressure vessel. The video comes from 16 hours' footage filmed by a remote-controlled submersible robot during a survey by plant operator TEPCO on July 19, 21 and 22.

The released video also shows craggy-shaped material that appears to be nuclear fuel debris hanging like an icicle from equipment at the bottom of the pressure vessel.

As the camera-equipped submersible robot advanced toward the bottom of the containment vessel, it captured how pipes and structures had collapsed in a heap.

Although the company thinks such lumps are highly likely to be nuclear fuel debris due to their shape, it has yet to determine exactly what they are. It is because TEPCO could neither measure radiation levels nor collect material in the probe for analysis.

The operator plans to analyze the collected footage in the days ahead to ascertain the extent of scattered debris.

If, or when, any further robot probe is conducted has yet to be decided.

"We have yet to plan a new survey so far," a TEPCO official said.

### See also : TEPCO releases new footage of suspected melted fuel debris at Fukushima plant

<https://mainichi.jp/english/articles/20170725/p2a/00m/0na/021000c>

This still image from a video provided by the International Research Institute for Nuclear Decommissioning shows what appears to be a bolt covered with deposits believed to be melted nuclear fuel at the No. 3 reactor of the Fukushima No. 1 Nuclear Power Plant.

Tokyo Electric Power Co. on July 24 released a new video of a containment vessel at the No. 3 reactor of the ravaged Fukushima No. 1 Nuclear Power Plant.

The video was filmed by an underwater robot, which was sent into the reactor to study the condition of melted fuel debris. The four-minute long footage showed a large amount of lava-like lumps believed to be debris of melted fuel stuck to machines and building frameworks.

### **Deposits in reactor likely to be fuel debris**

[https://www3.nhk.or.jp/nhkworld/en/news/20170724\\_27/](https://www3.nhk.or.jp/nhkworld/en/news/20170724_27/)

The operator of the damaged Fukushima Daiichi nuclear power plant released video footage on Monday of what is likely to be melted fuel debris.

Tokyo Electric Power Company, or TEPCO, found the solidified lumps during a robot inspection of the containment vessel of Fukushima's wrecked No. 3 reactor. The 3-day survey ended on Saturday.

TEPCO had earlier only made public still images from the probe. The 4-minute video shows black or grey lumps hanging down close to a structure just below the reactor.

The lava-like lumps are piled in layers, a phenomenon unknown before the accident.

TEPCO officials say the debris is probably melted nuclear fuel mixed with broken reactor parts.

In addition to metal scaffolding and other structural components, rocks and sand-like sediment can be seen getting stirred up by the movement of the robot.

The government and TEPCO plan further analysis of the footage in order to determine methods for removing the debris.

## **Melted fuel removal plan to be in place by September**

### **Fuel debris removal plan due by around Sept.**

[https://www3.nhk.or.jp/nhkworld/en/news/20170725\\_16/](https://www3.nhk.or.jp/nhkworld/en/news/20170725_16/)

Japan's industry minister says the government hopes to have a policy in place by around September on how to remove melted fuel from the No.3 reactor of the disabled Fukushima Daiichi nuclear power plant.

Hiroshige Seko told reporters on Tuesday that a robotic probe has confirmed lumps that could be fuel debris in the No.3 reactor, giving researchers valuable information.

Seko said he hopes a policy on how to remove the debris can be formulated, based on an analysis and assessment of the probe's findings.

During the survey last week, a submersible robot found lumps below the reactor pressure vessel and at the bottom of the containment vessel.

It's the first time a probe has identified what could be a mixture of melted nuclear fuel and broken metal parts lodged inside a reactor container.

Removing the fuel debris would require the use of remote-controlled robots. It is considered the most challenging step in the process to decommission the reactor.

The industry minister suggested that the government plans to honor the existing timetable for decommissioning.

The plan calls for setting specific methods for removing fuel debris by the first half of 2018, so the actual work can begin by the end of 2021.

July 31, 2017

### **'Dry method' recommended for fuel debris removal**

[https://www3.nhk.or.jp/nhkworld/en/news/20170731\\_24/](https://www3.nhk.or.jp/nhkworld/en/news/20170731_24/)

A Japanese government body has recommended a method known as "dry removal" to retrieve nuclear fuel debris from the damaged Fukushima Daiichi power plant.

The Nuclear Damage Compensation and Decommissioning Facilitation Corporation said on Monday that the method should be the first option for all 3 reactors that suffered meltdowns.

Fuel inside the reactors is believed to have melted in the 2011 accident and combined with the reactor structures to form fuel debris. The fuel in each of the 3 reactors apparently melted through their surrounding pressure vessels, and collected at the bottom of the containment vessels.

The corporation initially considered another fuel-retrieval method involving filling the vessels with water to block high levels of radiation given off by the debris.

But it now says this method is too technically difficult and risks exposing workers to radiation and leaks of contaminated water.

The corporation instead proposes that a remote-controlled robot be deployed through a pipe in the side of the containment vessel to retrieve the debris at its bottom.

The nuclear power plant at Three Mile Island in the United States is the only place where fuel debris has been retrieved. It was done using the submersion method.

If the Japanese government and the plant's operator, Tokyo Electric Power Company, decide to go ahead with the new removal plan, it will be the first time the dry method is used.

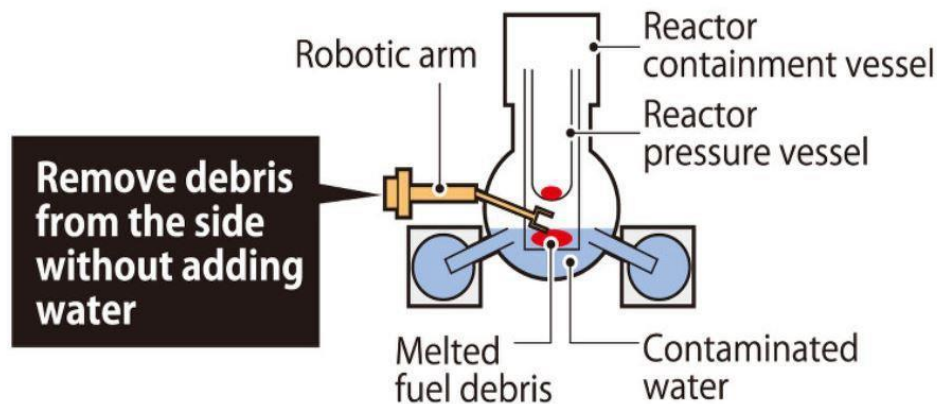
They want to decide on a removal method for each reactor by September. But they have to find ways to block the radiation and keep radioactive substances from being released.

State minister for economy and industry Yosuke Takagi says it's meaningful that a removal method is recommended, and that the government will base its discussion on the corporation's proposal.

August 1, 2017

## Removing debris without water

### Method for removing melted fuel debris from reactors



### New proposal suggests removing Fukushima plant's melted nuclear fuel from side

A method to remove melted nuclear fuel debris on the bottom of the containment vessels of Fukushima No. 1 Nuclear Power Plant's first, second and third reactors from the side was proposed by the Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) on July 31.

- **【Related】** TEPCO releases new footage of suspected melted fuel debris at Fukushima plant
- **【Related】** In Photos: Swimming robot probes Fukushima reactor to find melted fuel
- **【Related】** Underwater robot finds likely melted fuel heap inside Fukushima reactor

Hajimu Yamana, head of the NDF, which is tasked with considering how to remove fuel debris from the reactors, for the first time explained the organization's specific method proposal to the heads of local governments at a countermeasures for the decommissioning and handling of the contaminated water council meeting held in Iwaki, Fukushima Prefecture.

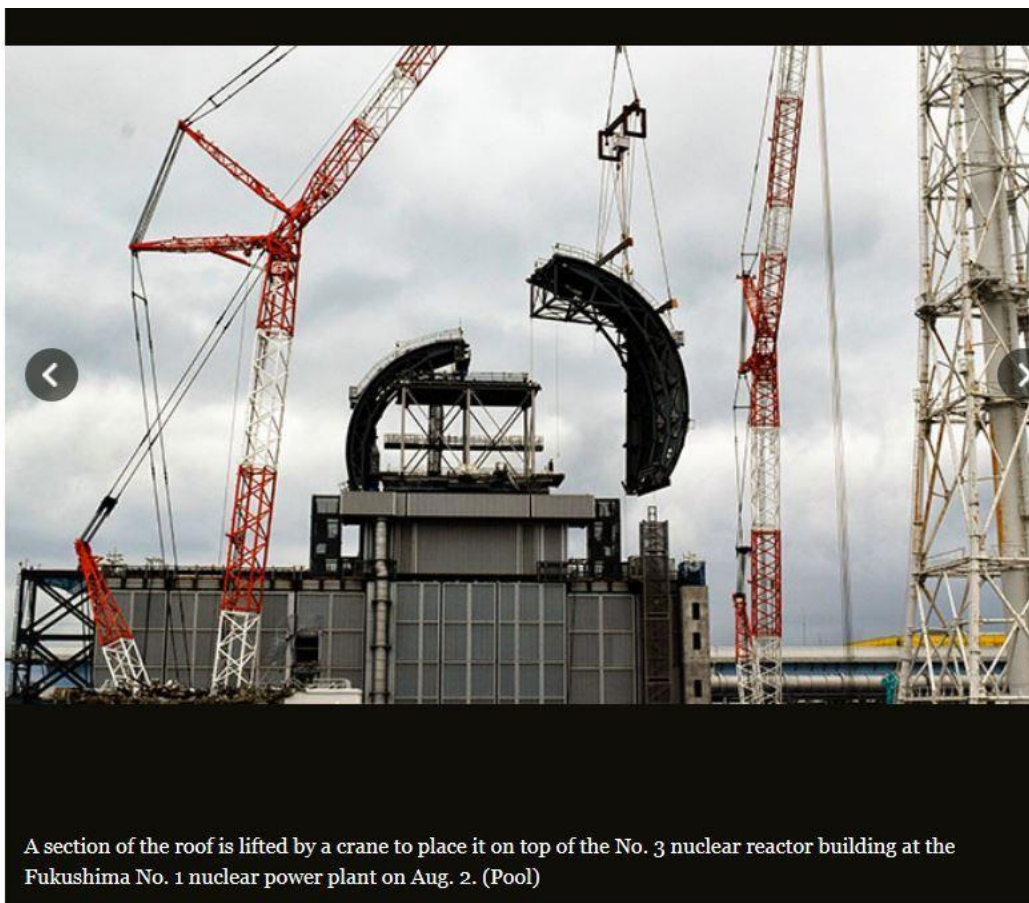
The method would focus on prioritizing the removal of debris from the bottom of the vessels from the side, using robotic arms and other remote devices while flushing water over the debris. However, ways to

block radiation and countermeasures against the scattering of airborne radioactive dust still remain unsolved. The central government and Tokyo Electric Power Co. (TEPCO) plan to finalize their policy to remove the debris and amend the decommission schedule in September.

In all three of the reactors, contaminated water has collected at the bottom of the containment vessels. The NDF had previously considered a "flooding method" that would fill the containment vessels completely with water to block radiation from leaking. However, measures to repair the containment vessels and prevent leakage of the radioactive water would be difficult, so the plan was put aside for having "too many issues."

August 2, 2017

## A new roof for reactor No.1



### Hydrogen blast reactor's new roof in progress at Fukushima

<http://www.asahi.com/ajw/articles/AJ201708020046.html>



By CHIKAKO KAWAHARA/ Staff Writer

OKUMA, Fukushima Prefecture--Tokyo Electric Power Co. showed reporters its progress in installing a new roof above Fukushima No. 1 nuclear plant's No. 3 reactor building on Aug. 2, ahead of work to remove spent nuclear fuel from a storage pool.

The company demonstrated how it is carrying out the work, which is necessary because the upper section of the reactor building was blown off in a hydrogen explosion in the nuclear disaster at the plant in March 2011.

The roof project marks a step toward removing nuclear fuel assemblies in the spent nuclear fuel storage pool in the building.

To prevent the spread of radioactive material, TEPCO started to set up the half-tubular shaped cover to shield the damaged reactor building at the end of last month.

The 566 nuclear fuel assemblies currently lying in the pool will become a significant risk if another major disaster strikes the area.

TEPCO is expected to start removing the fuel from around mid-fiscal 2018.

Early on Aug. 2, part of the roof measuring around 17 meters high and weighing 37 tons was lifted to the top floor of the reactor building with a large crane.

Workers connected the new part of the cover to another section that had been installed at the end of July, completing one eighth of the roof. When finished, it will be about 60 meters long.

Dedicated removal machines are needed to retrieve the fuel from the storage pool. The machines that had been used at the plant prior to the accident were removed because they were severely damaged by the hydrogen explosion.

## **Fuel removal prep begins at Fukushima Daiichi**

[https://www3.nhk.or.jp/nhkworld/en/news/20170802\\_17/](https://www3.nhk.or.jp/nhkworld/en/news/20170802_17/)

Workers at the crippled Fukushima Daiichi nuclear power plant are preparing to remove nuclear fuel from one of the damaged reactor buildings.

They began to put part of a dorm-shaped cover over the No.3 reactor building on Wednesday morning. This work is to prevent radioactive materials from spreading and shelter the area from winds.

The completed cover would measure 17 meters high and 11 meters wide and weigh 37 tons.

A total of 566 spent and unused fuel units remain in the fuel cooling pool.

Tokyo Electric Power Company plans to remove the fuel in the next fiscal year starting in April, 2018, as part of decommissioning the plant.

A Kajima Corporation official in charge of the installation said they may put a lid on the pool to ensure nothing falls into it.

392 fuel units remain in the No.1 reactor pool and 615 units in the No.2 reactor pool.

August 4, 2017

## Groundwater level plunges outside reactor building

### Groundwater level plunges near Fukushima reactor

[https://www3.nhk.or.jp/nhkworld/en/news/20170804\\_06/](https://www3.nhk.or.jp/nhkworld/en/news/20170804_06/)

The operator of the Fukushima Daiichi nuclear power plant says the groundwater level briefly plummeted near a building that houses one of the crippled reactors.

Tokyo Electric Power Company, or TEPCO, says the fall was observed in a monitoring well about 11 meters southwest of the No.4 reactor building on Wednesday.

The utility says the groundwater level temporarily sank roughly 1 meter below the level of contaminated water inside the reactor building.

The firm says the groundwater rose above the usual level 23 minutes later.

A sharp fall in the groundwater level just outside reactor buildings could cause contaminated water to leak from inside the buildings.

TEPCO says it assessed the density of radioactive substances in the well water on Thursday and has confirmed no leak of contaminated water took place.

TEPCO stopped pumping out water from the well and reported the case to relevant local governments and the Nuclear Regulation Authority.

The company says it is conducting an investigation, suspecting that improvement work on another well 6 meters away may have caused the drop.

The utility publicized the drop on Thursday, one day after the phenomenon was recorded. The firm apologized for the delay in disclosure, saying it initially decided a problem had developed with the well's water gauge as the water level in a nearby well remained unchanged.

The No.4 reactor building experienced a hydrogen explosion, but not a meltdown, during the 2011 accident.

August 15, 2017

## NRA allows completion of icewall

### Completion of Fukushima plant ice wall approved

[https://www3.nhk.or.jp/nhkworld/en/news/20170815\\_24/](https://www3.nhk.or.jp/nhkworld/en/news/20170815_24/)

Nuclear regulators have approved the completion of an ice wall being built to keep groundwater from entering the damaged Fukushima Daiichi reactor buildings.

The Nuclear Regulation Authority on Tuesday gave permission to complete the remaining part of the underground ice wall. Freezing of the soil started in March last year.

Plant operator Tokyo Electric Power Company is circulating coolant in pipes buried around the buildings to make the 1.5 kilometer-long ice barrier.

The utility hopes to keep groundwater from entering the buildings and being contaminated with radioactive substances.

TEPCO officials had left a 7-meter section of the wall unfrozen. Nuclear regulators were concerned that freezing the entire wall could lead to a sharp drop in the level of groundwater outside the buildings. They said this might cause tainted water inside to leak out.

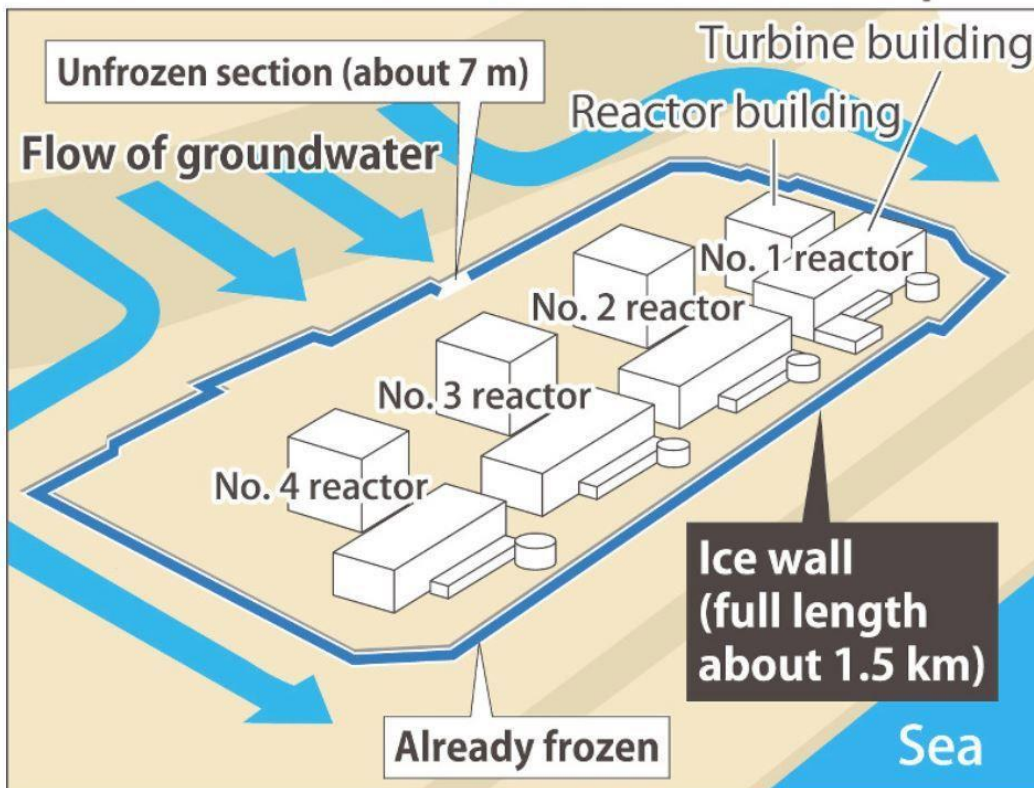
The utility explained to regulators they don't expect the groundwater level to plunge, and they are prepared to deal with such a case.

TEPCO officials plan to start freezing the remaining section on Tuesday next week. They say the completed ice wall will help to drastically reduce the amount of contaminated water.

August 16, 2017

## Icwall : "I can't say how effective"

## Fukushima No. 1 Nuclear Power Plant ice wall plan



### High-priced Fukushima ice wall nears completion, but effectiveness doubtful

<https://mainichi.jp/english/articles/20170816/p2a/00m/0na/016000c>

A subterranean ice wall surrounding the nuclear reactors at the stricken Fukushima No. 1 Nuclear Power Plant to block groundwater from flowing in and out of the plant buildings has approached completion.

- **【Related】** Concern as leaky 'ice wall' around Fukushima nuke plant resembles 'bamboo screen

Initially, the ice wall was lauded as a trump card in controlling radioactively contaminated water at the plant in Fukushima Prefecture, which was crippled by meltdowns in the wake of the March 2011 Great East Japan Earthquake and tsunami. But while 34.5 billion yen from government coffers has already been invested in the wall, doubts remain about its effectiveness. Meanwhile, the issue of water contamination looms over decommissioning work.

In a news conference at the end of July, Naohiro Masuda, president and chief decommissioning officer of Fukushima Daiichi Decontamination & Decommissioning Engineering Co., stated, "We feel that the ice wall is becoming quite effective." However, he had no articulate answer when pressed for concrete details, stating, "I can't say how effective."

The ice wall is created by circulating a coolant with a temperature of minus 30 degrees Celsius through 1,568 pipes that extend to a depth of 30 meters below the surface around the plant's reactors. The soil around the pipes freezes to form a wall, which is supposed to stop groundwater from flowing into the reactor buildings where it becomes contaminated. A total of 260,000 people have worked on creating the wall. The plant's operator, Tokyo Electric Power Co. (TEPCO) began freezing soil in March last year, and as of Aug. 15, at least 99 percent of the wall had been completed, leaving just a 7-meter section to be frozen. Soon after the outbreak of the nuclear disaster, about 400 tons of contaminated water was being produced each day. That figure has now dropped to roughly 130 tons. This is largely due to the

introduction of a subdrain system in which water is drawn from about 40 wells around the reactor buildings. As for the ice wall, TEPCO has not provided any concrete information on its effectiveness. An official of the Secretariat of the Nuclear Regulation Authority (NRA) commented, "The subdrain performs the primary role, and the ice wall will probably be effective enough to supplement that." This indicates that officials have largely backtracked from their designation of the ice wall as an effective means of battling contaminated water, and suggests there is unlikely to be a dramatic decrease in the amount of decontaminated groundwater once the ice wall is fully operational.

TEPCO ordered construction of the ice wall in May 2013 as one of several plans proposed by major construction firms that was selected by the government's Committee on Countermeasures for Contaminated Water Treatment. In autumn of that year Tokyo was bidding to host the 2020 Olympic and Paralympic Games, and the government sought to come to the fore and underscore its measures to deal with contaminated water on the global stage.

Using taxpayers' money to cover an incident at a private company raised the possibility of a public backlash. But one official connected with the Committee on Countermeasures for Contaminated Water Treatment commented, "It was accepted that public funds could be spent if those funds were for the ice wall, which was a challenging project that had not been undertaken before." Small-scale ice walls had been created in the past, but the scale of this one -- extending 1.5 kilometers and taking years to complete -- was unprecedented.

At first, the government and TEPCO explained that an ice wall could be created more quickly than a wall of clay and other barriers, and that if anything went wrong, the wall could be melted, returning the soil to its original state. However, fears emerged that if the level of groundwater around the reactor buildings drops as a result of the ice wall blocking the groundwater, then tainted water inside the reactor buildings could end up at a higher level, causing it to leak outside the building. Officials decided to freeze the soil in stages to measure the effects and effectiveness of the ice wall. As a result, full-scale operation of the wall -- originally slated for fiscal 2015 -- has been significantly delayed.

Furthermore, during screening by the NRA, which had approved the project, experts raised doubts about how effective the ice wall would be in blocking groundwater. The ironic reason for approving its full-scale operation, in the words of NRA acting head Toyoshi Fuketa, was that, "It has not been effective in blocking water, so we can go ahead with freezing with peace of mind" -- without worrying that the level of groundwater surrounding the reactor buildings will decrease, causing the contaminated water inside to flow out.

Maintaining the ice wall will cost over a billion yen a year, and the radiation exposure of workers involved in its maintenance is high. Meanwhile, there are no immediate prospects of being able to repair the basement damage in the reactor buildings at the crippled nuclear plant.

Nagoya University professor emeritus Akira Asaoka commented, "The way things stand, we'll have to keep maintaining an ice wall that isn't very effective. We should consider a different type of wall."

In the meantime, TEPCO continues to be plagued over what to do with treated water at the plant. Tainted water is treated using TEPCO's multi-nuclide removal equipment to remove 62 types of radioactive substances, but in principle, tritium cannot be removed during this process. Tritium is produced in nature through cosmic rays, and nuclear facilities around the world release it into the sea. The NRA takes the view that there is no problem with releasing treated water into the sea, but there is strong resistance to such a move, mainly from local fishing workers who are concerned about consumer fears that could damage their businesses. TEPCO has built tanks on the grounds of the Fukushima No. 1 plant to hold treated water, and the amount they hold is approaching 800,000 metric tons.

In mid-July, TEPCO Chairman Takashi Kawamura said in an interview with several news organizations that a decision to release the treated water into the sea had "already been made." A Kyodo News report on his comment stirred a backlash from members of the fishing industry. TEPCO responded with an explanation that the chairman was not stating a course of action, but was merely agreeing with the view of the NRA that there were no problems scientifically with releasing the treated water. However, the anger from his comment has not subsided.

Critical opinions emerged in a subsequent meeting that the Ministry of Economy, Trade and Industry held in the Fukushima Prefecture city of Iwaki at the end of July regarding the decontamination of reactors and the handling of contaminated water. It was pointed out that prefectural residents had united to combat consumer fears and that they wanted officials to act with care. One participant asked whether the TEPCO chairman really knew about Fukushima.

The ministry has been considering ways to handle the treated water, setting up a committee in November last year that includes experts on risk evaluation and sociology. As of Aug. 15, five meetings had been held, but officials have yet to converge on a single opinion. "It's not that easy for us to say, 'Please let us release it.' It will probably take some time to reach a conclusion," a government official commented.

See also <http://www.asahi.com/ajw/articles/AJ201708160032.html>

August 18, 2017

## Highly radioactive water leaks from ALPS facility

### Highly radioactive water leak at Fukushima No. 1 nuke plant

<https://mainichi.jp/english/articles/20170818/p2a/00m/0na/001000c>

Highly radioactive water has leaked from the disaster-crippled Fukushima No. 1 nuclear plant, Tokyo Electric Power Co. (TEPCO) announced on Aug. 17.

- **【Fukushima & Nuclear Power】**

The estimated 50 milliliters of contaminated water remained inside the station dike, and there was no leakage to the outer environment, plant operator TEPCO said. An analysis found that **the tainted water contained 22 million becquerels per liter of beta-ray-emitting radioactive materials.**

According to the utility, a worker from a company cooperating with TEPCO spotted water dripping from multi-nuclide removal equipment at the facility at around 2:15 p.m. on Aug. 16. After the worker **mended the part with tape**, the leakage stopped.

## Dahr Jamail: Fukushima is "an ongoing disaster"

## Dahr Jamail | Fukushima Plant Is Releasing 770,000 Tons of Radioactive Water Into the Pacific Ocean

<http://www.truth-out.org/news/item/41564-fukushima-plant-is-releasing-tons-of-radioactive-water-into-the-pacific-ocean>



When Japan's Fukushima Daiichi nuclear plant suffered a triple-core meltdown in March 2011 as the result of devastating earthquake, most people had no idea this was only the beginning of a nuclear disaster that has arguably become the single worst industrial accident in human history.

Keeping the three core meltdowns cool has been an ongoing challenge that has yet to be met. As fresh water is pumped over the cores, it is then stored on site in massive tanks. The Tokyo Electric Power company (TEPCO), the operator of the plant, then has to figure out what to do with that water.

Recently, TEPCO announced that it would dump 770,000 tons of radioactive tritium water into the Pacific Ocean.

The announcement infuriated local fishermen and environmental groups across Japan. According to Mozghan Savabieasfahani, an environmental toxicologist and winner of the 2015 Rachel Carson prize, their outrage and alarm is not without merit.

"The release of thousands of tons of radioactive tritium by a giant utility company into our aquatic and natural environments is a blood-chilling prospect," Savabieasfahani told Truthout.

She questions why there is not more outrage from those in the Japanese government who are responsible for safeguarding the health and wellbeing of the general public.

"Where are the defenders of our public's health?" she asked. "If they could pull the plug out of their mouth, they could tell us that tritium is a toxic radioactive isotope of hydrogen, and that, once released, tritium cannot be removed from the environment. Let that sink in."

**"The Decision Has Already Been Made"**

Takashi Kawamura, TEPCO's chairman, when asked about the decision to introduce this vast amount of radioactive water into the ocean, initially responded, "The decision has already been made."

While he quickly softened the statement, he has not stated that the action will not occur.

Meanwhile, the chairman of the Japanese Nuclear Regulation Authority (NRA), Shunichi Tanaka, has claimed that tritium is of little danger to humans and supports TEPCO's plans to dump the water into the ocean.

This claim, however, is vehemently disputed by toxicologists and nuclear experts with more background in toxicology than Tanaka.

M.V. Ramana is the Simons Chair in Disarmament, Global and Human Security at the Liu Institute for Global Issues at the University of British Columbia in Canada, and is also a contributing author to the World Nuclear Industry Status Report for 2016. He is critical of Prime Minister Shinzō Abe's administration's mishandling of Fukushima.

"The proposed release of radioactive, contaminated water from Fukushima against the wishes of the local residents, especially fishermen, represents yet another violation of people's rights to a clean environment and a decent livelihood so as to protect the financial interests of TEPCO," Ramana told Truthout.

Tanaka argued that dumping the radioactive water is safe because that level of tritium is unable to penetrate plastic wrapping. However, Ramana said that justification misses the point.

"NRA Chairman Tanaka is correct when he says that tritium is 'so weak in its radioactivity it won't penetrate plastic wrapping,' but that is irrelevant if the material is ingested," Ramana said. "Because the tritium that is released will be in the form of tritiated water, it can be easily absorbed by the body as it is chemically identical to water."

According to Ramana, a special concern with tritiated water is that, when ingested by pregnant women, it can pass through the placenta and affect the fetus.

"During this stage, the developing organism (the embryo and the fetus) is highly radiosensitive," he added. And this is only one of the many ways in which tritium is dangerous for humans, at even the lowest levels.

### **Fukushima Is an "Ongoing Disaster"**

Dr. Bruno Chareyron, an expert in radiation effects, won The Nuclear-Free Future Award in 2016. He is the director of the CRIIRAD lab (Commission de Recherche et d'Information Indépendantes sur la RADioactivité), founded in 1986, which not only monitors the environment for radiation contamination, but trains people to investigate radioactivity as well.

Chareyron was blunt with Truthout about what is happening at Fukushima.

"It is important to understand that the Fukushima disaster is actually an ongoing disaster," he said. "The radioactive particles deposited on the ground in March 2011 are still there, and in Japan, millions of people are living on territories that received significant contamination."

According to Chareyron, even territories located more than 200 kilometers away from the damaged nuclear reactors received significant fallout depending on wind direction, rainfall and/or snow.

And it's not just Fukushima prefecture that is affected by radioactive contamination.

"The Japanese authorities have launched a huge program of decontamination on a territory of about 2,400 square kilometers," Chareyron explained. "It is estimated that every day about 15,000 people are involved in this program. The ground and most contaminated tree leaves are removed only in the immediate vicinity of the houses, but a comprehensive decontamination is impossible."

Cesium 137 is a radioactive isotope that is one of the more common byproducts from the formation of Uranium-235 in nuclear reactors.

"Six years later, the radioactive Cesium 137 has decreased by only 14 percent," Chareyron said.



Chareyron said the powerful gamma rays emitted by Cesium 137 could travel dozens of meters in the air. Therefore, the contaminated soil and trees located around the houses, which have not been removed, are still irradiating the inhabitants.

To underscore these points, his lab produced a video that shows the power of gamma radiation emitted from outside a building in Fukushima city in May 2011. That video can be viewed here, as can another clip showing the contamination inside Fukushima city in June 2012.

"In the contaminated territories, people are also exposed to an internal contamination through the ingestion of food and inhalation of radioactive dust suspended by the wind," Chareyron said. "For example the forest fire that lasted several days in April and May 2017 in the contaminated forest of Mont Jûman has dispersed radioactive dust all around."

He also reminded us not to forget the workers in the nuclear plant who were exposed to radiation. This occurred even while managing the radioactive waste that continues to be generated by the disaster, as well as the management of the Fukushima Daiichi damaged reactors.

Chareyron said that, according to TEPCO, in May 2017, 8,862 workers were monitored for radiation exposure at the nuclear plant (of which 7,899 are contractors).

The most elevated individual external dose was 7.36 milliSievert in one month.

By comparison, the annual dose limit for a member of the public is 1 milliSievert per year.

### **"A Carcinogen, a Teratogen and a Mutagen All Rolled Into One"**

Hydrogen is the most abundant element in living cells.

"Once toxic tritium makes it into the environment, it will bind anywhere hydrogen binds," Savabieasfahani said. "Imagine a toxic particle that can freely travel through our cells and bind to every molecule of life in our bodies and cause damage. Tritium is a carcinogen, a teratogen and a mutagen all rolled into one."

According to Savabieasfahani, there is no safe threshold level for tritium, as it can harm living organisms no matter how low its concentrations.

"Tritium can cause tumors, cancer, genetic defects, developmental abnormalities and adverse reproductive effects," she explained. "Tritiated water is associated with significantly decreased weight of brain and genital tract organs in mice and can cause irreversible loss of female germ cells -- eggs -- in both mice and monkeys even at low concentrations. This we know."

Even at very low concentrations, tritium causes cell death, mutations and chromosome breaks. Per dose, it is twice as damaging to our genetic makeup as x-rays and gamma rays

"Once tritium travels up the food chain it becomes even more dangerous to life," Savabieasfahani said.

"When incorporated into animal or plant tissue and digested by humans, tritium can stay in the body for 10 years or more. Internally exposed individuals can expect to be chronically exposed to the toxic impacts of this carcinogen for years to come."

And for infants and growing children, tritium exposure is even more dangerous.

Savabieasfahani explained that qualitative, quantitative, physiological and epidemiological evidence show that the internal uptake of tritium is 10 times more likely to cause cancer and neurological deficit in infants and children than in adults.

"Infants' and children's higher vulnerability to tritium is attributed to their increased gut absorption and their smaller body mass, as well as their heightened sensitivity to radioactive exposures," she added. "We have already observed that childhood cancers and leukemia are 22 percent higher near nuclear reactors, and where tritium has leaked into the environment."

Citing numerous studies -- including research from the University of Florida and the journal Radiation Protection Dosimetry -- Savabieasfahani stated emphatically that it is not enough to store that knowledge in "dusty library stacks."

"That knowledge must be taken down from the shelf and broadcast now, before 777,000 tons of radioactive water hit us in the face," she said.

### **Surfing in Tritium?**

Truthout recently reported on how the Japanese government, by allowing TEPCO to dump tritium and then encouraging people who fled the Fukushima contamination zone to return to their homes, is essentially planning to expose both its own people and 2020 Tokyo Olympians to Fukushima radiation. Furthermore, the International Olympic Commission is also working to paint conditions as "normal" -- it even has plans for the 2020 Tokyo Olympics to hold baseball and softball games at Fukushima.

Why are so many powerful entities engaging in this bizarre and harmful attempt at normalization?

Chareyron believes that a nuclear disaster like the one affecting the TEPCO nuclear reactors at the Fukushima Daiichi site simply cannot be "handled properly," because highly radioactive material that should usually be kept confined inside the core of nuclear reactors has been dispersed in the environment. "Therefore, the Japanese government authorities and TEPCO both try to influence the general public and the workers so that a situation of exposure to radiation that would usually be considered as unacceptable becomes progressively 'accepted,'" he said. "For example, the annual dose limit of 1 milliSievert for the public has been changed into 20 milliSievert, the annual dose limit for the workers has been increased to 100 milliSievert for those exposed to 'especially high radiation,' contaminated water is still leaking into the sea, and the authorities are planning to re-use contaminated material for road construction in order to lower the cost of radioactive solid waste management."

Chareyron also said that corium, a highly radioactive material, accumulated at the bottom of reactors one and three and is still to this day has not been precisely located, and nobody yet knows when it will even be possible to dismantle the reactors.

Chareyron believes both the Japanese government and TEPCO face enormous difficulties, because of the fact that it is impossible to properly decontaminate the affected territories. Furthermore, Fukushima prefecture residents are more or less "forced" to come back to their houses while the radiation is still high, since the government announced it will cut housing subsidies that were being provided to any of them not under mandatory evacuation orders.

He also shed light on how this massive dumping of radioactive tritium water is not likely to be the last time this occurs. Chareyron said that TEPCO still must pump out on a daily basis massive amounts of heavily contaminated water that is used to cool the reactor cores, and this water is also already contaminating the water table with radiation. He also expressed concerns around the lack of monitoring of how the general population in the region is being affected by the contaminated water.

Chareyron emphasizes that both the Japanese government and TEPCO have been fundamentally dishonest with the public.

"Since the beginning of the crisis, the Japanese authorities and TEPCO have been lying to the people about the adverse impact of radiation on health and the extension of the disaster," he said.

Savabieasfahani noted that TEPCO has been rewarded with trillions of yen in government subsidies since the 2011 nuclear disaster began. That disaster was preceded by TEPCO's false reporting of technical data to authorities on hundreds of occasions, and by the 2008 shutdown of one of its nuclear power plants following an earthquake.

Instead of doling out future subsidies, Savabieasfahani said, the government should be holding the company accountable.

"A far better outcome would be to force TEPCO's shareholders, starting with the largest, to pay for cleaning up the damage their company has caused," she said. "Let it be a warning to everyone trying to make similar profits, worldwide, from similar nuclear power ventures. The insane alternative of dumping all that radiation into the seas, and letting TEPCO shareholders keep the trillions of yen they have made from poisoning and lying to the public, is simply unspeakable."

Savabieasfahani wonders why so many academics and universities are silent on these matters.

"From Los Angeles to Tokyo, the universities are loaded with environmental scientists, public health researchers, epidemiologists, medical school professors, and soon they will be drinking tritium along with everyone else," she said.

On July 27, the journal *Science of the Total Environment* published a peer-reviewed article about radioactively hot particles being detected in soil and dust across northern Japan.

The article details the analysis of radioactively hot particles collected in Japan following the Fukushima Daiichi meltdowns.

Based on 415 samples of radioactive dust from Japan, the USA and Canada, the study identified a statistically meaningful number of samples that were considerably more radioactive than current radiation models anticipated. If ingested, these more radioactive particles increase the risk of suffering a future health problem.

However, despite substantial scientific research that demonstrates the ongoing radioactive danger created by the Fukushima disaster, Savabieasfahani notes that -- much like the government and the industry -- most academics have chosen not to speak out about the contamination.

"Don't these academics have anything to teach us, before their fish, seaweed, plants, crops and children are poisoned with 770,000 tons of radioactive water?" Savabieasfahani asked. "The silence of the entire academic world, as these proposals to dump tritium in our laps are being favorably discussed in the media, teaches a very different lesson: to just drink it up and let the shareholders make another buck."

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Dahr Jamail

Dahr Jamail, a Truthout staff reporter, is the author of *The Will to Resist: Soldiers Who Refuse to Fight in Iraq and Afghanistan* (Haymarket Books, 2009), and *Beyond the Green Zone: Dispatches From an Unembedded Journalist in Occupied Iraq* (Haymarket Books, 2007). Jamail reported from Iraq for more than a year, as well as from Lebanon, Syria, Jordan and Turkey over the last 10 years, and has won the Martha Gellhorn Award for Investigative Journalism, among other awards.

His third book, *The Mass Destruction of Iraq: Why It Is Happening, and Who Is Responsible*, co-written with William Rivers Pitt, is available now on Amazon.

Dahr Jamail is also the author of the book, *The End of Ice*, forthcoming from The New Press. He lives and works in Washington State.

### **\*About Truthout:**

#### **Our Organization and Mission**

Truthout is a 501(c)3 nonprofit organization dedicated to providing independent news and commentary on a daily basis. Truthout works to spark action by revealing systemic injustice and providing a platform for transformative ideas, through in-depth investigative reporting and critical analysis. With a powerful,

independent voice, we will spur the revolution in consciousness and inspire the direct action that is necessary to save the planet and humanity.

August 21, 2017

## Icewall: Final phase

### Work to finish ice wall at crippled plant to begin

[https://www3.nhk.or.jp/nhkworld/en/news/20170821\\_13/](https://www3.nhk.or.jp/nhkworld/en/news/20170821_13/)

The operator of the crippled Fukushima Daiichi nuclear plant will begin the final phase of creating an underground ice wall on Tuesday.

Tokyo Electric Power Company started the work 17 months ago, with the aim of preventing groundwater from entering reactor buildings and getting contaminated with radioactive substances.

The 1.5-kilometer ice barrier is deemed a key step to curb the buildup of tainted water at the plant.

The soil is frozen by sending liquid at minus 30 degrees Celsius into pipes buried around the buildings. But the utility has left a 7-meter section unfrozen, fearing the sudden fall in groundwater levels around the buildings.

There were concerns that the difference of water levels in and outside the reactor buildings would cause tainted water inside to leak out.

But last Tuesday, the Nuclear Regulation Authority said safety measures are ready and gave its approval to freeze of the final section.

Officials of the utility say they will carefully monitor the freezing process of the remaining section.

They say it may take longer to fully freeze than other areas, because the flow of groundwater has been concentrated in that section.

The officials expect that the wall, when completed, will reduce the inflow of groundwater to the buildings from 140 tons a day to less than 100 tons.

August 22, 2017

## Icewall: Final phase (2)

### **Fukushima ice wall's last section being frozen**

[https://www3.nhk.or.jp/nhkworld/en/news/20170822\\_19/](https://www3.nhk.or.jp/nhkworld/en/news/20170822_19/)

Final procedures have begun to complete an ice wall to prevent groundwater from entering the contaminated Fukushima Daiichi nuclear power plant.

Tokyo Electric Power Company workers started the process to freeze the remaining 7-meter section of the ice wall on Tuesday.

They opened 11 valves to allow coolant at a temperature of minus 30 degrees Celsius to circulate in the underground pipes.

TEPCO began freezing the 1.5 kilometer long wall in March of last year. The last section on the mountain side of the facility had been left unfrozen as officials said the move could cause a sudden drop in groundwater levels around the reactor buildings.

But the Nuclear Regulation Authority said safety measures were in place and gave permission for the procedure earlier this month.

TEPCO says it could take longer than the 2 months projected based on past records for the section to freeze, because the groundwater is flowing at a rapid rate.

They say once the wall is completed, the volume of groundwater flowing into the reactor buildings will be reduced to less than 100 tons a day, from the current 140 tons.

The nuclear regulators say they will carefully monitor the effectiveness of the wall.

### **TEPCO begins extending ice wall to reduce tainted water in Fukushima**

<https://mainichi.jp/english/articles/20170822/p2g/00m/0dm/053000c>

FUKUSHIMA, Japan (Kyodo) -- The operator of the crippled Fukushima Daiichi nuclear complex began work Tuesday to extend an underground ice wall to prevent contaminated water increasing within the facilities.

The coolant-filled wall is designed to prevent groundwater from seeping into the facilities and touching melted nuclear fuel or becoming mixed with highly contaminated water inside reactor buildings.

The government has spent some 35 billion yen (\$320 million) on the project. Work by Tokyo Electric Power Company Holdings Inc. to freeze the wall began in March last year.

On Tuesday, the utility opened valves to circulate coolant for the remaining section of the 1.5-kilometer-long, 30-meter-deep wall around the four reactor buildings.

TEPCO is expected to complete the wall possibly this fall by cooling the remaining portion on the west side of the buildings, a section stretching for about 7 meters.

About 400 tons of water was initially flowing inside the buildings per day but the amount has fallen to 120 to 130 tons this year, according to TEPCO. The utility aims to slash the daily inflow of groundwater to less than 100 tons with the full operation of the ice wall.

Pipes have been inserted into the ground to circulate coolant and freeze the nearby soil. Since starting the freezing work in March last year, the operator has gradually expanded the ice wall as freezing the entire wall at once could change the groundwater level, possibly causing highly radioactive water in the basements of the buildings to leak outside.

"We want to carefully freeze (the wall) by monitoring water levels both inside and outside the reactor buildings," a TEPCO official told a press conference in the city of Fukushima.

See also : <https://www.japantimes.co.jp/news/2017/08/22/national/tepcO-begins-extending-ice-wall-reduce-tainted-water-fukushima-plant/>

September 10, 2017

## Using drones for safety to measure radiation inside

### Drone to measure radiation inside tainted Fukushima plant buildings

[https://mainichi.jp/english/articles/20170910/p2g/00m/0dm/008000c#cxrecs\\_s](https://mainichi.jp/english/articles/20170910/p2g/00m/0dm/008000c#cxrecs_s)

TOKYO (Kyodo) -- The operator of the crippled Fukushima Daiichi nuclear power plant is planning to use a drone to measure radiation inside heavily contaminated structures as it prepares to decommission damaged reactors there, according to officials of the operator.

Data obtained from its use is expected to help the operator, Tokyo Electric Power Company Holdings Inc., create 3-D maps and identify areas with high-level radiation inside buildings where workers cannot stay safely.

The drone envisioned for the task is 93 centimeters wide and 83 cm long, and, equipped with four propellers, can fly for around 15 minutes. The operator envisions its use inside buildings that house damaged reactors and inside those housing turbines.

In February Tepco, as it is known, tested a drone inside the turbine building for the No. 3 reactor, one of three reactors that experienced meltdowns in the March 2011 earthquake and tsunami.

After improving its performance, the plant operator has decided to put the drone into use for radiation measurement. But it is still considering where it should begin using the machine, according to the officials. The government and Tepco are aiming to start debris extraction work from 2021, and are currently in the process of determining a specific approach to removing melted fuel from each damaged reactor and of updating their decommissioning road map.

September 21, 2017

## **TEPCO to delay emptying fuel storage pools at Fukushima plant**

<http://www.asahi.com/ajw/articles/AJ201709210034.html>

By CHIKAKO KAWAHARA/ Staff Writer

Plans to remove fuel rods from two spent fuel pools at the Fukushima No. 1 nuclear plant will be delayed by up to three years because of difficulties in clearing debris and reducing radiation levels.

The government and plant operator Tokyo Electric Power Co. originally expected to start emptying the storage pools at the No. 1 and No. 2 reactor buildings in fiscal 2020.

But they plan to move the starting time to fiscal 2023 in their first review in two years of the roadmap for decommissioning the stricken nuclear plant, sources said Sept. 20.

They are expected to announce the revised roadmap later this month.

A survey of the upper levels of the two reactor buildings, where the storage pools are located, found debris piled up in a much more complicated way than initially envisaged.

That will lengthen the time needed to clear the debris, thus delaying the removal of the fuel rods, the sources said.

In addition, radiation levels remain extremely high inside the buildings.

The No. 1 reactor's storage pool holds 392 nuclear fuel assemblies, while the No. 2 reactor's pool has 615 assemblies.

Work to remove the 566 assemblies from the No. 3 reactor's pool is scheduled to begin in the middle of fiscal 2018 as originally planned.

The three reactors melted down in the 2011 disaster, triggered by the magnitude-9.0 Great East Japan Earthquake and tsunami.

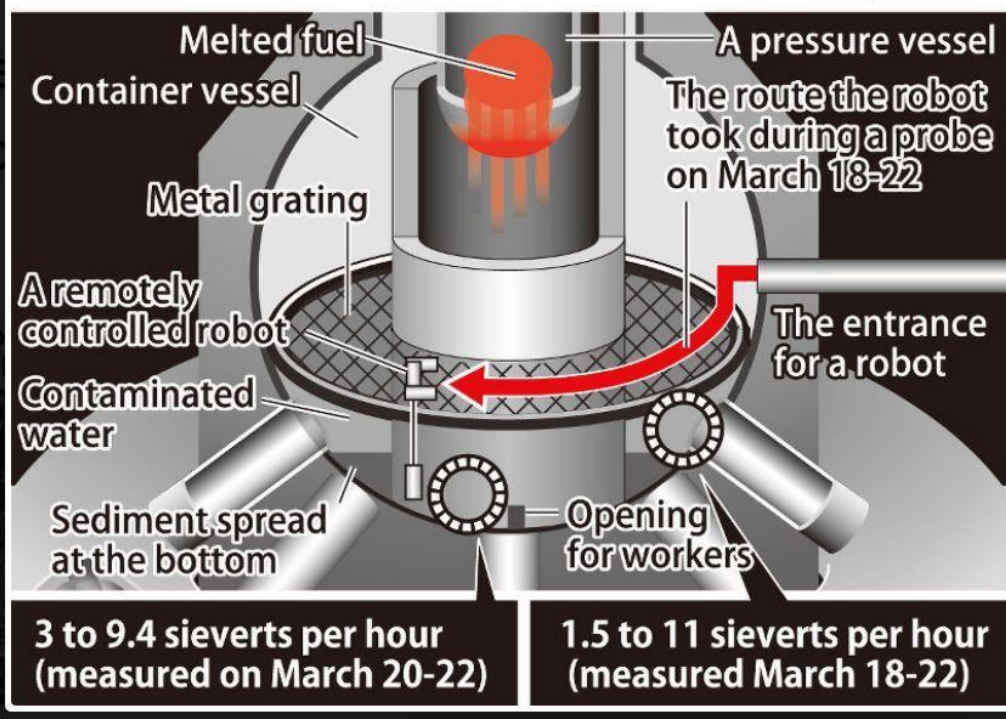
The review of the decommissioning roadmap is also expected to revise the target of "starting the removal" of melted nuclear fuel and debris in the three reactors in 2021 to "aiming to start the removal" in 2021.

But the government and TEPCO will maintain the goal of completing the decommissioning in "30 to 40 years," the sources said.

September 26, 2017

## **Fuel removal delayed again (2)**

## A probe inside the No. 1 reactor at the Fukushima No. 1 nuclear plant



### Spent nuclear fuel removal at Fukushima plant to be delayed again

[https://mainichi.jp/english/articles/20170926/p2g/00m/0dm/064000c#cxrecs\\_s](https://mainichi.jp/english/articles/20170926/p2g/00m/0dm/064000c#cxrecs_s)

TOKYO (Kyodo) -- The government and Tokyo Electric Power Company Holdings Inc. decided Tuesday to delay again the start of removing spent nuclear fuel left near two of the three reactors which suffered a meltdown at the Fukushima complex.

- **【Related】** New proposal suggests removing Fukushima plant's melted nuclear fuel from site
- **【Video】** TEPCO releases new footage of suspected melted fuel debris at Fukushima plant
- **【Related】** News Navigator: Why are costs for dealing with Fukushima disaster growing?

In the road map for decommissioning the Fukushima Daiichi plant, revised for the fourth time since it was first crafted in December 2011, highly radioactive spent nuclear fuel will be extracted from the Nos. 1 and 2 units' cooling pools starting in fiscal 2023 instead of fiscal 2020.

It is the third time that the schedule for spent fuel removal has been pushed back at the Nos. 1 and 2 reactors, with the previous postponement taking place in June 2015. The government said new technical issues and the need to take safety precautions led to the latest schedule change.

The cleanup process is to be completed in around 30 to 40 years.

For the No. 3 reactor at the Fukushima plant, the schedule to remove spent nuclear fuel during fiscal 2018 is unchanged after having already been pushed back earlier this year.



In the decommissioning process, taking out fuel rod assemblies from the spent fuel pools inside reactor buildings is one of the key steps before extracting melted fuel debris from the Nos. 1 to 3 reactors, all of which suffered core meltdowns following the March 2011 earthquake and tsunami disaster.

The schedule for extraction of the melted fuel debris at the reactors was also revised, with the determination of a specific approach to remove the debris to be made in fiscal 2019, rather than in the originally planned first half of fiscal 2018.

Despite the delay in finalizing specific methods, the road map kept the start of the debris extraction, the most challenging part of the decommissioning process, at 2021.

A method currently considered feasible by the government is debris removal from the side of the three crippled reactors by partially filling them with water.

The road map newly sets the goal of cutting the amount of underground water at the plant to address contaminated water buildup at the site. Underground water, which gets mixed with accumulated radioactive water generated in the process of cooling the damaged reactors -- is to be cut to around 150 tons per day in 2020 from the current 200 tons.

It did not mention a specific schedule for disposal of processed water that still contains radioactive tritium.

The road map was first crafted in December 2011 in the wake of the 2011 disaster which triggered at the Fukushima plant the world's worst nuclear crisis since the 1986 Chernobyl disaster.

Attempts have been made to confirm internal conditions of the damaged reactors using robots. A survey robot captured images of what is likely to be melted nuclear fuel at the bottom of the No. 3 reactor for the first time in July this year.

## Nos 1& 2 reactors: Plans for decommissioning revised

### 3-year delay in removal of fuel rods from Fukushima plant

<http://www.asahi.com/ajw/articles/AJ201709260025.html>

By CHIKAKO KAWAHARA/ Staff Writer

#### **The government on Sept. 26 revised its long-term plan to decommission the crippled Fukushima No. 1 nuclear power plant, citing high levels of radiation.**

It said the three-year delay concerns the removal of spent fuel rods kept in storage pools at the No. 1 and 2 reactor buildings and will not affect the overall plan to fully dismantle the facility within 30 to 40 years.

A committee of Cabinet ministers involved in the process met Sept. 26 and approved the changes submitted by the government and Tokyo Electric Power Co., operator of the Fukushima plant.

The decommissioning road map was last revised in June 2015.

The spent fuel storage pool in the No. 1 reactor building holds 392 fuel assemblies, while the pools in the No. 2 and No. 3 pools contain 615 and 566 assemblies, respectively.

The upper part of the No. 1 reactor building was destroyed in a hydrogen explosion, spreading rubble and debris throughout the building. Studies earlier this year showed that radiation levels within the building are still high.

The No. 2 reactor building was not damaged, but decontamination work within the building is expected to take longer than initially expected.

For those reasons, the start of removal of the fuel rods from the No. 1 and 2 reactor storage pools will be put off until fiscal 2023.

The start of removal of fuel rods from the No. 3 reactor storage pool remains unchanged from fiscal 2018. It was decided in February 2017 to delay the start of work from fiscal 2017 by one year. Work to remove melted nuclear fuel from the three reactors' containment vessels will also be delayed.

Remote-controlled robots have been used since the start of the year to study the interior of the vessels, but the state of the melted fuel has only partially been determined.

Further studies will be carried out to assess the dangers.

There is no change as yet in the plan to begin removing melted fuel from one of the three reactors before the end of 2021.

But a decision on which reactor to work on first will be delayed until fiscal 2019. At that time, the specifics of how to accomplish the removal work will also be decided. It was initially envisaged that these two points would be thought through in the first half of fiscal 2018.

September 27, 2017

## Melted fuel but also contaminated water and radioactive waste still to be faced



A Tokyo Electric Power Co. official wearing radiation protection gear stands in front of Advanced Liquid Processing Systems during a press tour at the Fukushima No. 1 nuclear power plant in 2014. (AP file photo)

## **Melted fuel, other challenges left in Fukushima nuclear cleanup**

<http://www.asahi.com/ajw/articles/AJ201709270019.html>

THE ASSOCIATED PRESS

Japan's government approved a revised road map Tuesday to clean up the radioactive mess left at the Fukushima No. 1 nuclear power plant after it was damaged beyond repair by an earthquake and tsunami in 2011. Decommissioning the damaged reactors is an uncertain process that is expected to take 30 to 40 years.

A look at some of the challenges:

### **THE FUEL RODS**

The three reactors that had meltdowns together have 1,573 units of mostly used nuclear fuel rods that are still inside and must be kept cool in pools of water. They are considered among the highest risks in the event of another major earthquake that could trigger fuel rods to melt and release massive radiation due to loss of water from sloshing or structural damage because the pools are uncovered. The plant operator, Tokyo Electric Power Co., or TEPCO, plans to begin moving the rods from reactor Unit 3 in the fiscal year beginning April 1.

However, the latest road map delays removal of the rods from units 1 and 2 for three years until fiscal 2023, because further decontamination work and additional safety measures are needed. Ironically, because the building housing reactor 3 was more heavily damaged, it is easier to remove that unit's fuel rods. The fuel rods will be moved to a storage pool outside the reactors, and eventually sent for long-term storage in what are known as dry casks.

### **THE MELTED FUEL**

By far the hardest part of decommissioning Fukushima will be removing the fuel that melted and presumably spilled out of the reactor cores. In July, an underwater robot for the first time captured images inside the primary containment chamber of Unit 3. They showed a large number of solidified lava-like rocks and lumps on the chamber's floor, believed to be melted fuel mixed with melted and mangled equipment and parts of the structure.

The search for melted fuel in units 1 and 2 has so far been unsuccessful. The water level is lower, so crawling robots have been tried, but they have been obstructed by debris as well as extremely high radiation levels. Despite the unknowns about the melted fuel and debris and their whereabouts, the road map calls for finalizing the removal method in 2019, and starting actual removal at one of the reactors in 2021. The government-funded International Research Institute for Nuclear Decommissioning is developing robots and other technology to carry out the work.

### **CONTAMINATED WATER**

TEPCO has treated and stored a massive amount of radioactive water--about 800,000 tons--and the volume is growing every day. Cooling water leaks out of the damaged reactors and mixes with groundwater that seeps into the basements of the reactor building, increasing the amount of contaminated water. The utility has managed to halve the volume to 200 tons per day by pumping up groundwater via dozens of wells dug upstream from the reactors, as well as installing a costly "ice wall" by freezing the ground to block some of the water from coming in and going out.

The water is stored in hundreds of tanks that cover much of the plant property. They get in the way of decommissioning work and pose another risk if they were to spill out their contents in another major earthquake or tsunami. After treatment, the water still contains radioactive tritium, which cannot be removed but is not considered harmful in small amounts. Experts say controlled release of the water into the ocean is the only realistic option, but TEPCO has not moved forward with that plan because of opposition from fishermen and residents who fear a negative image and possible health impact.

### **RADIOACTIVE WASTE**

Japan has yet to develop a plan to dispose of the highly radioactive waste that will come out of the Fukushima reactors. Under the road map, the government and TEPCO will compile a basic plan during fiscal 2018. Managing the waste will require new technologies to compact it and reduce its toxicity. Finding a storage site for the waste seems virtually impossible, as the government has not been able to find a site even for the normal radioactive waste from its nuclear power plants. The prospect raises doubts about whether the cleanup can really be completed within 40 years.

September 29, 2017

## **Faulty equipment may have masked leaks**

### **Fukushima plant may have leaked radioactive water**

[https://www3.nhk.or.jp/nhkworld/en/news/20170929\\_19/](https://www3.nhk.or.jp/nhkworld/en/news/20170929_19/)

The operator of the Fukushima Daiichi nuclear plant says the groundwater level fell below the level of contaminated water inside the No.1 reactor building **in May**. This means that radioactive water may have leaked from the building.

Officials with the Tokyo Electric Power Company say there were errors in the settings of 6 indicators installed since April to monitor the groundwater levels around the No.1 to No.4 reactor buildings. They say **the actual levels were about 70 centimeters lower than the readings taken with the equipment**.

Contaminated water could leak out if groundwater levels are lower than the level of contaminated water inside a reactor building.

The officials say **the groundwater level of a well outside the No.1 reactor building was up to 2 centimeters lower than the contaminated water level, and this occurred at least 8 times between May 17th and the 21st**.

They say they cannot tell how long this situation lasted, and are continuing their investigation.

The utility says there are no reports of any irregularities in the density of radioactive substances in the groundwater around the reactor buildings.

## Faulty equipment (2)

### Botched gauge settings might have contaminated Fukushima groundwater from April onward: Tepco

<https://www.japantimes.co.jp/news/2017/09/29/national/radioactive-water-may-leaking-fukushima-reactor-buildings-since-april-tepco/#.Wc5w9sZpGos>

Jiji, Kyodo

The discovery of falsely configured monitoring equipment at the stricken Fukushima No. 1 nuclear power plant means the groundwater flowing underneath it might have gotten contaminated **from April onward**, Tokyo Electric said Friday.

The utility said incorrect gauge settings were used to measure groundwater levels in six of the wells near reactors 1 and 4. This resulted in groundwater readings about 70 cm higher than reality, which means **the beleaguered power utility has been mismanaging the groundwater there for months**.

To prevent tainted water from leaking from the plant, Tokyo Electric Power Company Holdings Inc. installed water gauges so it could keep the groundwater levels in the wells a meter higher than the contaminated water in the buildings.

Tepco adjusts the amount of water in wells called subdrains around the buildings to keep the groundwater higher than the tainted water inside them, which prevents it from flowing out. If the groundwater levels sink below the level of the radioactive water, it might leak out.

On Friday, Tepco said the estimated groundwater level in one of the six subdrain wells close to reactor 1 fell below the level in the reactor building at least eight times during the five-day period to May 21 because the gauges were set incorrectly.

Groundwater levels were 2 mm to 19 mm lower than the level in the buildings, Tepco said, adding that it does not know precisely how long each of these problematic situations lasted because water level data is collected by the hour.

Tepco said groundwater levels in five other wells affected by the incorrect settings did not fall below the levels in the nearby reactor buildings.

All six are in the area surrounded by an underground ice wall designed to prevent groundwater leakage. According to Tepco, the incorrect settings date as far back as April 19. The earliest error affected the gauge in a well where groundwater fell to hazardous levels.

In the world's worst nuclear disaster since Chernobyl, reactors 1, 2 and 3 at the plant experienced core meltdowns and reactors 1, 3 and 4 were severely damaged by hydrogen explosions following a massive offshore earthquake that spawned large tsunami in March 2011.

## New incinerator at Fukushima Daiichi

### **Fukushima Daiichi waste incinerator starts up**

<http://www.world-nuclear-news.org/WR-Fukushima-Daiichi-waste-incinerator-starts-up-2203164.html>  
22 March 2016

**A facility for incinerating miscellaneous solid low-level waste has begun operating at the damaged Fukushima Daiichi nuclear power plant in Japan. The incinerator will be used for disposing of items such as used protective clothing and construction waste.**

The miscellaneous solid waste incineration facility houses two incineration lines, each comprising a rotary kiln incineration system and a series of exhaust filters. The two lines share a common exhaust stack. Ash generated in the incinerators is stored in sealed drums for final disposal. Each incineration line has the capacity to process 300 kilograms of waste per hour. The facility can operate around the clock.

Construction of the facility began in May 2013 and was completed last November. It was built by Kobelco, part of Kobe Steel Group, under contract from Tokyo Electric Power Company (Tepco). Cold testing of the facility - in which non-contaminated waste was burned - was carried out between 25 November and the end of December. This was followed last month by hot testing - in which actual contaminated waste was incinerated.

Tepco announced today that the facility had now started full operation.

It is designed to burn solid wastes such as used personal protective equipment (including gloves and overalls), construction materials (rags, wood, packing materials, paper, etc), as well as waste oil and spent resins.

Tepco said, "The waste materials can't be taken off the site, so incinerating it and then storing the ash in sealed containers has been found to be the safest and most efficient way to reduce its volume." It noted that the facility was fitted with filters to prevent the dispersal of radioactivity in the air. "The amount of radioactive materials in the exhaust gas will be measured on a regular basis to prevent any impact on the surrounding environment," the company said.

The facility is intended to reduce the volume of the radioactive waste "to one several tenth or less", Tepco said.

Three existing low-level waste incinerators on the Fukushima Daiichi site - with a combined capacity of handling over eight tonnes of waste per day - are not in operation as they are now being used to store and process radioactive water instead.

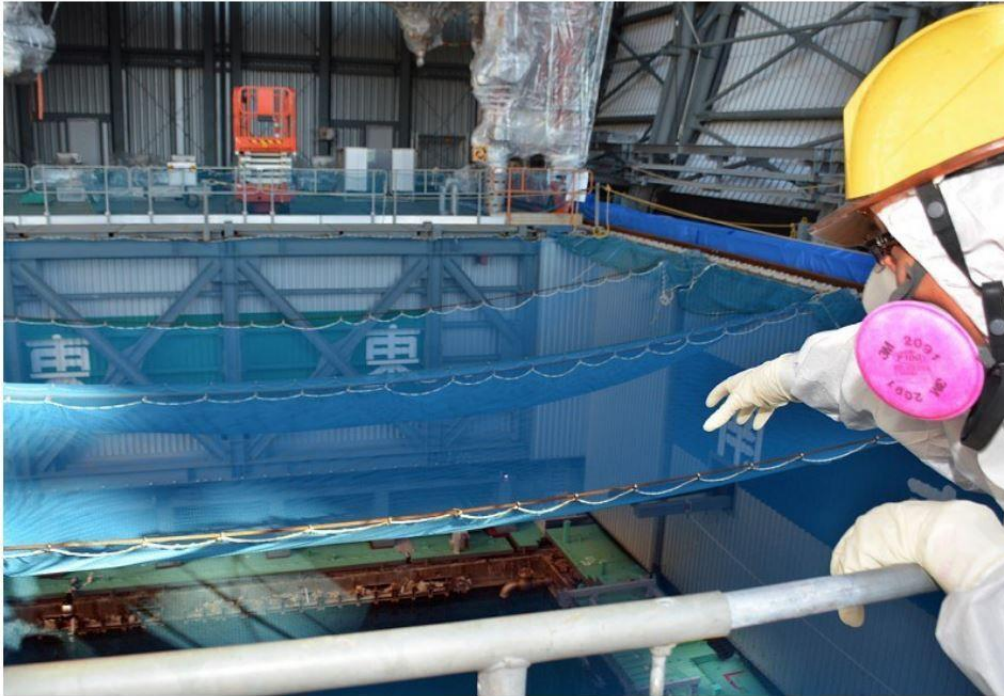
*Researched and written  
by World Nuclear News*

November 22, 2017

## Fukushima plant opened to media

## Once severely damaged Fukushima reactor building opened to media to showcase progress

[https://mainichi.jp/english/articles/20171122/p2a/00m/0na/017000c#cxrecs\\_s](https://mainichi.jp/english/articles/20171122/p2a/00m/0na/017000c#cxrecs_s)



The top floor of the Fukushima No. 1 nuclear plant's No. 3 reactor building is seen on Nov. 21, 2017. The spent fuel pool can be seen at lower left. (Mainichi)

The top floor of the Fukushima No. 1 nuclear plant's No. 3 reactor building is seen on Nov. 21, 2017. The spent fuel pool can be seen at lower left. (Mainichi)

The top level of the Fukushima No. 1 nuclear plant's No. 3 reactor building was opened to the news media on Nov. 21.

- **【Related】** Nuclear plant operator to request 20-year extension for 'boiling water reactor'
- **【Related】** Fukushima radioactive waste storage starts full operation
- **【Related】** Plaintiffs appeal ruling in Fukushima nuclear disaster damages suit

The Ministry of Economy, Trade and Industry along with plant operator Tokyo Electric Power Co. (TEPCO) guided reporters to the reactor building's top floor for a tour lasting about 15 minutes. The building was badly damaged by a hydrogen explosion in the first days of the Fukushima nuclear crisis in March 2011. However, the debris has been cleared away, and radiation that had stood at 800 millisieverts per hour just after the reactor meltdowns was measured at 0.08 mSv/h on the 7-meter-high platform, on which fuel removal equipment and other devices have been installed, on Nov. 21. Closer to the fuel pool, the figure rose to 0.7 mSv/h. According to TEPCO, workers are limited to just one to two hours on the platform.



Fuel removal equipment is seen beneath a semi-cylindrical cover atop the No. 3 reactor building. (Mainichi)

The top floor is about 30 meters from the ground. The spent fuel pool currently contains 566 fuel assemblies, and preparations are underway to start the removal process as early as mid-fiscal 2018, with equipment for the job already installed on the platform. A net currently covers the pool to prevent anything -- or anyone -- from falling in.

A semi-cylindrical cover is also being constructed to prevent radioactive materials from escaping when fuel removal operations begin.

**watch video**

November 25, 2017

**And so the tanks remain**





## Still at a stalemate as Fukushima's radioactive water grows by 150 tons a day

[https://www.japantimes.co.jp/news/2017/11/25/national/japan-stalemate-fukushima-radioactive-water-grows-150-tons-day/#.Whl\\_33mDOos](https://www.japantimes.co.jp/news/2017/11/25/national/japan-stalemate-fukushima-radioactive-water-grows-150-tons-day/#.Whl_33mDOos)

by Mari Yamaguchi  
AP

ONAHAMA, FUKUSHIMA PREF. – More than six years after a tsunami overwhelmed the Fukushima No. 1 nuclear power plant, Japan has yet to reach consensus on what to do with a million tons of radioactive water, stored on site in around 900 large and densely packed tanks that could spill should another major earthquake or tsunami strike.

The stalemate is rooted in a fundamental conflict between science and human nature.

Experts advising the government have urged a gradual release to the Pacific Ocean.

Treatment has removed all the radioactive elements except tritium, which they say is safe in small amounts. Conversely, if the tanks break, their contents could slosh out in an uncontrolled way.

Local fishermen are balking. The water, no matter how clean, has a dirty image for consumers, they say. Despite repeated tests showing most types of fish caught off Fukushima are safe to eat, diners remain hesitant. The fishermen fear any release would sound the death knell for their nascent and still fragile recovery.

“People would shun Fukushima fish again as soon as the water is released,” said Fumio Haga, a drag-net fisherman from Iwaki, a city about 50 kilometers (30 miles) down the coast from the nuclear plant.

And so the tanks remain.

Fall is high season for saury and flounder, among Fukushima's signature fish. It was once a busy time of year when coastal fishermen were out every morning.

Then came March 11, 2011. A magnitude 9 offshore earthquake triggered a tsunami that killed more than 18,000 people along the coast. The quake and massive flooding knocked out power for the cooling systems at the Fukushima nuclear plant. Three of the six reactors had partial meltdowns. Radiation spewed into the air, and highly contaminated water ran into the Pacific.

Today, only about half of the region's 1,000 fishermen go out, and just twice a week because of reduced demand. They participate in a fish testing program.

Lab technicians mince fish samples at Onahama port in Iwaki, pack them in a cup for inspection and record details such as who caught the fish and where. Packaged fish sold at supermarkets carry official "safe" stickers.

Only three kinds of fish passed the test when the experiment began in mid-2012, 15 months after the tsunami. Over time, that number has increased to about 100.

The fish meet what is believed to be the world's most stringent requirement: less than half the radioactive cesium level allowed under Japan's national standard and one-twelfth of the U.S. or EU limit, said Yoshiharu Nemoto, a senior researcher at the Onahama testing station.

That message isn't reaching consumers. A survey by the Consumer Affairs Agency in October found that nearly half of Japanese weren't aware of the tests, and that consumers are more likely to focus on alarming information about possible health impacts in extreme cases, rather than facts about radiation and safety standards.

Fewer Japanese consumers shun fish and other foods from Fukushima than before, but 1 in 5 still do, according to the survey. The coastal catch of 2,000 tons last year was 8 percent of pre-disaster levels. The deep-sea catch was half of what it used to be, though scientists say there is no contamination risk that far out.

Naoya Sekiya, a University of Tokyo expert on disaster information and social psychology, said that the water from the nuclear plant shouldn't be released until people are well-informed about the basic facts and psychologically ready.

"A release only based on scientific safety, without addressing the public's concerns, cannot be tolerated in a democratic society," he said. "A release when people are unprepared would only make things worse." He and consumer advocacy group representative Kikuko Tatsumi sit on a government expert panel that has been wrestling with the social impact of a release and what to do with the water for more than a year, with no sign of resolution.

Tatsumi said the stalemate may be further fueling public misconception: Many people believe the water is stored because it's not safe to release, and they think Fukushima fish is not available because it's not safe to eat.

The amount of radioactive water at Fukushima is still growing, by 150 tons a day.

The reactors are damaged beyond repair, but cooling water must be constantly pumped in to keep them from overheating. That water picks up radioactivity before leaking out of the damaged containment chambers and collecting in the basements.

There, the volume of contaminated water grows, because it mixes with groundwater that has seeped in through cracks in the reactor buildings. After treatment, 210 tons is reused as cooling water, and the

remaining 150 tons is sent to tank storage. During heavy rains, the groundwater inflow increases significantly, adding to the volume.

The water is a costly headache for Tokyo Electric Power Company Holdings Inc., the utility that owns the plant. To reduce the flow, it has dug dozens of wells to pump out groundwater before it reaches the reactor buildings and built an underground “ice wall” of questionable effectiveness by partially freezing the ground around the reactors.

Another government panel recommended last year that the utility, known as Tepco, dilute the water up to about 50 times and release about 400 tons daily to the sea — a process that would take almost a decade to complete. Experts note that the release of tritiated water is allowed at other nuclear plants.

Tritiated water from the 1979 Three Mile Island accident in the United States was evaporated, but the amount was much smaller, and still required 10 years of preparation and three more years to complete.

A new chairman at Tepco, Takashi Kawamura, caused an uproar in the fishing community in April when he expressed support for moving ahead with the release of the water.

The company quickly backpedaled, and now says it has no plans for an immediate release and can keep storing water through 2020. Tepco says the decision should be made by the government, because the public doesn’t trust the utility.

“Our recovery effort up until now would immediately collapse to zero if the water is released,” Iwaki abalone farmer Yuichi Manome said.

Some experts have proposed moving the tanks to an intermediate storage area, or delaying the release until at least 2023, when half the tritium that was present at the time of the disaster will have disappeared naturally.

see also :

### **Risky stalemate as science battles human fears at Fukushima**

<http://www.asahi.com/ajw/articles/AJ201711250021.html>

THE ASSOCIATED PRESS

Follow Mari Yamaguchi on Twitter at <https://www.twitter.com/mariyamaguchi>

Find her work at <https://www.apnews.com/search/mari%20yamaguchi>

## **Under the facelift**

## Fukushima face-lift masks morass inside

<https://www.japantimes.co.jp/news/2017/11/25/national/fukushima-face-lift-masks-morass-inside/#.WhmDAHmDOos>

by Mari Yamaguchi

AP

OKUMA, FUKUSHIMA PREF. – Above ground, the tsunami-hit Fukushima nuclear power plant has had a major face-lift since the 2011 disaster. Inside and underground, a morass remains.

A stylish new office building was the first thing that came into view during a tour for foreign media last month. Another building has a cafeteria and a convenience store. It is easy to forget you are in the official no-go zone, where access is restricted.

We first went through automated security checks and radiation measurement at the new building, where 1,000 employees of Tokyo Electric Power Co.'s decommissioning unit work.

A sign prohibits games such as Pokemon Go.

Visitors no longer must put on hazmat suits and full-face charcoal-filter masks or plastic shoe covers unless they go to the most contaminated areas. We donned the gear for low-dose areas: a helmet, double socks, cotton gloves, surgical mask, goggles and a vest with a personal dosimeter.

There was little reminder of the devastation 6½ years ago. The highly contaminated debris and mangled vehicles are gone. The feeble-looking plastic hoses mended with tape and the outdoor power switchboard that rats got into — once causing a blackout — have been replaced with proper equipment.

A curved cover has been built over the Unit 3 reactor, whose roof was blown off, leaving a mess of girders, concrete and cables. A horizontal smudge high up on a nearby waste-storage building marks the height of the tsunami: 17 meters (56 feet).

The 900 huge tanks built to store a growing volume of radioactive water tower over visitors. A water management team monitored the contaminated water at what was once the crisis command center.

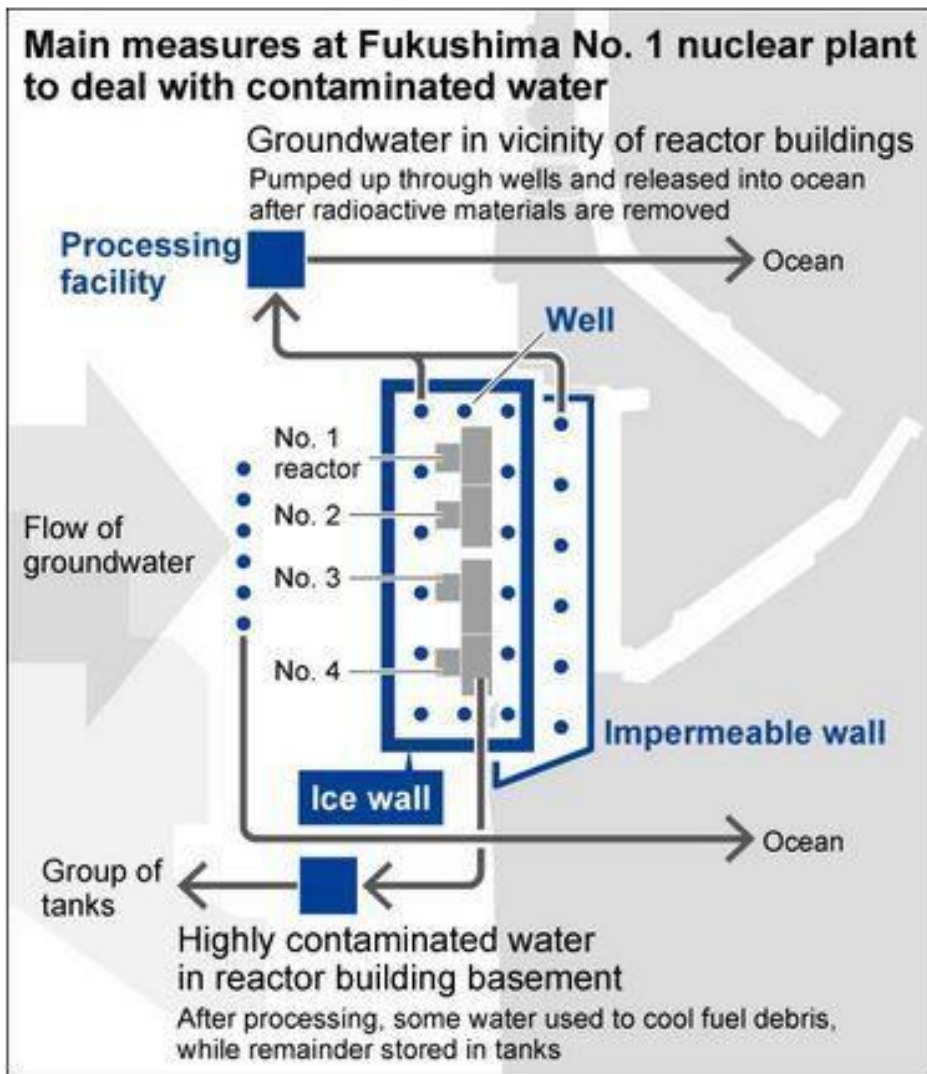
Strings of paper cranes still hang in the hallway to bring good fortune.

The tanks underscore the challenges that remain in the basements of the reactor buildings, where the water collects, and deep inside the three reactors that had meltdowns.

Remote-controlled robots provided a limited view of the melted fuel earlier this year, in areas where it is too dangerous for humans to go. The exact location of the fuel remains largely unknown. It was an early step in the still-uncertain, decadeslong plan to decommission the plant.

November 26, 2017

## Icewall: Disappointing



## Fukushima 'ice wall' linchpin not living up to high hopes

<http://www.asahi.com/ajw/articles/AJ201711260031.html>

Although 34.5 billion yen (\$309 million) in taxpayer money has funded an "ice wall" to keep out groundwater from the Fukushima No. 1 nuclear power plant site, the frozen barrier may not be meeting hopes and expectations.

In particular, the wall has been vulnerable to heavy rain brought by typhoons.

Reducing the volume of radiation-contaminated water is vital to proceeding with the removal of melted fuel from the reactors at the Fukushima No. 1 plant so it can be decommissioned.

But officials of Tokyo Electric Power Co., the operator of the plant, are still not completely sure if the ice wall is performing as designed.

Heavy rain appears to pose a major problem because the ice wall has so far proved incapable of stopping groundwater when typhoons have passed near the plant.

**In theory, the ice wall should serve as a dam to prevent groundwater from the mountainside of the plant from flowing into the reactor buildings.**

The total length of the wall is about 1,500 meters, and the wall surrounds the reactor and turbine buildings of four reactors at the No. 1 plant. Pipes have been buried about 30 meters deep at one-meter intervals.

Liquid at temperatures of minus 30 degrees have been poured into the pipes to freeze the surrounding ground. Freezing of the final section of the wall began on Aug. 22, but TEPCO officials on Nov. 22 still stopped short of offering an assessment of whether the ice wall was actually working as planned. Utility officials have said that after about two months, ground temperatures where the freezing had begun have fallen below 0 degrees.

The estimated volume of groundwater that has leaked into the reactor and other buildings was 190 tons a day at the start of 2016, but it had decreased to 110 tons a day by early October.

However, **the situation changed dramatically when two typhoons passed by in late October.**

**The groundwater level rose rapidly and the average daily flow of groundwater into the building basements for October was estimated to be 310 tons. That was close to the 400 tons that was flowing into the building basements before any measures were implemented to deal with the contaminated water.**

There was no realistic expectation of building an ice wall that would keep out all groundwater because the pipes had to be buried in a way that would avoid underground piping from the reactors that were already in place. That meant there were underground portions that could not be frozen.

Masashi Kamon, a professor emeritus at Kyoto University who specializes in environmental geotechnics, said TEPCO should have considered a number of measures to stem the flow of groundwater from the long-term perspective of eventually removing the melted fuel from the reactors.

**Another measure that is receiving more attention of late is pumping up groundwater from the 42 wells located around the reactor buildings and releasing it into the ocean.** TEPCO plans to double the number of pumps and processing capacity of decontamination facilities by early 2018.

But other measures will likely have to be considered before work can begin to remove melted fuel from the reactor cores. **The first step would be to remove as much as possible the highly radioactive water that remains in the reactor building basements.** Such water poses a huge risk to the workers who will have to enter the buildings to remove the fuel.

Toyoshi Fuketa, chairman of the Nuclear Regulation Authority, said the ice wall was a measure implemented when the situation was much more serious, but that now is the time for calmer consideration about whether that investment of time and money was the proper one.

December 1, 2017

## Corroded tubes



Severely damaged parts of a device once used to move control rods are stuck in a hole inside the pressure vessel of the No. 3 reactor at the Fukushima No. 1 nuclear plant. (Provided by International Research Institute for Nuclear Decommissioning)

## Image shows extent of damage to reactor at Fukushima plant

THE ASAHI SHIMBUN

An image taken by an underwater robot shows corroded tubes stuck in a hole created by melted fuel in the pressure vessel of the No. 3 reactor at the Fukushima No. 1 nuclear plant.

The image offers clues on the extent of the damage caused when fuel rods in the reactor melted through the bottom of the pressure vessel after the disaster at the nuclear plant unfolded in March 2011.

Tokyo Electric Power Co., operator of the plant, sent the specially designed robot into the reactor in July. The company earlier released images taken by the robot that showed what is believed to be melted nuclear fuel debris.

**In the image released on Nov. 30, TEPCO identified the severely corroded and damaged tubes as parts of a device used to move control rods. Normally, that device is located inside the pressure vessel.**

TEPCO on Nov. 30 also said it would conduct another study inside of the containment vessel of the No. 2 reactor at the plant in January. The containment vessel surrounds the pressure vessel.

A telescopic stick more than 10 meters long and equipped with a camera will be used for the survey.

December 4, 2017

**Can't stay more than 20 minutes on the roof**



Media representatives walk on top of the No. 3 reactor building at the Fukushima No. 1 nuclear power plant where a huge dome is being constructed over the storage pool for spent nuclear fuel. (Video footage by Shigetaka Kodama)

## Fukushima dome roof takes shape, but radiation remains high

By CHIKAKO KAWAHARA/ Staff Writer

High radiation levels are still limiting recovery work at the Fukushima No. 1 nuclear plant, a stark reality that reporters saw firsthand when they observed efforts to remove risk factors there.

Media representatives were invited into the plant in early December to see construction work, with the building of a domed roof over the No. 3 reactor building as the main focus.

However, they were only allowed to stay on top of the roof for 20 minutes due to high radiation levels.

The roof is being put together directly above the storage pool for spent fuel. The dome is designed to prevent the spewing of radioactive materials when the fuel is actually removed from the pool.

The original roof of the No. 3 reactor building was severely damaged by a hydrogen explosion in the days following the March 11, 2011, Great East Japan Earthquake and tsunami, which led to the crippling of the Fukushima No. 1 plant.

Spent fuel still remains in the storage pools located on the top floors of the No. 1 to No. 3 reactor buildings.

**Plans call for removing the spent fuel first from the No. 3 reactor building.**

Although the dome will help prevent the spread of radioactive materials, building parts and other debris as well as some equipment have still not been completely removed from the storage pool, which holds 566 fuel rods.

The collapsed roof and walls were removed to allow for the construction of the domed roof, which began in the summer. The domed roof is about 17 meters high, and a crane was also installed under it in November.

Plans call for the removal of the spent fuel from the No. 3 building to begin in the middle of the next fiscal year.

Internal radiation exposure levels were measured before media representatives headed to the No. 3 reactor building. They were also required to don protective clothing as well as a partial face mask covering the mouth and nose from about 100 meters from the building.



Radiation levels close to the building were 0.1 millisieverts per hour.

An elevator installed into the scaffolding next to the reactor building took the media representatives to the roof, which had been covered with metal plates.

The so-called operating floor looked like any other newly constructed building roof, a sharp contrast to the twisted metal parts that covered the building shortly after the nuclear accident.

Tokyo Electric Power Co., the plant's operator, captured video footage from within the reactors for the first time in July. Debris that appears to be melted nuclear fuel was found in various parts of the containment vessel.

To the south of the No. 3 reactor building stands the No. 4 reactor building, from where all the spent nuclear fuel has been removed.

To the north is the No. 2 reactor building, which avoided a hydrogen explosion. Beyond the building, cranes and other large equipment are working in preparation for the removal of debris from the No. 1 reactor building.

TEPCO officials cautioned media representatives about standing too long right next to the storage pool, which could be seen located about six meters below the roof. Debris was found within the pool while insulating material floated on the pool surface.

The radiation level near the pool was 0.68 millisieverts per hour. While that was a major improvement from the 800 millisieverts per hour recorded in the immediate aftermath of the nuclear accident close to seven years ago, it was still too high to allow for a stay of longer than 20 minutes.

December 22, 2017

### **Tool for Fukushima reactor vessel probe shown**

[https://www3.nhk.or.jp/nhkworld/en/news/20171222\\_30/](https://www3.nhk.or.jp/nhkworld/en/news/20171222_30/)

The operator of the Fukushima Daiichi nuclear power plant has given a media preview of equipment that will be used to investigate the inside of the containment vessel of one of the damaged reactors.

Tokyo Electric Power Company, or TEPCO, showed a tool called a "guide pipe" at a factory in Yokohama on Friday.

The pipe can be extended to 16 meters in length and has a camera and a dosimeter at its tip.

TEPCO plans to use it to get a better look inside the containment vessel of the No.2 reactor.

The operator believes fuel debris, made up of a mixture of molten fuel and broken interior parts, lies at the bottom of the vessel.

In January, workers confirmed the presence of a mass on the floor under the reactor.

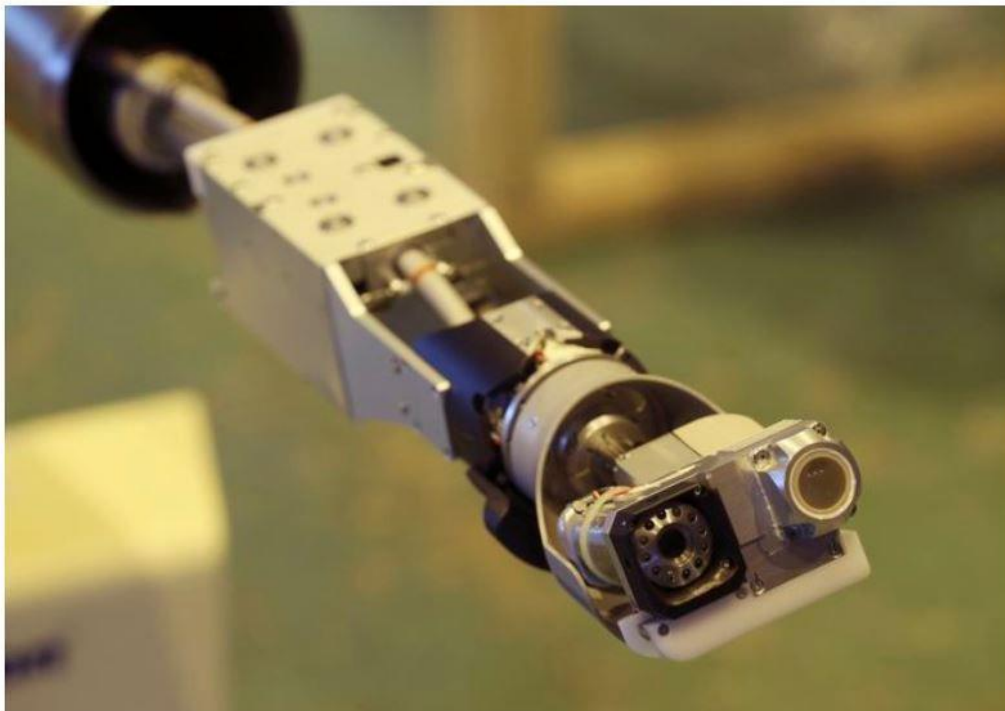
But they could not confirm if it was fuel debris because they could not measure the radiation levels there.

In January next year, workers hope to confirm that it is fuel debris by sending in a camera and a dosimeter using the guide pipe.

The government and TEPCO plan to determine which reactor they should remove debris from first and how to conduct the procedure during fiscal 2019, which begins in April.

December 23, 2017

## New device to probe Fukushima's insides



Toshiba Corp. unveiled a pan-tilt camera which it jointly developed with the International Research Institute for Nuclear Decommissioning (IRND), to inspect the interior of the damaged primary containment vessel of Fukushima No. 1 nuclear power plant's No. 2 reactor in Yokohama on Dec. 22. (AP Photo)

### **Toshiba unveils device for Fukushima nuclear reactor probe**

<http://www.asahi.com/ajw/articles/AJ201712230012.html>

THE ASSOCIATED PRESS

YOKOHAMA--Toshiba Corp.'s energy systems unit on Friday unveiled a long telescopic pipe carrying a pan-tilt camera designed to gather crucial information about the situation inside the reactor chambers at Japan's tsunami-wrecked Fukushima nuclear plant.

The device is 13 meters long and designed to give officials a deeper view into the nuclear plant's No. 2 reactor primary containment vessel, where details on melted fuel damage remain largely unknown. The Fukushima plant had triple meltdowns following the 2011 quake and tsunami. Finding details about the fuel debris is crucial to determining the right method and technology for its removal at each reactor, the most challenging process to safely carry out the plant's decades-long decommissioning. Japan's stricter, post-Fukushima safety standards also require nuclear plant operators elsewhere to invest more time and money into safety measures.

On Friday, Kansai Electric Power Co. announced that it would decommission two idle reactors at the Oi nuclear power plant in western Japan, citing the difficulty of adding all the safety requirements at the nearly 40-year-old reactors that would be needed to get approval for their restart.

Reports have said it would cost about 58 billion yen (\$500 million) and take 30 years to decommission a reactor, about half the estimated cost to restart one.

Also Friday, Japan Nuclear Fuel said that it was postponing the planned launch of its trouble-plagued spent fuel reprocessing plant by three more years until 2021. It cited delayed approval by the authorities. It also said it was postponing the planned manufacturing of fuel from recycled plutonium and uranium. The mission involving Toshiba's new probe at Fukushima's No. 2 reactor could come as soon as late January. Company officials said the new device will be sent inside the pedestal, a structure directly below the core, to investigate the area and hopefully to find melted debris.

The device looks like a giant fishing rod about 12 centimeters in diameter, from which a unit housing the camera, a dosimeter and thermometer slowly slides down. The probe, attached by a cable on the back, can descend all the way to the bottom of the reactor vessel if it can avoid obstacles, officials said.

Two teams of several engineers will be tasked with the mission, which they will remotely operate from a radiation-free command center at the plant.

A simpler predecessor to the pipe unveiled Friday had captured a limited view of the vessel during a preparatory investigation in February. A crawling robot sent in later in February struggled with debris on the ground and stalled in the end due to higher-than-expected radiation, its intended mission incomplete. The upgraded probe has been co-developed by Toshiba ESS and International Research Institute for Nuclear Decommissioning, a government-funded unit of construction and nuclear technology companies over the past nine months.

See also : <https://mainichi.jp/english/articles/20171223/p2g/00m/0bu/010000c>

January 16, 2018

## Resuming investigation of No.2

### **Tepco to resume attempt to probe damaged reactor at Fukushima No. 1 plant**

<https://www.japantimes.co.jp/news/2018/01/16/national/tepco-resume-attempt-probe-damaged-reactor-fukushima-no-1-plant/#.Wl3BZHkiGos>

Kyodo

The operator of the Fukushima No. 1 nuclear power plant has said it will resume late this week a survey of the crippled No. 2 reactor using a telescopic arm, hoping to obtain images of melted nuclear fuel.

January 19, 2018

## Fuel debris

### TEPCO finds 'fuel debris' in No. 2 reactor

[https://www3.nhk.or.jp/nhkworld/en/news/20180119\\_34/](https://www3.nhk.or.jp/nhkworld/en/news/20180119_34/)

The operator of the damaged Fukushima Daiichi nuclear power plant says it has found what looks like fuel debris in the plant's No. 2 reactor.

The nuclear accident occurred in March, 2011.

Tokyo Electric Power Company, or TEPCO, on Friday looked inside the containment vessel of the No. 2 reactor.

TEPCO confirmed, for the first time, the existence of chunks that are believed to be a mixture of melted nuclear fuel and parts of bindings.

The company plans to determine how to remove the debris based on the results of the investigation.

## Reactor No.2: Fuel assembly likely dropped through pressure vessel



Pebble-like nuclear fuel debris lies scattered at the bottom of the containment vessel in the No. 2 reactor of the Fukushima No. 1 nuclear power plant. An L-shaped handle, center, for a nuclear fuel assembly is also visible. (Provided by the International Research Institute for Nuclear Decommissioning)

For more details, see TEPCO's handouts on

[http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2018/images/handouts\\_180119\\_01-e.pdf](http://www.tepco.co.jp/en/nu/fukushima-np/handouts/2018/images/handouts_180119_01-e.pdf)

January 20, 2018

### **Melted nuclear fuel seen inside second Fukushima reactor**

<https://mainichi.jp/english/articles/20180120/p2g/00m/0dm/002000c>

A photo provided by the International Research Institute for Nuclear Decommissioning on Jan. 19, 2018 and taken by a robotic probe shows a part of what is believed to be the handle of a fuel rod container and melted fuel in small lumps scattered on a structure below the No. 2 reactor core at the Fukushima No. 1 nuclear plant. (International Research Institute for Nuclear Decommissioning via AP)

TOKYO (AP) -- The operator of Japan's crippled Fukushima nuclear plant said Friday that a long telescopic probe successfully captured images of what is most likely melted fuel inside one of its three damaged reactors, providing limited but crucial information for its cleanup.

Tokyo Electric Power Co. said the fishing rod-like device carrying a camera went deep into the plant's Unit 2 primary containment vessel. The images indicated that at least part of the fuel had breached the core, falling to the vessel's floor, TEPCO spokesman Takahiro Kimoto said.

"There is so much that we still haven't seen," Kimoto told reporters. "But we were able to obtain important information that we need in order to determine the right method for removing the melted fuel debris."

A massive earthquake and tsunami in 2011 caused three reactors at the Fukushima plant to melt. The plant's decommissioning is expected to take decades.

Melted fuel has previously only been documented inside Unit 3, where an underwater probe captured images of large amounts of melted fuel debris that looked like molten lava mixed with broken parts of equipment and structures on the concrete floor.

During Friday's investigation, the device -- developed by Toshiba Corp. and the International Research Institute for Decommissioning, a government-funded organization of nuclear companies -- found deposits in the shape of pebbles, clay and other forms, Kimoto said. Determining the location of the melted fuel is crucial in planning for its removal, the hardest process in the plant's decommissioning.

The government and TEPCO plan to determine the methods and start removing melted fuel from one of the three reactors in 2021. But experts say a lack of data is delaying the development of the precise type of technology and robots.

The images from Friday's probe show what is believed to be a stainless steel handle of a case containing bundles of fuel rods sitting on a pile of pebble-shaped and clayish substances, in a sign the rods melted and breached the bottom of the core. The deposits seemed to be scattered in a wide area around the pedestal, the main structure that sits underneath the core.

Experts say they believe part of the fuel still remains inside the core of the Unit 2 reactor, while almost all of the fuel rods in Unit 1 and 3 melted and fell to the bottom of the primary containment chambers.

See also : <https://www.japantimes.co.jp/news/2018/01/19/national/tepcu-spots-fukushima-fuel-debris-reactor-2-says-fuel-rod-assembly-fell-reactor/#.WmMFunkiGos>

## **Tepco spots Fukushima fuel debris in reactor 2, says fuel rod assembly 'fell out of reactor'**

by Kazuaki Nagata

Tokyo Electric on Friday said it had spotted what is almost certainly fuel debris in reactor 2 at the Fukushima No. 1 plant that **shows its fuel assembly likely dropped through the pressure vessel.[...]**

January 20, 2018

## **Melted nuclear fuel seen inside No. 2 reactor at Fukushima plant**

By CHIKAKO KAWAHARA/ Staff Writer

A remote-controlled camera captured what appears to be melted fuel inside a reactor of the stricken Fukushima No. 1 nuclear power plant, operator Tokyo Electric Power Co. said.

The released footage showed pebble-like nuclear fuel debris and part of a nuclear fuel assembly scattered at the bottom of a containment vessel, located just below the pressure vessel.

The footage was taken Jan. 19 inside the No. 2 reactor, which went into meltdown due to the 2011 earthquake and tsunami disaster.

"From the look of things, it must be nuclear fuel debris," said a TEPCO official.

The utility inserted an extendable rod with a span of 16 meters into the containment vessel from an opening in the side. It was positioned in an area just below the pressure vessel.

The remote-controlled camera was affixed to the tip of the rod and then lowered, along with a dosimeter to measure the amount of radiation inside.

The footage showed that a handle for a 4-meter-long nuclear fuel assembly, which had been originally located in the pressure vessel, had dropped to the bottom of the containment vessel.

The handle had been installed on the top of the nuclear fuel assembly. This led TEPCO to conclude that all of the nuclear fuel below the handle had melted.

An accumulation of pebble-like materials around the handle prompted the official to remark that the same phenomenon was observed after the Three Mile Island nuclear accident in Pennsylvania in 1979.

"(What we found this time) is apparently the same situation," the official said.

January 31, 2018

## **High Radiation at Fukushima Daiichi 7 Years on**

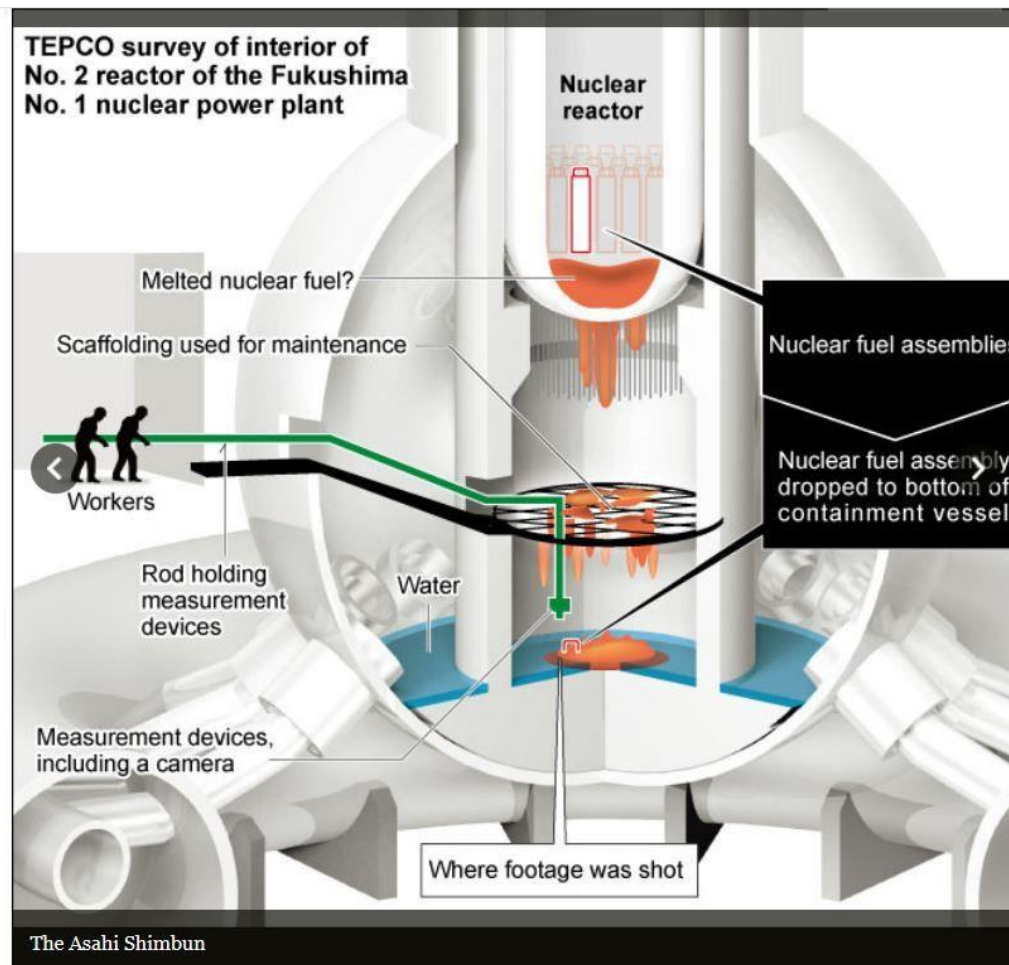
<https://www3.nhk.or.jp/nhkworld/nhknewsline/nuclearwatch/highradiationatfukushimadaiichi7years>  
n

New data from Japan's crippled nuclear plant underscore the challenges of decommissioning. Workers at the Fukushima Daiichi site found extremely high radiation in a reactor during a remote-controlled inspection.

Tokyo Electric Power Company recorded up to 8 sieverts per hour under the core of reactor 2. Experts say that level would kill a person in an hour.

Tokyo Electric staff want to remove fuel debris from all the reactors that melted down in 2011.

They hope to figure out a method during the fiscal year through March 2020.



February 1, 2018

## Radiation still major challenge

### Lethal radiation detected at Fukushima plant

[https://www3.nhk.or.jp/nhkworld/en/news/20180201\\_40/](https://www3.nhk.or.jp/nhkworld/en/news/20180201_40/)

The operator of the crippled Fukushima Daiichi nuclear power plant has released the results of its latest probe of the site.

A remote-controlled inspection of the Unit 2 reactor containment vessel last month detected a maximum of 8 sieverts per hour of radiation.

Experts say exposure to such radiation for about an hour would be fatal.



Officials from Tokyo Electric Power Company, or TEPCO, released the results on Thursday.

They said the radiation reading was taken near what appeared to be fuel debris, the term used to describe a mixture of molten fuel and broken interior parts.

The finding shows that nearly 7 years after the meltdowns, radiation levels remain so high that they present a major challenge to decommissioning work.

During the probe, 42 sieverts per hour of radiation was also detected outside the foundations of the reactor.

But officials said they have doubts about the accuracy of the reading because a cover had not been removed from the measuring instrument at the time.

They added that they don't know why radiation levels were lower near the suspected fuel debris than around the foundations.

They gave a number of possible reasons, such as that cooling water may have washed radioactive materials off the debris.

TEPCO's Chief Decommissioning Officer, Naohiro Masuda, says the company will develop debris-removal technology based on the outcome of the investigation.

February 2, 2018

**"This problem is not gone, this is not just a local problem"**

### **Fukushima nuclear disaster: Lethal levels of radiation detected in leak seven years after plant meltdown in Japan**

<http://www.independent.co.uk/news/world/asia/fukushima-nuclear-disaster-radiation-lethal-levels-leak-japan-tsunami-tokyo-electric-power-company-a8190981.html>

Expert warns of 'global' consequences unless the plant is treated properly

Lethal levels of radiation have been detected at Japan's Fukushima nuclear power plant, seven years after it was destroyed by an earthquake and tsunami.

The Tokyo Electric Power Company (Tepco), which operated the complex and is now responsible for its clean up, made the discovery in a reactor containment vessel last month.

The energy firm found eight sieverts per hour of radiation, while 42 units were also detected outside its foundations.

A sievert is defined as the probability of cancer induction and genetic damage from exposure to a dose of radiation, by the International Commission on Radiological Protection (ICRP). One sievert is thought to carry with it a 5.5 per cent chance of eventually developing cancer.

Experts told Japanese state broadcaster NHK World that exposure to that volume of radiation for just an hour could kill, while another warned the leaks could lead to a “global” catastrophe if not tackled properly.

It came as Tepco said the problem of contaminated water pooled around the plants three reactors that is seeping into the ground has caused a major headache in its efforts to decommission the plant.

Thousands of workers have been hired by the company to as it attempts to secure the plant, which was the scene of the most serious nuclear accident since Chernobyl in 1986.

Three of its reactors went into a meltdown after the earthquake and tsunami which killed at least 15,000 people.

Tepco has admitted that it could be until 2020 until the contamination issue is resolved. Only then can it move onto the second stage of removing nuclear debris at the site, including the damaged reactors.

Richard Black, director of the Energy and Climate Intelligence Unit, said the high levels of radiation found in and around the reactor last month were “expected” and unlikely to pose a danger.

He told *The Independent*: “Although the radiation levels identified are high, a threat to human health is very unlikely because apart from workers at the site, no-one goes there.

“The high readings from fuel debris would be expected – the higher reading from the foundations, if confirmed, would be more of a concern as the cause is at present unclear. But as officials indicate, it might not be a genuine reading anyway.

“What this does demonstrate is that, seven years after the disaster, cleaning up the Fukushima site remains a massive challenge – and one that we’re going to be reading about for decades, never mind years.”

But Mycle Schneider, an independent energy consultant and lead author of the World Nuclear Industry Status Report, said that Tepco “hasn’t a clue what it is doing” in its job to decommission the plant.

He added that the contaminated water that is leaking at the site could end up in the ocean if the ongoing treatment project fails and cause a “global” disaster, he told *The Independent*. “Finding high readings in the reactor is normal, it’s where the molten fuel is, it would be bizarre if it wasn’t,” he said.

“I find it symptomatic of the past seven years, in that they don’t know what they’re doing, Tepco, these energy companies haven’t a clue what they’re doing, so to me it’s been going wrong from the beginning. It’s a disaster of unseen proportions.”

Mr Schneider added that the radiation leaks coupled with the waste from the plant stored in an “inappropriate” way in tanks could have global consequences.

“This is an area of the planet that gets hit by tornadoes and all kinds of heavy weather patterns, which is a problem. When you have waste stored above ground in inappropriate ways, it can get washed out and you can get contamination all over the place.

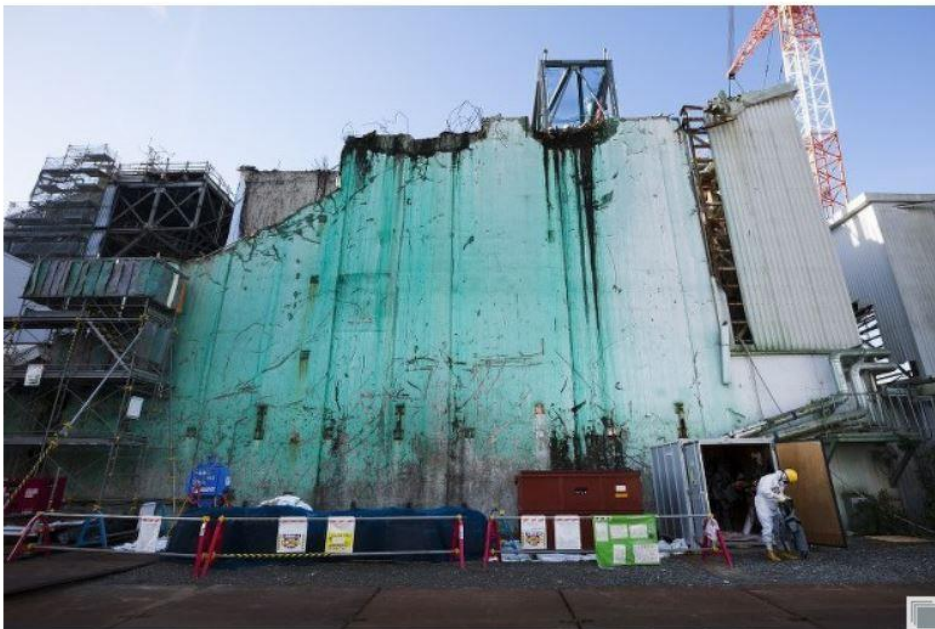
“This can get problematic anytime, if it contaminates the ocean there is no local contamination, the ocean is global, so anything that goes into the ocean goes to everyone.”

He added: “It needs to be clear that this problem is not gone, this is not just a local problem. It’s a very major thing.”

*The Independent* contacted Tepco for comment, but the energy giant had not responded at the time of publication.

February 15, 2018

## Joe Nishizawa publishes photos taken inside Fukushima plant



The building housing reactor No. 3 of the Fukushima No. 1 Nuclear Power Plant still shows stark signs of the disaster in September 2016. (Photo by Joe Nishizawa, courtesy of Tokyo Electric Power Co.)

## Photo collection shot inside Fukushima nuke plant to be released in March

Photographer Joe Nishizawa will offer a rare look inside the Fukushima nuclear plant damaged in the March 2011 earthquake and tsunami disaster with the release this March of a photo book recording of decommissioning work over a 3 1/2-year period.

- **【In Photos】** Photo book offers rare view inside Fukushima nuke plant
- **【Related】** TEPCO unveils footage of deposits inside Fukushima reactor
- **【Related】** Once severely damaged Fukushima reactor building opened to media to showcase progress
- **【Related】** 'For a nostalgic future': Spaniard snaps Tohoku's past, post-3.11 present in 360 degrees

Published by Misuzu Shobo, "Decommissioning Fukushima: A Photographer's Journey into the Depths of the Fukushima Daiichi Nuclear Power Plant" will present roughly 150 photos of workers in protective gear and restorative efforts, arranged to show the passage of time. "I want to convey the scene exactly as it is," the Takasaki, Gunma Prefecture-based photographer explains.

For the last 15 years, Nishizawa has taken photos of steel work factories, expressways and other construction scenes to cover Japan at various work sites. After the nuclear disaster occurred on March 11, 2011, plant operator Tokyo Electric Power Co. (TEPCO) released photos but they were blurred and difficult to make out. Nishizawa said he felt the need to document the state of the reactor for future generations. After negotiating with TEPCO, the photographer was granted access to the plant roughly once a month.

Wearing a mask and a protective suit covering his entire body, he first stepped foot on the grounds of the nuclear plant in July 2014. At the time, there was still debris on the premises scattered along the coastline and the destruction from the accident was still starkly evident. Once, a worker at whom he pointed his camera glared back and asked, "Just what are you photographing?"

Still, he continued to document the equipment used to purify water contaminated by radioactive materials, as well as the construction site filled with tanks of processed water. Along with the flow of time, Nishizawa also sensed the gradual progress of decommissioning efforts. Still, radiation levels around the reactor buildings are high, and the difficult labor conditions continue to this day.

"The decommissioning won't end with this generation," says Nishizawa. "We can't afford to let the accident fade into the past, so I will continue taking photographs."

March 2, 2018

## How useful is the icewall?

### **TEPCO defends Fukushima 'ice wall,' but it is still too porous**

<http://www.asahi.com/ajw/articles/AJ201803020042.html>



Rows of tanks holding contaminated groundwater are seen at the Fukushima No. 1 nuclear power plant in February. (Naoko Kawamura)

The “frozen soil wall” erected around the crippled reactor buildings at the Fukushima No. 1 nuclear power plant at huge taxpayer expense appears limited in keeping groundwater from flowing in.

Tokyo Electric Power Co., which operates the plant, said March 1 that 95 tons of radioactive water has been reduced a day on average between December and early February because of the underground barrier.

“Contaminated groundwater was cut in half due to the wall,” a TEPCO official said.

TEPCO estimated that the volume of polluted groundwater would have amounted to about 189 tons if the ice wall had not been in place during that period.

The utility also said the amount of polluted groundwater was reduced by about 400 tons a day now due to combined measures, such as the wall and wells pumping up water, compared with before such measures were taken.

But Toyoshi Fuketa, chairman of the Nuclear Regulation Authority, has insisted that the wells, not the wall, are the “key” to controlling the groundwater, voicing skepticism about the role of the ice wall.

The utility is proceeding with work to reinforce the wells.

The 34.5 billion yen (\$322 million) frozen soil wall project began in 2014 to lay out the 1,500-meter-long underground wall around the No. 1-4 reactor buildings.

A large number of pipes were inserted to a depth of 30 meters to circulate liquid with a temperature of minus 30 degrees through them to freeze the surrounding soil.

It was designed to prevent groundwater from flowing into the plant and mixing with highly radioactive water in the basements of the buildings.

TEPCO’s recent assessment of the effectiveness of the frozen soil wall came after temperatures around the structure dropped to below zero following work that began last August to freeze the remaining final section of the wall.

But **experts pointed out that the utility’s assessment is based on figures only when there was little rain.**

The water volume rose to 1,000 tons or so a day in late October when two typhoons struck the area. TEPCO believes that the surge at that time is largely attributable to the downpours from the typhoons. Heavy rain accumulated in the basement after flowing down holes in the ceilings caused by hydrogen explosions during the 2011 triple meltdown.

**It costs more than 1 billion yen a year in electricity fees to keep the wall frozen.**

**The company plans to remove all the groundwater from the buildings by 2020 so that it can begin work to decontaminate the facilities later.**

(This article was written by Masanobu Higashiyama and Yusuke Ogawa.)

## **TEPCO estimates 'ice wall' reduces contaminated water by 95 metric tons per day**

<https://mainichi.jp/english/articles/20180302/p2a/00m/0na/009000c>

An underground wall of frozen soil surrounding the stricken Fukushima No. 1 Nuclear Power Plant that blocks groundwater from flowing into the plant has cut back on the amount of radiation-tainted water that is generated by an estimated 95 metric tons a day, plant operator Tokyo Electric Power Co. (TEPCO) announced March 1.

- **【Related】** High-priced Fukushima ice wall nears completion, but effectiveness doubtful
- **【Related】** Ice wall at Fukushima nuclear plant revealed for first time
- **【Related】** NRA casts doubt on TEPCO ice wall project at Fukushima nuke plant

**This marks the first time a provisional calculation has been made on the efficacy of the "ice wall" on its own.**

The 1.5-kilometer wall comprises approximately 1,500 pipes that have been buried 30 meters underground surrounding the nuclear plant's No. 1 to 4 reactors, through which a liquid with a temperature of minus 30 degrees Celsius is circulated to create a wall of frozen soil.

TEPCO used computers to estimate the flow of groundwater, concluding that having the ice wall reduces the amount of contaminated water that is generated by **95 metric tons, or half of what would be produced if the wall did not exist.**

At the same time, according to the utility, by the winter of 2017, when the construction of the ice wall was almost fully completed, the amount of contaminated water that was generated had dropped by approximately 380 metric tons per day compared to the winter of 2015, when the freezing process of the wall had not yet begun.

**The effects of the ice wall at the Fukushima plant are believed to be limited compared to the process of pumping groundwater upstream and releasing it into the Pacific Ocean, and introducing a subdrain system in which water is drawn from wells around the reactor buildings.** Not only did it cost 34.5 billion yen from public coffers to build the structure, maintaining the ice wall will cost 1 billion-plus yen per year. The Nuclear Regulation Authority had been doubtful about the cost efficiency of the project from the outset.

"It has become clear that the ice wall, on its own, has the effect of reducing contaminated water," a TEPCO representative said. A government panel of experts will deliberate the validity of the power company's estimate.

When the construction of an ice wall was given the green light in May 2013, the Japanese government was fighting to win the bid for the 2020 Summer Olympics, and presented the wall as a trump card in controlling the ever-increasing volumes of radiation-tainted water. It was a way for the Japanese government to show the rest of the world that it was leading efforts to suppress further generation of contaminated water, and gave the government an excuse to pump public funds into the cleanup of a disaster caused by a private company.

March 7, 2018

### **Experts discuss Fukushima frozen soil wall**

[https://www3.nhk.or.jp/nhkworld/en/news/20180307\\_30/](https://www3.nhk.or.jp/nhkworld/en/news/20180307_30/)

A panel of government-appointed experts says more measures are needed to contain the increase of contaminated water at the Fukushima Daiichi nuclear power plant even after a frozen soil wall was built there. The panel says it's also essential to block the flow of rainwater into reactor buildings.

The panel met on Wednesday to discuss a recent estimate by plant operator Tokyo Electric Power Company, or TEPCO, of the effectiveness of the wall around 4 damaged reactor buildings at the plant.

The 1.5-kilometer-long impermeable wall was nearly completed in November. Its purpose was to block groundwater from flowing into the buildings. 500 tons of groundwater had been contaminated daily by radioactive substances in the buildings.

TEPCO now estimates that the amount of newly contaminated water was reduced by about 95 tons per day.

The panel members agreed that the wall is effective to an extent. They said water contamination was reduced as a result of combined effects from the wall and pumping up of water from wells around the damaged reactor buildings.

The members also suggested that paving ground around the buildings is needed to keep rainwater from entering them.

The government spent 34.5 billion yen, or more than 300 million dollars, to help build the wall. Its annual operating cost is 10 million dollars.

### **Fukushima plant ice wall only partly reduces radioactive water**

THE ASSOCIATED PRESS

<http://www.asahi.com/ajw/articles/AJ201803070059.html>

A government-commissioned group of experts has concluded that a costly underground ice wall is only partially effective in reducing the ever-growing amount of contaminated water at Japan's destroyed Fukushima nuclear plant, and other measures are needed as well.

The plant's operator says the ice wall has helped reduce the radioactive water by half. The plant also pumps out several times as much groundwater before it reaches the tsunami-damaged reactors.

The panel agreed Wednesday that the 35 billion yen (\$320 million) ice wall helps, but doesn't completely solve the problem.

The 1.5-kilometer coolant-filled underground structure was installed around the wrecked reactor buildings to create a frozen soil barrier to keep groundwater from flowing into the heavily radioactive area.

The groundwater mixes with radioactive water leaking from the damaged reactors.

## **NRA: 2011 accident not over**

### **Nuclear regulator: Fukushima accident not over**

[https://www3.nhk.or.jp/nhkworld/en/news/20180307\\_37/](https://www3.nhk.or.jp/nhkworld/en/news/20180307_37/)

Nearly 7 years after the triple meltdown at Fukushima Daiichi nuclear power plant, Japan's chief nuclear regulator says the 2011 accident is not over.

Toyoshi Fuketa, Nuclear Regulation Authority Chairman, held a news conference on Wednesday, 4 days before the 7th anniversary of the severe accident.

He suggested the perceived magnitude of damage from the accident can change based on many factors that will influence future judgment. He cited decontamination and radioactive waste disposal efforts, areas where evacuation orders can be lifted, and the reconstruction of affected areas.

Fuketa also said that attitudes towards regulation have changed since the accident but he suggested that people should not forget what happened 7 years ago.

He predicted there would be almost no risk of any new problems affecting areas outside the compounds of the nuclear plant in the decommissioning process.

The biggest challenge of the decommissioning is said to be the removal of fuel debris, a mixture of molten nuclear fuel and broken interior parts, from the 3 reactors.

He said the removal work has not yet reached a point where "exit is in sight."



March 8, 2018

## Icwall clearly insufficient to reduce amount of contaminated water

### Experts: Fukushima must do more to reduce radioactive water

<https://mainichi.jp/english/articles/20180308/p2g/00m/0dm/002000c>

TOKYO (AP) -- A government-commissioned group of experts concluded Wednesday that a costly underground ice wall is only partially effective in reducing the ever-growing amount of contaminated water at Japan's destroyed Fukushima nuclear plant, and said other measures are needed as well. The plant's operator, Tokyo Electric Power Co., says the ice wall has helped reduce the radioactive water by half. The plant also pumps out several times as much groundwater before it reaches the reactors via a conventional drainage system using dozens of wells dug around the area.

The groundwater mixes with radioactive water leaking from the damaged reactors. Contaminated water also results from rainwater that comes in contact with tainted soil and structures at the plant, which suffered meltdowns of three reactors after a March 2011 earthquake and tsunami.

The panel agreed that the ice wall helps, but said it doesn't completely solve the problem. Panel members suggested that additional measures be taken to minimize the inflow of rainwater and groundwater, such as repairing roofs and other damaged parts of buildings. Results from the recent dry season were positive, but they noted that heavy rainfalls caused spikes in the amount of contaminated water.

"We recognize that the ice wall has had an effect, but more work is needed to mitigate rainfall ahead of the typhoon season," said panel chairman Yuzo Onishi, a Kansai University civil engineering professor.

The 1.5-kilometer (1-mile) coolant-filled underground structure was installed around the wrecked reactor buildings to create a frozen soil barrier and keep groundwater from flowing into the heavily radioactive area. The ice wall has been activated in phases since 2016. Frozen barriers around the reactor buildings are now deemed complete.

On Wednesday, TEPCO said the amount of contaminated water that collects inside the reactor buildings was reduced to 95 tons per day with the ice wall, compared to nearly 200 tons without one. That is part of the 500 tons of contaminated water created every day at the plant, with the other 300 tons pumped out via wells, treated and stored in tanks.

In addition to the 35 billion yen (\$320 million) construction cost funded by taxpayers' money, the ice wall needs more than 1 billion yen (\$9.5 million) annually in operating and maintenance costs. Critics have been skeptical about the ice wall and suggested greater use of wells -- a standard groundwater drainage method -- as a cheaper and more proven option.

The head of TEPCO's decommissioning company, Naohiro Masuda, said the ice wall deserves more recognition because it has stabilized groundwater movement and helped eliminate emergencies, while reducing the total amount of water pumped up, which also saves costs for water treatment and storage tanks.

"We can work more stably thanks to the ice wall. Intuitively, it is very effective," Masuda said at the meeting, adding that the wall contributed more than its cost.

The plant has been struggling with the ever-growing amounts of water -- only slightly contaminated after treatment -- now totaling 1 million tons and stored in 1,000 tanks, taking up significant space at the

complex, where a decades-long decommissioning effort continues. Officials aim to minimize the contaminated water in the reactor before starting to remove melted fuel in 2021.

March 9, 2018

## Icewall clearly insufficient to reduce amount of contaminated water (2)

### TEPCO's 'ice wall' fails to freeze Fukushima's toxic water buildup

<http://www.asahi.com/ajw/articles/AJ201803090036.html>

OKUMA, Fukushima Prefecture--A costly "ice wall" is failing to keep groundwater from seeping into the stricken Fukushima No. 1 nuclear power plant, data from operator Tokyo Electric Power Co. shows, preventing it from removing radioactive melted fuel at the site seven years after the disaster.

When the ice wall was announced in 2013, TEPCO assured skeptics that it would limit the flow of groundwater into the plant's basements, where it mixes with highly radioactive debris from the site's reactors, to "nearly nothing."

However, since the ice wall became fully operational at the end of August, an average of 141 metric tons a day of water has seeped into the reactor and turbine areas, more than the average of 132 metric tons a day during the prior nine months, a Reuters analysis of the TEPCO data showed.

The groundwater seepage has delayed TEPCO's clean-up at the site and may undermine the entire decommissioning process for the plant, which was battered by a tsunami seven years ago this Sunday. Waves knocked out power and triggered meltdowns at three of the site's six reactors that spewed radiation, forcing 160,000 residents to flee, many of whom have not returned to this once-fertile coast. Though called an ice wall, what TEPCO has attempted to create is something more like a frozen soil barrier.

Using 34.5 billion yen (\$324 million) in public funds, TEPCO sank about 1,500 tubes filled with brine to a depth of 30 meters in a 1.5-kilometer perimeter around four of the plant's reactors. It then cools the brine to minus 30 degrees.

The aim is to freeze the soil into a solid mass that blocks groundwater flowing from the hills west of the plant to the coast.

However, the continuing seepage has created vast amounts of toxic water that TEPCO must pump out, decontaminate and store in tanks at Fukushima that now number 1,000, holding 1 million tons. It says it will run out of space by early 2021.

"I believe the ice wall was 'oversold' in that it would solve all the release and storage concerns," said Dale Klein, the former chairman of the U.S. Nuclear Regulatory Commission and the head of an external committee advising TEPCO on safety issues.

"The hydrology of the Fukushima site is very complicated and thus the exact water flow is hard to predict," he said, "especially during heavy rains."

## TYPHOON

The water inflows often fluctuate with rainfall. The dry month of January averaged 83 tons a day, TEPCO data showed.

But when a typhoon struck during the last week of October, 866 tons a day poured into the reactors. Overall, TEPCO says a combination of drains, pumps and the ice wall has cut water flows by three-quarters, from 490 tons a day during the December 2015 to February 2016 period to an average of 110 tons a day for December 2017 to February 2018.

It is hard to measure exactly how much the ice wall is contributing, TEPCO officials say, but based on computer analysis, the utility estimates the barrier is reducing water flows by about 95 tons a day compared to two years ago, before the barrier was operating.

"Our assessment is that the ice wall has been effective," said Naohiro Masuda, TEPCO's chief decommissioning officer, adding that rain falling within the ice wall perimeter contributed to surging volumes. "We now believe we have a system in place to manage the water level."

However, a government-commissioned panel on Wednesday offered a mixed assessment of the ice wall, saying it was partially effective but more steps were needed.

Controlling the groundwater seepage using the ice wall has been central to Japan's program to show it had the Fukushima decommissioning in hand.

The barrier was announced just days before Tokyo won the bid to host the 2020 Summer Olympics and Prime Minister Shinzo Abe declared that Fukushima was "under control" in his final pitch to the International Olympic Committee.

In addition to the building costs, the ice wall needs an estimated 44 million kilowatt hours of electricity a year to run, enough to power about 15,000 typical Japanese homes.

## **NO MORE SPACE**

Meanwhile, TEPCO must decide how to cope with the growing volume of water stored on site.

The purification process removes 62 radioactive elements from the contaminated water but it leaves tritium, a mildly radioactive element that is difficult to separate from water. Not considered harmful in low doses, tritium is released into oceans and rivers by nuclear plants around the world at various national standard levels.

But local residents, particularly fishermen, oppose ocean releases because they fear it will keep consumers from buying Fukushima products. Many countries, including South Korea and China, still have restrictions on produce from Fukushima and neighboring areas.

A government-commissioned task force is examining five options for disposing of the tritium-laced water, including ocean releases, though no decision has been made.

Ken Buesseler, a radiochemist at the Woods Hole Oceanographic Institution in the United States, suggests that TEPCO should open the tanks to external inspections to see if the water is safe.

"From the public's viewpoint, I think they'd want a bit of independent confirmation," Buesseler said. "It's no harder and a lot cheaper than building an ice wall."

March 15, 2018

## Fukushima update



### Fukushima Daiichi Nuclear Power Plant 7 Years After the Disaster

Seven years of data have been collected on the Fukushima Daiichi nuclear power plant, in which 3 of its reactors suffered one of the worst meltdowns in history.

Tokyo Electric Power Company, or TEPCO, has published information on the amount of radioactive material released after the accident, based on data and simulations taken from around the Fukushima Daiichi nuclear power plant.

A total of 900 quadrillion becquerels of iodine-131 and cesium-137 were leaked into the environment between March 12 and March 31, 2011. This is around 17 percent of what was released after the Chernobyl nuclear disaster. The level fell to more than one-1000th in April. While radiation levels around the plant continue to decrease, they still remain 7 years after the disaster.

The data released by TEPCO shows that the average amount of radiation released by the number 1 through 4 reactors every March amounted to 3.4 million becquerels per hour in 2012, 2.5 million becquerels per hour in 2013, 1.3 million becquerels per hour in 2014, and 1.2 million becquerels per hour in 2015. Following a review of the assessment methods, the figures stood at 270,000 becquerels per hour in 2016, 25,000 becquerels per hour in 2017, and 130,000 becquerels per hour in January 2018. While the number has increased this year compared to 2017, TEPCO says it is within the range of variation and maintains that the total level is continuing to drop.

The radiation level measured near the main entrance of the facility, located about 1 kilometer from the reactor building, was 1 microsievert per hour this month. The figure has hardly changed from a year ago. Still, it's less than one-200th of the amount detected in the same location shortly after the accident, when levels reached a maximum of 236 microsieverts per hour.

Protective gear is no longer required in 95 percent of the plant's site.

The average number of TEPCO employees and subcontractors involved in decommissioning work stood at around 5,000 per day as of January 2018. That number has fluctuated between 5,000 and 5,500 since April 2017.

## **Decommissioning is Underway**

The latest roadmap established by the government and TEPCO in September 2017 says it could take 40 years at most to complete the decommissioning.

Removing spent fuel rods from the storage pools of the reactor buildings, as well as removing nuclear fuel debris, are the keys to carrying out the project.

Of the plant's 6 reactors, numbers 1 to 3 suffered meltdowns. Hydrogen explosions occurred in the buildings of number 1, 3, and 4.

The removal of nuclear fuel from the pool of the number 4 reactor was completed in 2014. The reactor avoided a meltdown as it was not operating and all its nuclear fuel had been moved to the pool at the time of the accident.

Decontamination and the removal of nuclear fuel debris are under way in the number 1 to 3 reactor buildings. They were severely contaminated by the meltdowns.

The fastest progress is reported in the number 3 reactor, with a dome-shaped cover and a construction crane, both necessary to remove nuclear fuel debris, having been installed in February.

TEPCO plans to begin removing fuel rods from the pool of the number 3 reactor around this fall after workers have gotten trained in remote-control and other operations. They also plan to do the same in the number 1 and 2 reactors in fiscal 2023.

Removing the nuclear fuel debris is expected to be the most difficult part of the decommissioning process. Chunks appearing to be fuel debris have been found inside the number 2 and 3 reactors in robot probes. Pebble-like sediments appearing to be fuel debris were found on the bottom of the containment vessel of the number 2 reactor in January. A part of fuel assembly packaging was also found. Extremely high radiation of up to 8 sieverts an hour -- beyond a level permissible to human exposure -- was observed under the reactor core.

A robot was also deployed to check the number 3 reactor in July 2017. It showed dark rocky sediments on the bottom of the containment vessel that were not there before the accident. TEPCO said they are likely to be nuclear fuel debris.

No fuel debris was identified in a probe of the number 1 reactor in March 2017.

Dealing with the impact of extremely high radiation and the spread of radioactive substances will be a big challenge in fuel debris removal. One way that has been studied is filling the containment vessels with water. But the government and TEPCO say they will focus on a method known as "dry removal" -- extraction without filling the vessels with water.

The government and TEPCO plan to discuss details of fuel removal and decide by fiscal 2019 which reactor to start the process with, and begin actual removal in 2021.

The Industry Ministry says there have been delays in steps including fuel removal from the pools, but that hasn't led to any significant delays in the overall process. It says it will continue to carry out decommissioning safely and steadily without worrying too much about progress.

## **Tackling the issue of contaminated water**

Water is being poured into the reactors 1 to 3 to help cool the molten nuclear fuel. It's becoming tainted with highly radioactive substances and is accumulating in the basement of the reactors.

With groundwater from the hillside of the plant also flowing into the buildings, tons of radioactive water has been building up.

TEPCO has been pumping up groundwater on the hillside of the plant before it reaches the reactors, and releasing it into the ocean. It calls the method a "groundwater bypass."

The utility has also introduced a "sub-drain" system, pumping up water using wells dug near the reactor buildings.

It is also keeping groundwater from reaching the site by freezing the soil around the buildings to surround them with a 1,500-meter-long wall of ice. TEPCO announced in November 2017 that the ice wall was nearly finished.

The utility announced in March that such measures have resulted in a decrease of 380 tons of contaminated water a day. It based the calculation on 3 months of data. It adds that the frozen wall alone helped to slash the amount by 95 tons a day.

A panel of government-appointed experts said the wall was effective to an extent, while more measures are needed to contain the increase of contaminated water, especially during heavy rains. The panel suggested that paving the ground around the buildings is needed to keep rainwater from entering them. While systems have been installed to remove radioactive substances from the wastewater, they have not been able to remove radioactive tritium.

About one million tons of contaminated water is still being kept in nearly 850 tanks within the facility's premises. More than 75 percent of these tanks have tritium-tainted water.

Water containing radioactive tritium can be released into the sea after the concentration of the substance is reduced to below the government limit.

A chairman of the Nuclear Regulation Authority said releasing radioactive water would not affect the environment and ecological systems, and that it is up to TEPCO to decide on how to proceed.

But local fisheries are concerned that discharging radioactive water into the sea could spark harmful rumors and affect their businesses. TEPCO remains undecided over how to deal with the contaminated water.

### **74% drop in radiation levels within 80km of Fukushima Daiichi plant**

The Nuclear Regulation Authority, or NRA, uses helicopters to gauge per-hour radiation levels one meter from the ground in areas within 80 kilometers of the plant. It creates maps that show differences in radiation levels using 9 colors.

A map created using a similar method 7 months after the nuclear accident shows yellow and red areas stretching more than 30 kilometers northwest of the plant. The colors mean more than 3.8 microsieverts per hour of radiation were observed there. That comes out to an over 20 millisieverts annually, which is the threshold for issuing evacuation orders.

The latest survey held last September shows areas with over 3.8 microsieverts per hour had shrunk outside the 30-kilometer radius of the plant. The level was still recorded in parts of Iitate Village and Namie Town.

The NRA says the comparison of the 2 sets of data shows radiation levels fell about 74 percent on average within areas 80 kilometers of the plant.

It explains that 63 percent accounts for radioactive substances turned into non-radioactive material. It adds that the remaining 11 percent was due to other factors.

Since 2016, the NRA has been gauging radiation levels in 5 municipalities using vehicles on the request of Okuma Town, Futaba Town and other municipalities that have areas subjected to evacuation orders.

It has been releasing the results of the survey in the form of maps with greater details than those created in aerial surveys. It hopes the data will be used in discussions on whether to allow evacuees to return home.

### **Prospects for nuclear reactors in Japan**

Japan has 40 reactors at 16 plants, excluding the reactors set to be decommissioned.

Operations of 6 nuclear reactors at 4 plants were resumed under new regulations adopted after the 2011 nuclear accident at the Fukushima Daiichi power plant. Three more reactors at 2 plants are likely to be restarted between March and May.

The Nuclear Regulation Authority holds safety screenings under the new regulations, a precondition to restart reactors. It has so far received screening applications for 26 reactors. They include reactors at the Oma plant, which is under construction in Aomori Prefecture.

Twelve pressurized water reactors at 6 plants passed the screening. Of them, operations were resumed at the number 1 and 2 reactors at the Sendai plant in Kagoshima Prefecture, the number 3 reactor at the Ikata plant in Ehime Prefecture, and the number 3 and 4 reactors at the Takahama plant in Fukui Prefecture.

The operation of Ikata's number 3 reactor has been suspended due to an injunction ordered by the Hiroshima High Court last December. Operation of Sendai's number 1 reactor has also been suspended for regular inspections. This means 3 reactors at 2 plants are currently online in the country.

The number 3 reactors at the Ohi plant in Fukui Prefecture and the Genkai plant in Saga Prefecture are expected to be put back online this month. The number 4 reactors at both plants are also likely to be restarted in May.

The NRA received screening applications for 10 boiling water reactors at 8 plants. They're the same type as the crippled Fukushima Daiichi reactors.

The number 6 and 7 reactors at the Kashiwazaki-Kariwa plant in Niigata Prefecture cleared the screening last December, becoming the first boiling water reactors to do so under the new regulations.

The screening for the sole reactor at the Tokai Number 2 plant in Ibaraki Prefecture is in the final stages. Whether the life span of the reactor will be extended will be another focus as the facility will reach its operational limit of 40 years in November.

Meanwhile, 8 reactors at 6 plants, excluding the Fukushima Daiichi, will be decommissioned largely due to huge costs of safety measures.

Kansai Electric Power Company, the operator of the Ohi plant, decided last December that it will scrap the plant's number 1 and 2 reactors. The utility cites massive costs of measures to prevent serious incidents.

The generation capacity of the reactors is relatively large at more than one million kilowatts each. Estimates show that if the reactors were put back online, they would improve the firm's financial conditions by 9 billion yen, or about 84 million dollars, per month.

March 29, 2018

## **Radioactive water still flowing into Pacific**

### **Seven years on, radioactive water at Fukushima plant still flowing into ocean, study finds**

<https://www.japantimes.co.jp/news/2018/03/29/national/seven-years-radioactive-water-fukushima-plant-still-flowing-ocean-study-finds/#.WrzdR38uCos>

Kyodo

More than seven years after the March 2011 Fukushima nuclear crisis, radioactive water is continuing to flow into the Pacific Ocean from the crippled No. 1 plant at a rate of around 2 billion becquerels a day, a study has found.

The amount of leaking cesium 137 has decreased from some 30 billion becquerels in 2013, Michio Aoyama, a professor at the Institute of Environmental Radioactivity at Fukushima University, said in his study, which was presented Wednesday at an academic conference in Osaka.

The study said the concentration of radiation — 0.02 becquerel per liter of seawater found in samples collected near a coastal town 8 km south of the No. 1 plant — is at a level that does not affect the local fishing industry.

The radioactive water is generated in a process to cool melted nuclear fuel at three damaged reactors at the complex. The reactors experienced core meltdowns after the March 2011 earthquake and tsunami. “It can be assumed that there is a path from the complex to the ocean” through which contaminated water flows, Aoyama said.

The water accumulates in the basements of the buildings at the site after being used to cool the melted fuel.

Tokyo Electric Power Company Holdings Inc., the operator of the Fukushima complex, has been trying to prevent contaminated water from increasing within the facilities by building an underground ice wall in an effort to block ground water. It has also built a seawall aimed at preventing contaminated water from entering the ocean.

April 18, 2018

## Self-driving bus for Fukushima Daiichi

### Driverless bus runs in Fukushima Daiichi plant

[https://www3.nhk.or.jp/nhkworld/en/news/20180418\\_30/](https://www3.nhk.or.jp/nhkworld/en/news/20180418_30/)

Japan's first self-driving bus service has begun at the crippled Fukushima Daiichi nuclear power plant as decommissioning work continues at the facility.

The French-made electric bus was shown to reporters on Wednesday.

Passengers will be able to choose their routes from pre-registered courses listed on an onboard device. The bus uses GPS to navigate.

The vehicle can carry up to 15 passengers and has a maximum speed of 18 kilometers an hour. It has sensors to stop the bus if it gets too close to people or other vehicles. The bus is also programmed to stop in front of pedestrian crossings.

Officials of the plant's operator, Tokyo Electric Power Company, say they are first running the vehicle on a



1-kilometer route between the plant's gate and its rest facility, then adding routes in stages.

They also say that for now, a staff member is riding the vehicle to enter destinations into the routing device.

Plant official Tetsunori Kobayashi says the service is part of efforts to carry out the decommissioning work safely and smoothly with the help of new technology.

April 27, 2018

## **New video of fuel debris (No.2)**

### **Fresh analysis of Fukushima Daiichi 'fuel debris'**

[https://www3.nhk.or.jp/nhkworld/en/news/20180427\\_02/](https://www3.nhk.or.jp/nhkworld/en/news/20180427_02/)

A fresh video analysis by the operator of the Fukushima Daiichi nuclear power plant shows that molten fuel at the No.2 reactor may have fallen along several paths. The unit is one of the 3 reactors that experienced a meltdown in 2011.

Tokyo Electric Power Company processed images that were taken inside the reactor's containment vessel in January. The firm pieced them together so that the resulting footage can better show conditions within the entire vessel.

The footage shows all of the vessel's bottom covered with what looks like pebbles and clay. A roughly 70-centimeter-high pile of such materials is located near where part of the fuel casing was spotted in the January probe.

Another heap is close to a pillar-like structure at the bottom.

The utility says the materials may be fuel debris, which is a mixture of molten nuclear fuel and structural parts.

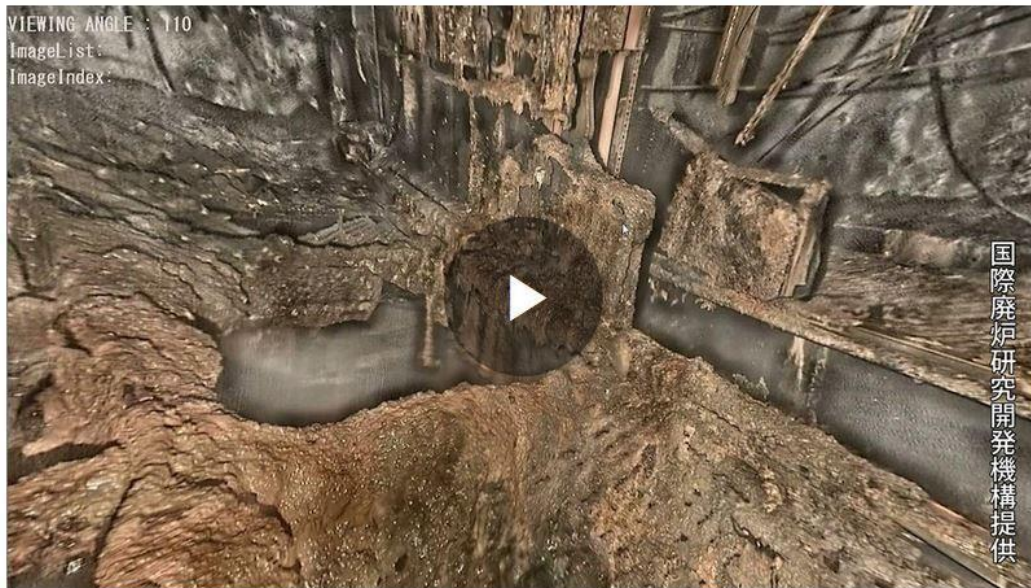
The firm also released a 3-dimensional video that reconstructs the interior of the containment vessel of the No.3 reactor. The unit also suffered from a meltdown.

The footage shows a mound of materials near the center of the vessel's bottom. The company says it may have emerged after fuel debris fell onto structural parts that had already dropped there during the 2011 accident.

The utility says the new images provide clues to determine the paths along which molten fuel fell. It plans to decide in the next fiscal year how to remove the fuel debris.

The company is seeking to remove the molten fuel as part of its effort to decommission the plant.

## TEPCO footage shows fuel debris in No.2 reactor



Inside the bottom of the containment vessel in the No. 2 reactor of the Fukushima No. 1 nuclear power plant in January, revealed fully by new image processing. (Provided by the International Research Institute for Nuclear Decommissioning)

### Full extent of melted fuel in Fukushima No. 2 reactor revealed

<http://www.asahi.com/ajw/articles/AJ201804270041.html>

By CHIKAKO KAWAHARA/ Staff Writer

Inside the bottom of the containment vessel in the No. 2 reactor of the Fukushima No. 1 nuclear power plant in January, revealed fully by new image processing. (Provided by the International Research Institute for Nuclear Decommissioning)

The bottom of the containment vessel in the No. 2 reactor of the Fukushima No. 1 nuclear power plant, as captured on Jan. 19, 2018. Fused materials thought to be melted nuclear fuel debris is attached to pillars and the floor. (Provided by the International Research Institute for Nuclear Decommissioning)

The bottom of the inside of Fukushima No. 1 nuclear plant's crippled No. 2 reactor has been revealed in a much clearer and wider range in footage released by plant operator Tokyo Electric Power Co. on April 26. The film shows the clearest pictures yet inside the containment vessel just below the pressure vessel of the nuclear reactor, which went into meltdown due to the 2011 earthquake and tsunami disaster.

Melted nuclear fuel debris is seen attached to pillars, walls and the ceiling, and accumulations between approximately 40 and 70 centimeters thick are piled up and cover the whole floor.

TEPCO captured the footage on Jan. 19 by attaching a remote-controlled camera to an extendable rod with a span of 16 meters into the containment vessel from an opening in its side.

Excerpts were released at the time, but new processing of the footage has revealed a much clearer picture. In the bottom of the containment vessel, fuel debris has fused to some areas particularly thickly. It is possible that the bottom of the reactor has several holes that caused the debris to fall and solidify as it cooled.

The improved knowledge of the nuclear reactor's state will help to calculate an estimate of the amount of the debris inside, and suggest at how it could be removed in the future.

TEPCO hopes to start its next investigation inside the reactor within this fiscal year.

## **TEPCO footage shows deposits inside damaged Fukushima reactor**

<https://mainichi.jp/english/articles/20180427/p2a/00m/0na/016000c>

TOKYO -- Tokyo Electric Power Co. (TEPCO) on April 26 released footage taken inside the containment vessel of the No. 2 reactor at the disaster-hit Fukushima No. 1 Nuclear Power Plant, showing spots where molten fuel appears to have fallen through the reactor pressure vessel.

- **【Related】** TEPCO unveils footage of deposits inside Fukushima reactor
- **【Related】** Once severely damaged Fukushima reactor building opened to media to showcase progress
- **【Related】** First samples of Fukushima plant nuclear fuel debris to be collected in FY 2019

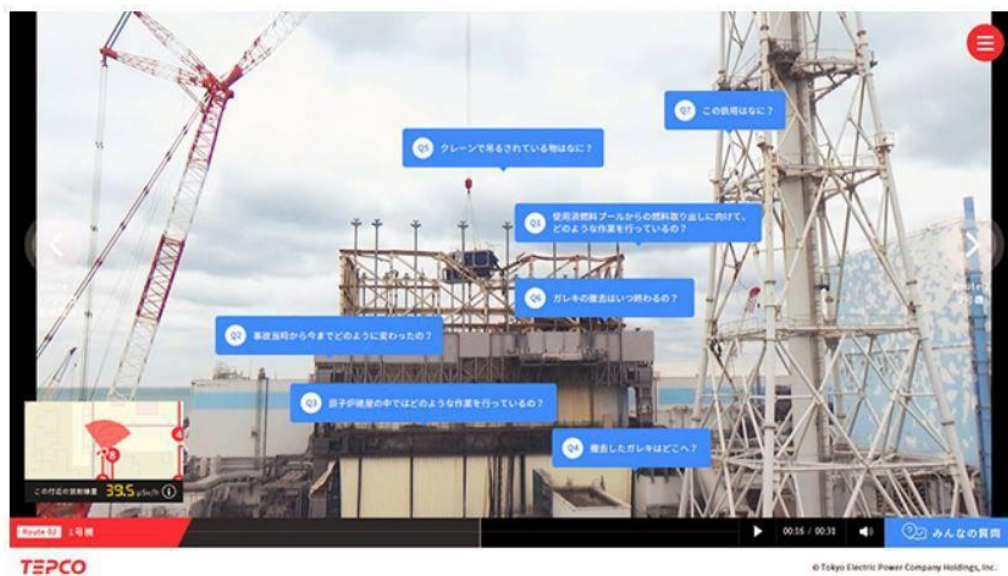
Photos and video footage show deposits -- believed to be fuel debris -- at the bottom of the containment vessel. In two spots, the debris is piled higher than in other places. TEPCO officials said they suspect that the bottom of the pressure vessel, situated at the upper part of the containment vessel, was damaged in more than one place, which allowed melted fuel to fall into the containment vessel.

TEPCO captured the images in January using a camera attached to a pipe inserted into the containment vessel, and found deposits spread across the bottom of the vessel. The nuclear plant operator will use a robot arm to analyze the containment vessel in more detail.

(Japanese original by Ei Okada and Riki Iwama, Science & Environment News Department)

May 5, 2018

## **Helping to understand the situation at Fukushima Daiichi?**



Explanations are provided if the questions are clicked when passing through elevated land in front of the No. 1 reactor. (Captured from Tokyo Electric Power Co. website)

## TEPCO offers virtual tour of Fukushima No. 1 plant on website

<http://www.asahi.com/ajw/articles/AJ201805050001.html>

By HIROSHI ISHIZUKA/ Staff Writer

FUKUSHIMA--The crippled Fukushima No. 1 nuclear power plant is open for all to explore in a virtual tour on operator Tokyo Electric Power Co.'s website.

TEPCO released the "Inside Fukushima Daiichi" feature, **only available on personal computers, so visitors can feel as if they are touring the decommissioning venue by car.**

The service is aimed at helping more people understand the current state of the plant, also known as Fukushima Daiichi, after the nuclear crisis triggered by the 2011 Great East Japan Earthquake and tsunami.

While visitors can tour the plant grounds on the website, the radiation level around the displayed area is shown in the lower left portion of the monitor.

Front and side views of the No. 1 to No. 4 reactors, which suffered serious damage, can be seen up close.

In some sections, images taken both recently and immediately after the disaster are shown to offer comparisons. Explanations of the plant are provided in Q&A format for some areas as well.

A 360-degree view of the inside of the No. 5 reactor building, which has almost the same structure as the No. 1 to No. 4 reactors, and other facilities is also offered.

TEPCO is looking to provide an English-language version in the future.

The virtual tour is available at (<http://www.tepco.co.jp/insidefukushimadaiichi/index-j.html>).

## TEPCO to measure radiation levels in No.2

### TEPCO to Gauge Radiation in Reactor Building

<https://www3.nhk.or.jp/nhkworld/nhknewsline/nuclearwatch/tepcotogauge/>

The operator of the crippled Fukushima Daiichi nuclear power plant intends to send a robot into the No.2 reactor building as early as next week to measure interior radiation levels in detail. It is a key step toward removing all 615 nuclear fuel rod units that remain in a storage pool in the building, and eventually decommissioning the reactor. The pool is located on the top floor of the building. The No.2 reactor experienced a meltdown after the major earthquake and tsunami that hit eastern Japan in 2011. Tokyo Electric Power Company, or TEPCO, plans to transfer the fuel units to reduce the risks posed by possible earthquakes and other factors. TEPCO needs to map radiation levels and other detailed conditions inside the building before retrieving the fuel units. The utility on Thursday finished breaching a wall of the building to allow entry to a robot and heavy machinery. Work on the 5-meter wide and 7-meter high hole started last month. TEPCO plans to send a robot fitted with a camera and a radiation measurement device through the opening as early as next week. And TEPCO could start removing the fuel around fiscal 2023 based upon the survey results. TEPCO also seeks to begin retrieving nuclear fuel from the No.1 reactor around fiscal 2023 and from the No.3 reactor as soon as this autumn. Both reactors had a meltdown following the natural disaster.

July 3, 2018

## Radiation levels on top floor of No.2 still way too high for human work

### Radiation still too high in reactor building

[https://www3.nhk.or.jp/nhkworld/en/news/20180702\\_35/](https://www3.nhk.or.jp/nhkworld/en/news/20180702_35/)

A robotic probe has found that radiation levels remain too high for humans to work inside one of the reactor buildings at the damaged Fukushima Daiichi nuclear power plant.

Tokyo Electric Power Company, the operator of the plant, plans to relocate 615 units of nuclear fuel from the spent fuel pool, which is located on the top floor of the No. 2 reactor building and is separate from the reactor itself.

TEPCO says the relocation will help reduce risks, including possible damage caused by earthquakes.

The No. 2 reactor underwent a meltdown, but did not experience a hydrogen explosion in the 2011 nuclear accident. The building is likely to still have a high concentration of radioactive materials.

Last month, TEPCO drilled a hole in the wall of the building in order to use a camera-equipped robot to create a detailed map of the radiation on the top floor.

On Monday, workers started the survey and measured radiation levels at 19 points, mainly near the opening. **Up to 59 millisieverts were detected per hour.**

**That's above workers' allowable annual exposure of 50 millisieverts and more than half of their 5-year exposure limit.** TEPCO has concluded it cannot let humans work inside the building.

TEPCO will use the results to determine specific ways to remove the fuel from the pool. It plans to start the work in fiscal 2023.

July 27, 2018

## TEPCO to get to fuel debris in No.2 as of October



The inside of the containment vessel of the No. 2 reactor at the Fukushima No. 1 nuclear plant is seen in this frame grab from video provided by the International Research Institute for Nuclear Decommissioning (IRID).

## TEPCO eyes 1st contact with fuel debris in damaged nuke reactor from Oct.

<https://mainichi.jp/english/articles/20180727/p2a/00m/0na/034000c>

TOKYO -- Tokyo Electric Power Co. (TEPCO) will directly touch melted fuel debris inside a damaged reactor at the Fukushima No. 1 Nuclear Power Plant for the first time sometime from October onward, the utility and the government announced on July 26.

- **【Related】** Gov't, TEPCO consider starting removal of debris from 2nd reactor at Fukushima nuke plant
- **【Related】** TEPCO footage shows deposits inside damaged Fukushima reactor
- **【Related】** First samples of Fukushima plant nuclear fuel debris to be collected in FY 2019
- **【Related】** Decommissioning Fukushima reactors will take time but progress continues
- **【Related】** TEPCO unveils footage of deposits inside Fukushima reactor

The company will insert a pipe into the containment vessel of the plant's No. 2 reactor and use a device at its tip to confirm the hardness and other properties of the debris, before retrieving a small amount from that reactor and the No. 1 reactor in fiscal 2019. Full-scale removal of debris is scheduled to start in 2021, likely at the No. 2 reactor, where probes have been the most extensive.

The pipe to be used to make direct contact with the debris will be an improved version of one equipped with a camera that was used to film inside the No. 2 reactor's containment vessel in January. Besides checking the hardness of the debris, the company will also examine whether it can be moved. It will incorporate the results of its test removal of debris in deciding on a method for full-scale removal.

"We don't know what the debris will be like. We will examine it step by step as we look ahead to its removal," Akira Ono, president of Fukushima Daiichi Decontamination & Decommissioning Engineering Co. said at a news conference.

Meanwhile, TEPCO has announced that in November it will start to remove 566 nuclear fuel rods which have been kept in the No. 3 reactor's fuel pool. It will aim to complete the removal of these fuel rods in 2020.

(Japanese original by Toshiyuki Suzuki, Science & Environment News Department)

July 25, 2018

## Gov't, TEPCO consider starting removal of debris from 2nd reactor at Fukushima nuke plant

[https://mainichi.jp/english/articles/20180725/p2a/00m/0na/002000c#cxrecs\\_s](https://mainichi.jp/english/articles/20180725/p2a/00m/0na/002000c#cxrecs_s)

TOKYO -- The government and Tokyo Electric Power Co. (TEPCO) are considering starting the removal of molten nuclear fuel from the No. 2 reactor of the Fukushima No. 1 Nuclear Power Plant, people familiar with the matter have told the Mainichi Shimbun.

- **【Related】** Nuclear watchdog OKs restart of aging nuclear plant hit by tsunami
- **【Related】** Editorial: TEPCO should quickly decommission Fukushima No. 2 nuclear plant
- **【Related】** Foreign workers vital for Japanese contractor in cleanup at Fukushima nuke plant

- **【Related】** What's behind TEPCO ban on term 'core meltdown' after Fukushima crisis?

Three of the four reactors at the plant in the northern Japanese prefecture of Fukushima suffered core meltdowns after the reactors' cooling systems shut down due to tsunami triggered by the Great East Japan Earthquake of March 2011.

According to the sources, an on-site inspection of molten fuel debris inside the reactor's containment vessel using remote control equipment will be conducted this fiscal year. Data from the test, such as the hardness of the debris and whether it is movable, will be used to develop equipment to remove and store the highly radioactive materials.

Under the road map for decommissioning the power plant revised in September last year, the government and TEPCO are to decide on a reactor on which to start debris removal and determine how to carry out the procedure by March 2020, the end of next fiscal year. Actual removal is scheduled to begin in 2021. In January of this year, the government and TEPCO managed to insert a pipe with a camera into the No. 2 reactor's containment vessel and captured the image of gravel- or clay-like deposits believed to be fuel debris on the floor.

According to the people familiar with the matter, the government and TEPCO have judged that it is necessary to further examine the conditions of the No. 2 reactor as a possible starting point for fuel debris removal, since inspections needed for such an operation have progressed further on the No. 2 unit more than on the other two reactors that suffered core meltdowns in 2011.

The government and TEPCO will carry out the new probe in the fall or later of this year by inserting a camera-equipped pipe attached with a device capable of directly touching the debris, which will gather data on the reactor's current conditions. The debris is not taken out of the containment vessel at any point of this survey. In the next fiscal year starting April 2019, they will consider examining wider areas inside the containment vessel and recovering a small sample of molten fuel for analysis ahead of full-fledged extraction in 2021.

As for the other reactors, the No. 3 unit has water inside the containment vessel, the removal of which is difficult, although images of what appeared to be fuel debris were captured inside the reactor in July 2017. The No. 1 reactor, meanwhile, will receive another probe to determine the existence of molten fuel inside because an inspection carried out in March last year failed to spot any debris.

TEPCO will shortly submit a plan for the examination of the No. 1 and No. 2 reactors' interior for fiscal 2019 and later to the Nuclear Regulation Authority.

(Japanese original by Toshiyuki Suzuki and Ei Okada, Science & Environment News Department)

August 28, 2018

## Technology developed to remove tritium from water

### Researchers develop technology to remove radioactive tritium from water

<https://mainichi.jp/english/articles/20180828/p2a/00m/0na/013000c>

OSAKA -- A team of researchers from Kindai University and private companies in western Japan has developed a new filter enabling the removal of water containing radioactive tritium.



- **【Related】** Decommissioning Fukushima reactors will take time but progress continues
- **【Related】** NRA chair ties nuke plant restart to TEPCO taking lead on Fukushima decommissioning
- **【Related】** High-priced Fukushima ice wall nears completion, but effectiveness doubtful

The researchers hope their technology will eventually be used in processing water leaking from the Tokyo Electric Power Co.'s crippled Fukushima No. 1 Nuclear Power Plant. The waste water contains tritium but the radioactive material cannot be removed with the current filtering technology.

Tritium is an isotope of hydrogen. Water containing tritium has chemical features almost identical to water with ordinary hydrogen, and separating tritium water is difficult.

The research team, comprising professor Tatsuhiko Ihara of Kindai University specializing in inorganic material chemistry, and researchers from Osaka-based Toyo Aluminium K.K. and others, has developed an aluminum filter with extremely tiny holes 5 nanometers or less in diameter each. The filter can stop vapors of tritium water, and the separation rate was "almost 100 percent," according to a team representative.

At the Fukushima No. 1 plant, over 800,000 metric tons of radioactive water that leaked from the facility is stored on the premises. The research team will cooperate with local companies in Fukushima Prefecture and others to develop equipment that can be put to actual use to separate tritium.

The radioactive material exists in the natural environment, and the Nuclear Regulation Authority maintains that there should be no problem in releasing water containing tritium into the sea if its concentration levels are lowered sufficiently. This stance faces strong oppositions from local fishermen and others who worry about negative rumors about their catches due to the discharge of such water. The government has set up a panel of experts to examine how to process tritium water.

(Japanese original by Koki Matsumoto, Osaka Science & Environment News Department)

September 6, 2018

## Radioactive water in Fukushima: What to do?



Contaminated water is stored in large tanks at the crippled Fukushima No. 1 nuclear power plant.  
(Asahi Shimbun file photo)

## **EDITORIAL: All options need to be weighed for Fukushima plant tainted water**

<http://www.asahi.com/ajw/articles/AJ201809060020.html>

The government has held public hearings on plans to deal with growing amounts of radioactive water from the ruined Fukushima No. 1 nuclear power plant.

The hearings, held in Tomioka and Koriyama in Fukushima Prefecture as well as in Tokyo, underscored the enormous difficulty government policymakers are having in grappling with the complicated policy challenge.

The crippled reactors at the plant are still generating huge amounts of water contaminated with radiation every day. Tons of groundwater percolating into the damaged reactor buildings as well as water being injected into the reactors to cool the melted fuel are constantly becoming contaminated.

Almost all the radioactive elements are removed from the water with a filtering system. But the system cannot catch tritium, a mildly radioactive isotope of hydrogen.

The tritium-contaminated water is stored on-site in hundreds of large tanks. As the number of tanks has reached 900, the remaining space for them is shrinking and expected to run out by around 2020, according to the government.

Clearly, time is growing short on deciding what to do about the problem.

A task force of the Ministry of Economy, Trade and Industry has considered five options, including release into the Pacific Ocean after dilution, injection into deep underground strata and release into the air after vaporization. The group has concluded that dumping the water into the ocean would be the quickest and least costly way to get rid of it.

This is seen as the best option within the government.

Tritium is a common radioactive element in the environment that is formed naturally by atmospheric processes. Nuclear power plants across the nation release tritium produced in their operations into the sea according to legal safety standards.

But these facts do not automatically mean that releasing the tritium-laced water into the sea off Fukushima is a good approach to the problem.

Local communities in areas affected by the 2011 nuclear disaster are making strenuous efforts to rebuild the local fishing and agricultural industries that have been battered by the radiation scare. There are still countries that ban imports of foodstuffs produced in Fukushima Prefecture.

Local fishermen and other community members have every reason to oppose the idea of releasing tritium into the ocean. They are naturally concerned that the discharge would produce new bad rumors that deliver an additional blow to the reputation and sales of Fukushima food products.

Unsurprisingly, most of the citizens who spoke at the hearings voiced their opposition to the idea.

Moreover, it was reported last month that high levels of radioactive strontium and iodine surpassing safety standards had been detected in the treated water.

The revelation has made local communities even more distrustful of what they have been told about operations to deal with the radioactive water.

It is obvious that the hearings at only three locations are not enough to sell any plan to cope with the sticky problem to skeptical local residents. The government needs to create more opportunities for communication with them.

In doing so, the government should show a flexible stance without adamantly making the case for the idea of releasing the water into the sea. Otherwise, there can be no constructive debate on the issue.

It can only hope to win the trust of the local communities if it gives serious consideration to other options as well.

During the hearings, many speakers suggested that the water should be kept in large tanks until the radioactivity level falls to a very low level.

The pros and cons of all possible options, including this proposal, should be weighed carefully through cool-headed debate before the decision is made.

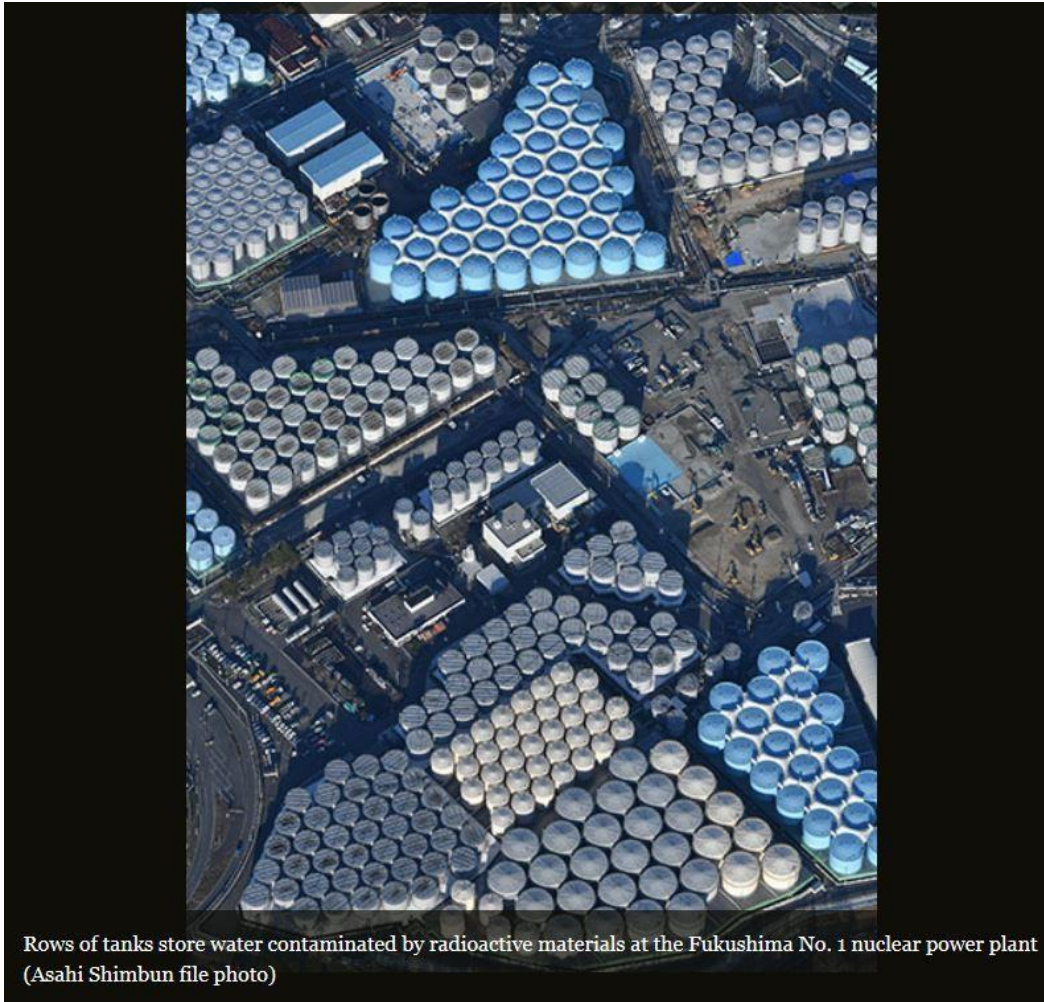
**Repeated discussions with fruitful exchanges of views among experts and citizens including local residents are crucial for ensuring that the final decision on the plan will win broad public support.**

The government and Tokyo Electric Power Co., the operator of the Fukushima plant, should disclose sufficient information for such discussions and give thoughtful and scrupulous explanations about relevant issues and details.

The government, which has been promoting nuclear power generation as a national policy priority, has the responsibility of building a broad and solid consensus on this problem.

October 9, 2018

## Disturbing new revelations



Rows of tanks store water contaminated by radioactive materials at the Fukushima No. 1 nuclear power plant (Asahi Shimbun file photo)

## EDITORIAL: TEPCO bungles it again in dealing with Fukushima tainted water

<http://www.asahi.com/ajw/articles/AJ201810090025.html>

Disturbing new revelations about increasing amounts of radioactive water at the Fukushima No. 1 nuclear power plant have undoubtedly further darkened the already dim prospects for solving this tricky and complicated challenge.

Tokyo Electric Power Co. (TEPCO), the operator of the nuclear plant destroyed by the 2011 earthquake and tsunami disaster, has said **the filtering system to decontaminate the polluted water, known as ALPS (advanced liquid processing system), has failed to remove such radioactive elements as strontium 90 and radioactive iodine.**

**On Sept. 28, the utility acknowledged that about 80 percent of the water in storage tanks for ALPS-treated water on the plant premises exceeded government standards for radioactive materials.**

TEPCO previously claimed that the ALPS system could remove all radioactive elements except for tritium, a mildly radioactive isotope of hydrogen.

But the fact is that of the 890,000 tons of water treated by the ALPS system and stored in the tanks, about 750,000 tons contain higher concentrations of radioactive materials than levels permitted by the safety regulations for release into the ocean.

In 65,000 tons of treated water, the levels of strontium 90 are more than 100 times the safety standards, according to TEPCO. The levels are as high as 20,000 times the standards in some tanks.

In explaining the reasons for this failure, TEPCO pointed to problems with the ALPS system shortly after it was first installed. The utility also reduced the frequency of the replacement of absorbents for removing radioactive materials to keep the system running as long as possible.

**The company had long known these facts, but was less than eager to share them with the public.**

TEPCO says it has disclosed the data on its website. But it is virtually impossible for an uninformed third-party information seeker to detect such problems in the massive reams of data.

The company deserves to be criticized for having deliberately concealed these inconvenient facts.

The utility reported the facts to an industry ministry subcommittee dealing with the problem of radioactive water and apologized. It appears that the company is not yet fully aware of its responsibility to solve this problem as the operator of the plant where an unprecedented nuclear accident occurred.

**The ministry, for its part, should be held accountable for its failure to ensure appropriate disclosure of the information by TEPCO. The subcommittee should be faulted for concentrating its attention almost exclusively on tritium.**

**Tackling this formidable challenge requires debate from a broad perspective based on diverse information.**

This point has been underscored afresh by the latest revelations.

The consequent radical changes in the basic assumptions concerning the problem of radioactive water have brought the process of figuring out a workable way to deal with the challenge **back to square one.**

TEPCO plans to treat the contaminated water with the ALPS system again to lower the levels of radioactive materials below the safety standards.

**This approach, however, is expected to make the water treatment process far costlier and more time-consuming than originally expected, possibly affecting the entire project to decommission the crippled reactors at the plant.**

The biggest blow comes from the serious damage the revelations have caused to TEPCO's already strained relationship with local communities.

To build a broad consensus on how to cope with the problem, the government and the utility should work together to ensure timely and adequate information disclosure and set up opportunities for dialogue with local residents.

A system should also be created to promote a national conversation on this issue.

The tanks to store treated water is expected to be filled to capacity by around 2020, according to the government.

But **no time limit should be set for debate on the problem. There is no shortcut to a solution.**

November 9, 2018

## **Chalkboards at Fukushima base for nuke accident tell of the chaos**

<http://www.asahi.com/ajw/articles/AJ201811090033.html>

By HIROSHI ISHIZUKA/ Staff Writer

OKUMA, Fukushima Prefecture--As if frozen in time, uneraser chalkboards still carry the scribbles of emergency officials closely monitoring the catastrophic nuclear disaster at the Fukushima No. 1 nuclear power plant.

A whiteboard carries the poignant communications between an emergency headquarters of the Fukushima prefectural government and teams working outside at the moment a hydrogen explosion blew apart the No. 3 reactor building on March 14, 2011.

"Stop monitoring, evacuate now," an order said.

The next line follows, "1F3 (No. 3 reactor of Fukushima No. 1 plant) hydrogen explosion."

"Don't return here, head west," another directive said.

Media representatives were invited on Nov. 8 for the first time to the emergency headquarters that was set up at the prefecture-run Environmental Radioactivity Monitoring Center of Fukushima here to monitor the radiation levels around the Fukushima No. 1 nuclear plant when a massive tsunami crippled the power supply on March 11, 2011.

The center was originally constructed as a facility to monitor radiation levels in the area as well as serve as an education center for nuclear power generation.

The headquarters were abandoned on the night of March 14, 2011, after the evacuation order was issued following the explosion at the No. 3 reactor building. No one since then has returned to use or tidy up the site.

During the emergency, the center, which sits about 4 kilometers west of the nuclear plant on the border of the towns of Okuma and Futaba, served as the base for staff from the prefectural and central governments monitoring radiation levels around the plant.

On a blackboard, readings remain of radiation dosages at various locations around the plant on March 12, 2011, taken about six and a half hours before a hydrogen explosion ripped through the No. 1 reactor building.

One spot recorded a reading of 15 microsieverts per hour, showing that radioactive particles were already leaking from the plant at the time.

The media invitation to the center was part of the prefecture's project to collect and preserve documentation and memories of the Great East Japan Earthquake and tsunami.

A team from Fukushima University was also at the headquarters checking the radiation levels inside the building, ahead of collecting materials.

The collection will be preserved and displayed at an education facility under construction in Futaba, scheduled to be completed in the summer of 2020.

November 14, 2018

## IAEA wants quick fix to water problem

### IAEA urges quick plan on Fukushima radioactive water cleanup

<https://mainichi.jp/english/articles/20181114/p2g/00m/0dm/007000c>

TOKYO (AP) -- Experts from the International Atomic Energy Agency urged the operator of Japan's tsunami-wrecked Fukushima nuclear plant on Tuesday to urgently decide on a plan to dispose of massive amounts of treated but still radioactive water stored in tanks on the compound.

- **【Related】** Nuclear experts to test water, fish around Japan power plant
- **【Related】** Contaminated water, fuel extraction stand in way of decommissioning Fukushima plant
- **【Related】** 3 years after new nuclear rules, work continues to evaluate safety of plants

A 13-member IAEA team told reporters in Tokyo after a weeklong review that managing nearly 1 million tons of radioactive water is critical to the plant's safe and sustainable decommissioning.

The IAEA team said in a preliminary report that hundreds of tanks currently used to store the water over large areas of the plant's compound can only be a temporary solution and must be removed "urgently."

The cores of three reactors at the plant suffered meltdowns following a massive 2011 earthquake and tsunami that devastated parts of northeastern Japan.

Radioactive water has leaked from the damaged reactors and mixed with groundwater and rainwater at the plant. The water is treated and stored in large tanks.

More than 7 1/2 years since the accident, officials have yet to agree on what to do with the radioactive water. A government-commissioned panel has picked five alternatives, including the **controlled release of the water into the Pacific Ocean**, which nuclear experts say is the only realistic option. Fishermen and residents, however, strongly oppose the proposal.

**That option faced a major setback this summer when the plant's operator, Tokyo Electric Power Co., acknowledged that the water, which it said had been carefully treated, was not clean enough. It said the water contains cancer-causing cesium and other elements in excess of allowable limits for release into the environment.**

The IAEA interim report said TEPCO could run out of space for tanks in a few years, and the water storage adds to safety risks and could hamper the decommissioning of the plant, which is already an unprecedented challenge.

It said the water problem has improved recently because of measures such as an underground frozen wall installed around the reactor buildings to keep the radioactive water from mixing with groundwater. It

suggested that **TEPCO could further reduce the amount of contaminated water by cutting back on the use of cooling water injected into the reactors because the temperature of the melted fuel has fallen significantly.**

IAEA mission leader Christophe Xerri told reporters that **it is uncertain whether all of the melted fuel can ever be successfully removed because too little is known about the damage to the cores of the three reactors.**

TEPCO and government officials plan to start removing the melted fuel in 2021. Robotic probes inside the reactors have detected traces of damaged fuel but its exact location, contents and other details remain largely unknown.

"If you don't have the information it's very difficult to say it's possible or not" to remove all the fuel, Xerri said.

The team's final report from its review is expected in late January.

## **IAEA urges quick plan to clean up Fukushima radioactive water**

THE ASSOCIATED PRESS

<http://www.asahi.com/ajw/articles/AJ201811140010.html>

## **IAEA urges Japan to reach decision soon on handling of radioactive water at crippled Fukushima nuke plant**

<https://www.japantimes.co.jp/news/2018/11/14/national/iaea-urges-japan-make-decision-treated-radioactive-water-crippled-fukushima-uke-plant/#.W-v0mzGNyos>

Kyodo

A team of nuclear experts from the International Atomic Energy Agency urged Japan this week to reach a decision quickly on what to do with treated water that contains low toxicity radioactive tritium, which is accumulating at the crippled Fukushima No. 1 nuclear plant.

"We advised the Japanese government that ... (a) decision should be taken very rapidly for the disposition path for water which is stored in these tanks," said Christophe Xerri, leader of the 13-member team, on Tuesday following a nine-day review of progress on scrapping the Fukushima No. 1 plant, which was damaged in the March 2011 earthquake and tsunami.

"There is space limitation, so some solution has to be decided and implemented," he said, adding that the volume of treated water containing tritium in tanks is expected to reach the planned capacity within the "coming three to four years."



As of last Thursday around 970,000 tons of tritium-containing water was stored on the premises of the plant, according to Tokyo Electric Power Company Holdings Inc.

The government has studied options for the tritium-containing water, including releasing it into the sea, as it is regarded as not harmful to humans. The tainted water has been stored in tanks after being produced as a byproduct of cooling the plant's reactors, which suffered core meltdowns following the 2011 disaster.

But local fishermen and residents have expressed concern about discharging the water, fearing the potential impact on food.

"Controlled discharge to the sea is something which is applied in many nuclear facilities, so it's not something which is new," Xerri said, while adding, "Our review was not to advise the Japanese government on one solution or another one."

"It is up to the Japanese government to decide — in engaging with stakeholders, of course — on the option Japan wants to implement," he said.

Toyoshi Fuketa, who heads the Nuclear Regulation Authority, has described discharging the water into the sea as the "only" solution.

Tepco has been running the Advanced Liquid Processing System, said to be capable of removing almost all radioactive materials from the toxic water except tritium.

It was the fourth such review conducted by a team of experts from the Vienna-based agency, following two in 2013 and one in 2015. The IAEA will issue its final report by the end of January 2019.

Xerri said his team was impressed by the progress that has been made at the plant since the previous review, including the full operation of a frozen soil wall around the reactors that has reduced the volume of groundwater that enters the reactor buildings.

But he acknowledged many challenges in the decommissioning process, which is set to take "30 to 40 years or even more," including the removal of melted fuel from the reactors — seen as the hardest part.

When asked about the possibility of discarding the fuel — the location and volume of which remaining within the reactors is yet to be grasped due to high levels of radiation — Xerri said, "We don't have enough information to tell you yes or no."

November 19, 2018

## No.1 control room opened to journalists

### Untouched Fukushima No. 1 control room opened to journalists after seven years

<https://www.japantimes.co.jp/news/2018/11/19/national/fukushima-no-1-control-room-opened-untouched-journalists-seven-years/#.XBJRg2lCeos>

Kyodo

FUKUSHIMA – In the main control room for the crippled Nos. 3 and 4 reactors at the Fukushima No. 1 nuclear power plant, time seems to have stood still.

That was the impression reported Thursday by the first journalists to enter the facility since the 2011 nuclear meltdowns there.

The control room's interior is reported to have been left almost untouched since the disaster. Handwriting was found on the wall near an instrument used to measure water levels within the No. 3 reactor, hinting at the circumstances faced by some 10 workers who were there at the time of the crisis.

“We don't write (on the wall) in a normal situation, so it indicates that it was an emergency,” said an official at the plant's operator, Tokyo Electric Power Company Holdings Inc.

The nuclear crisis was triggered by the magnitude 9.0 earthquake and ensuing tsunami that flooded the facility, located on the Pacific coast, on March 11, 2011.

The No. 3 reactor suffered a fuel meltdown and a hydrogen explosion, while the No. 4 reactor, which did not have nuclear fuel inside, also exploded due to a hydrogen inflow from the nearby reactor.

In February 2014, Tepco allowed the media to view the control room for the Nos. 1 and 2 reactors, which also suffered meltdowns, but had kept the control room for the Nos. 3 and 4 closed due to high levels of radiation in the area.

Radiation levels inside the control room for Nos. 3 and 4, the floor of which is now covered by plastic sheeting, was 6 microsieverts per hour. In contrast, readings in Tokyo's Shinjuku Ward on Sunday were 0.037 microsievert per hour. The control room, which now has only a few lights, is no longer in use as its functions have been transferred to a quake-resistant building.

Following the crisis, which equaled the severity of the 1986 Chernobyl disaster, some 160,000 people were evacuated. More than 40,000 remained displaced as of late September.

November 27, 2018

## Virtual "homecoming" for young evacuees

### Drone footage probably closest evacuees will get to going home

<http://www.asahi.com/ajw/articles/AJ201811270053.html>

By KAZUMASA SUGIMURA/ Staff Writer

Children living as evacuees are glued to images shot by a drone of their hometown of Futaba during a special presentation at their temporary campus in Iwaki, Fukushima Prefecture, on Nov. 26. (Yosuke Fukudome)

IWAKI, Fukushima Prefecture--With barely no recollections of growing up in Futaba, a town rendered uninhabitable by the 2011 nuclear disaster, 11 young evacuees had a "homecoming" of sorts on Nov. 26.

The children, fourth- to sixth-graders at two public elementary schools who currently study at a temporary campus in Iwaki, 80 kilometers south of Futaba, attended a special 45-minute presentation in a school gym to watch drone footage of the area where they were born.

A satellite feed allowed the pupils to talk to local officials about efforts to decontaminate the once-bustling community.

Futaba was transformed into a ghost town by the triple meltdown at the Fukushima No. 1 nuclear power plant triggered by the earthquake and tsunami disaster. High radiation levels mean that entry still remains restricted.

The children watched aerial footage of scenic spots shot by drones on three 70-inch monitors. Beautiful images of beaches and mountains in fall colors caused them to lean forward and express amazement.

Fifth-grader, Mao Oyano, 11, who has few memories of living in Futaba as she left at the age of 3, expressed surprise at seeing "many more houses than I expected."

The children fell silent when eerie images appeared of the wrecked nuclear plant.

Ninety-six percent of Futaba, a town that co-hosts the stricken nuclear facility, is located in a difficult-to-return zone because of high radiation levels and remains uninhabited.

Adults must receive permission to enter the area, but children under the age of 15 are not allowed access.

The children were aged between 2 and 4 when they left, and have not set foot in Futaba since then.

Prior to the disaster, Futaba had two elementary schools with 309 pupils. In spring 2014, the town opened a temporary school facility in Iwaki, a coastal city to where many Futaba residents evacuated, but the number of pupils dropped to 31.

The “homecoming” was the school’s first attempt to give the children an opportunity to ponder the tragedy that befell their hometown, according to a school official.

December 19, 2018

## Tohoku's reconstruction behind schedule

### **Tohoku disaster reconstruction to miss '20 deadline for completion**

<http://www.asahi.com/ajw/articles/AJ201812190031.html>

By NORIYOSHI OHTSUKI/ Senior Staff Writer

Reconstruction of areas devastated by the 2011 triple disaster will not be completed by fiscal 2020 as initially scheduled, and Fukushima Prefecture residents could be hit hardest by the delay, the Reconstruction Agency said.

Agency officials said Dec. 18 that further measures would be needed after fiscal 2020 to help areas affected by the triple meltdown at the Fukushima No. 1 nuclear power plant, as well as municipalities heavily damaged by the tsunami triggered by the Great East Japan Earthquake on March 11, 2011.

The government had set a 10-year reconstruction period as its basic policy, with the first five years described as an “intensive reconstruction period” and the second five years labeled as the “reconstruction and revitalization period.”

The Reconstruction Agency will also be eliminated at the end of March 2021, meaning the government will need new legislation to designate an agency that will handle the reconstruction effort in the Tohoku region from fiscal 2021.

Reconstruction Agency officials conducted studies in the five prefectures of Aomori, Iwate, Miyagi, Fukushima and Ibaraki during the current fiscal year to determine the extent of progress as well as what support measures should be continued beyond fiscal 2020.

The officials said some public works projects were taking longer than expected because of delays in buying land for those projects and revisions in reconstruction plans.

Although no specific project names or locations were revealed, the officials said all of those public works projects would not be completed by the end of fiscal 2020.

Under the government's plan, the need for temporary prefabricated homes will no longer exist at the end of fiscal 2020.

However, elderly people who move out of such housing will still require care and supervision especially if they live alone and are suffering from psychological damage stemming from the natural disaster.

The situation looks especially dire in the locales most seriously affected by the nuclear accident.

Mountains of decontaminated soil will be moved outside of Fukushima Prefecture, but the relocation is not expected to happen for another 20 years. That means support measures for evacuees as well as Fukushima farmers and fishermen still dealing with negative publicity about their harvests will have to continue well beyond fiscal 2021.

A total of 32 trillion yen (\$285 billion) has been set aside for the reconstruction effort. Whatever is left can be carried over after fiscal 2021 for still-incomplete projects.

At the end of fiscal 2017, 4.6 trillion yen had still not been spent. Reconstruction Agency officials did not say if additional budgetary measures would be needed.

December 25, 2018

## Focusing on nukes will lead Japan nowhere

### **Editorial: Japan must ditch nuclear plant exports for global trends in renewable energy**

<https://mainichi.jp/english/articles/20181225/p2a/00m/0na/011000c>

Projects to export nuclear power plants, a pillar of the "growth strategy" promoted by the administration of Prime Minister Shinzo Abe, appear to be crumbling.

- **【Related】** Hitachi may freeze British nuclear project due to swelling costs
- **【Related】** Effects of suspected radiation exposure seen in Fukushima wild monkeys: researchers
- **【Related】** Residents of nuclear crisis hit Namie to sue TEPCO, gov't after settlement talks fail

Factors behind the failures include ballooning construction costs due to strengthened safety standards after the triple core meltdowns at Tokyo Electric Power Co.'s (TEPCO) Fukushima Daiichi Nuclear Power Station in March 2011, and growing anti-nuclear sentiments around the world.

Nothing else can be said but that the export projects have effectively failed. The prime minister's office and the Ministry of Economy, Trade and Industry must bear the responsibility of continuing to promote these exports despite a massive change in the attitude toward nuclear power plants.

"We are really stretched to our limit," Hitachi Chairman Hiroaki Nakanishi recently said of the company's nuclear power plant construction plan in Britain. The statement came at a regular press conference of the Japan Business Federation, or Keidanren, indicating that continuing the project is not feasible.

Hitachi coordinated closely with the Japanese government to advance the U.K. project. The company was to build two nuclear power reactors in midwestern Britain through a local subsidiary, and to start operating the facilities in the first half of the 2020s.

But, the total estimated cost of the project has skyrocketed from the initial figure of 2 trillion yen to 3 trillion yen due to growing safety measure costs. Hitachi, hoping to distribute financial risk, sought investments from major power utilities and other firms, but the negotiations hit a snag due to the lowered profitability of the project.

In a bid to secure profits at an early stage, Hitachi requested that the British government raise the price of the electricity to be generated by the plants, which was guaranteed to be purchased in advance. This arrangement also hit a wall as confusion spread in the British political sphere over the nation's planned exit from the European Union. Hitachi, which has a stake in the local subsidiary, would lose some 300 billion yen if the project was cancelled.

Similar trouble has arisen in Turkey. A plan to export nuclear power plants, which began from a close relationship between Prime Minister Abe and Turkish President Recep Tayyip Erdogan, has also run aground.

Under the original plan, Mitsubishi Heavy Industries and other businesses were to build four midsized reactors in Turkey along the coast of the Black Sea at a total estimated cost of 2.1 trillion yen. The amount has more than doubled to 5 trillion yen, due in part to increased cost estimates for earthquake-proof measures. This development now requires the Japanese and Turkish governments to extend additional financial support for the project, but the two sides have apparently failed to reach an agreement.

The Abe administration has thrown its weight behind the export of nuclear power plants as a major element of its economic "growth strategy," with the trade ministry choreographing the moves for the projects. The ministry regards nuclear power generation as one of the main sources of power generation, always protecting and promoting the nuclear power industry.

However, after the Fukushima nuclear disaster in 2011, building such plants within Japan has become difficult, and the ministry hoped to maintain the size of the nuclear power industry through exports and the transference of relevant technologies and human resources to the next generation. But this has ignored the fact that international trends have shifted since the disaster.

The construction cost for nuclear power plants has grown exponentially with the increased focus on safety measures, while renewable energy sources such as solar power have become cheaper with the

rapid expansion of their use. As such, the relative price competitiveness for nuclear power reactors has declined; it can no longer be called an "inexpensive energy source."

According to the International Energy Agency (IEA), global investments for new nuclear power plant construction in 2017 dropped to 30 percent of the previous year's figure. Global policy is moving away from nuclear power plants and instead tipping toward renewable energy sources.

The failure to reflect this trend led to the huge losses incurred by Toshiba Corp., which bought Westinghouse Electric Co. with backing from the trade ministry to pursue its troubled nuclear power projects in the United States.

In 2012, a national referendum in Lithuania voted down a project to build a Hitachi nuclear power plant, and then in 2016, Vietnam scrubbed a similar construction plan. The same year, Japan signed a nuclear cooperation agreement with India, eyeing exports of nuclear power plants despite concerns about the proliferation of nuclear materials to the nuclear weapon state outside of the Nuclear Non-proliferation Treaty. Still, the export plan has yet to materialize. It is clear that the export of nuclear power plants has been backed into a corner for quite some time already.

It is Japan that caused one of the world's worst nuclear accidents, and is now working on decommissioning the damaged reactors in a process that will take decades to complete. Many people in Japan hold deeply rooted feelings against the government's placement of nuclear power plant exports as a pillar of the nation's growth strategy.

In response, the government has simply justified the projects by saying they will contribute to developing countries with a growing power demand by offering a cheap source of power to support their economic growth. Rising construction costs, however, has rendered this explanation moot.

Japan still has many nuclear power plants to run, and the decommissioning of older plants will soon be in full-swing. The latest technology and skilled experts are vital for these projects to be completed successfully.

Continuing to focus on nuclear power export, however, will lead Japan nowhere. The government should take another look at global trends, and review the basis of its nuclear power policy to rid Japan of nuclear power as soon as possible.

January 22, 2019

## **Greenpeace report on contaminated water tanks**

## **Technical failures increase risk of contaminated Fukushima water discharge into Pacific – Greenpeace**

<https://www.greenpeace.org/international/press-release/20351/technical-failures-increase-risk-of-contaminated-fukushima-water-discharge-into-pacific-greenpeace/>

*by Greenpeace International*

Tokyo, 22 January 2019 – The nuclear water crisis at the Fukushima Daiichi plant has been compounded by multiple technical failures and flawed decision making driven by short term cost cutting by the Japanese government and TEPCO, a new Greenpeace Germany analysis concludes.

The report details how plans to discharge over 1 million tonnes of highly contaminated water into the Pacific Ocean was proposed by the same Government task force that ignored alternative options that would have avoided threatening further contamination of the ocean.

“The decision not to develop water processing technology that could remove radioactive tritium was motivated by short term cost cutting not protection of the Pacific ocean environment or the health and livelihoods of communities along the Fukushima coast,” said Kazue Suzuki, Energy Campaigner at Greenpeace Japan. “We have raised the water crisis with the UN International Maritime Organization and firmly stand with local communities, especially fisheries, who are strongly opposed to any plans to discharge contaminated water into their fishing grounds.”

The report concludes that the water crisis remains unresolved, and will be for the foreseeable future. The only viable option to protect the environment and the communities along the Fukushima coast being long term storage for the contaminated water.

The discharge option for water containing high levels of radioactive tritium was recommended as least cost by the Government’s Tritiated Water Task Force and promoted by Japan’s Nuclear Regulation Authority (NRA). The Task Force concluded in 2016 that “sea discharge would cost 3.4 billion yen (US\$30 million) and take seven years and four months to complete. It concluded that this was cheapest and quickest of the five methods.” However, technical proposals for removing tritium were submitted to the same Government Task Force by multiple nuclear companies with estimated costs ranging from US\$2- US\$20 billion to US\$50-US\$180 billion depending on the technology used. These were dismissed as not viable but without detailed technical consideration.

TEPCO has claimed since 2013 that its ALPS technology would reduce radioactivity levels “to lower than the permissible level for discharge.” However, in September 2018 TEPCO admitted that the processing of over 800,000 tons of contaminated water in 1000 storage tanks, including strontium, had failed to remove radioactivity to below regulatory limits, including for strontium-90, a bone seeking radionuclide that causes cancer. TEPCO knew of the failure of the technology from 2013. The Greenpeace report details technical problems with the ALPS system.

The Fukushima Daiichi site, due its location, is subject to massive groundwater contamination which TEPCO has also failed to stop. Each week an additional 2-4000 tonnes of contaminated water is added to the storage tanks.

“The Japanese government and TEPCO set an objective of ‘solving’ the radioactive water crisis by 2020 – that was never credible. TEPCO has finally admitted that its ALPS technology has failed to reduce levels of



strontium, and other hazardous radioactivity, to below regulatory limits,” said Shaun Burnie, nuclear specialist with Greenpeace Germany.

“The reality is there is no end to the water crisis at Fukushima, a crisis compounded by poor decision making by both TEPCO and the government. Discharging into the Pacific is the worst option and must be ruled out. The only viable option, and it’s not without risks, is the long term storage of this water in robust steel tanks over at least the next century, and the parallel development of water processing technology.” Greenpeace offices are calling on the government and TEPCO to urgently reassess options for the long term management of highly contaminated water at Fukushima Daiichi. Paramount in any future decision making should be the protection of the environment and the interests of the those in the front line – the communities and fishing industries of Fukushima’s Pacific coast.

END

**Photos and video can be accessed here**

**Notes:**

“TEPCO Water Crisis” briefing can be accessed here

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January 28, 2019

## New robot to inspect molten fuel



## **TEPCO unveils device for handling nuclear debris**

[https://www3.nhk.or.jp/nhkworld/en/news/20190128\\_32/](https://www3.nhk.or.jp/nhkworld/en/news/20190128_32/)

The operator of the Fukushima Daiichi nuclear power plant has unveiled a device that could become the first to directly handle fuel debris inside one of the facility's crippled reactors.

Tokyo Electric Power Company showed the device to the media on Monday ahead of a survey scheduled for next month at the plant's Number 2 reactor. It's one of the reactors that experienced meltdowns in 2011.

TEPCO has found what appears to be a mixture of molten nuclear fuel and structural parts at the bottom of the reactor's containment vessel.

The device, which is equipped with a camera and a dosimeter, is attached to a pole that extends up to 15 meters long. Its tip works like tongs, allowing it to pick up the possible debris.

TEPCO plans to send the device into the containment vessel to see how hard the possible debris is, and whether it can be moved.

Removing debris is a key step toward decommissioning the plant.

Toshihiro Yasuda of Toshiba Energy Systems & Solutions, which developed the device, says the survey is an important step toward coming up with ways to remove the debris.

In the second half of fiscal 2019, which starts in April, TEPCO plans to conduct a more detailed survey that would involve extracting a small sample of the debris.

The company aims to decide by March 2020 at which reactor to start removing debris. It hopes to start the work in 2021.

See also : <http://www.asahi.com/ajw/articles/AJ201901290020.html>

January 29, 2019

## **Toshiba unveils robot to probe melted Fukushima nuclear fuel**

THE ASSOCIATED PRESS

Toshiba Corp. unveiled a remote-controlled robot with tongs on Monday that it hopes will be able to probe the inside of one of the three damaged reactors at Japan's tsunami-hit Fukushima nuclear plant and grip chunks of highly radioactive melted fuel.

The device is designed to slide down an extendable 11-meter (36-foot) long pipe and touch melted fuel inside the Unit 2 reactor's primary containment vessel. The reactor was built by Toshiba and GE.

An earlier probe carrying a camera captured images of pieces of melted fuel in the reactor last year, and robotic probes in the two other reactors have detected traces of damaged fuel, but the exact location, contents and other details remain largely unknown.

Toshiba's energy systems unit said experiments with the new probe planned in February are key to determining the proper equipment and technologies needed to remove the fuel debris, the most challenging part of the decommissioning process expected to take decades.

The three reactors at the Fukushima plant suffered core meltdowns after a massive 2011 earthquake and tsunami damaged key cooling systems.

In last year's probe, a camera developed by Toshiba Energy Systems & Solutions Corp. and the International Research Institute for Nuclear Decommissioning found large amounts of deposits in that area, including parts that resembled pebbles or gravel.

The 30-centimeter (12-inch) long robot unveiled Monday will carry a radiation dosimeter, thermometer, LED lights, a camera and a pair of tongs as it slowly slides down from a pipe. The probe, attached by a cable on its back, is to dangle from the pipe and descend to the bottom of the reactor vessel's pedestal, a structure directly below the core from which the melted fuel fell.

Toshiba plans to use the new device to touch and grip the deposits with the tongs, which can hold a lump as wide as 8 centimeters (3 inches) weighing up to two kilograms (4.4 pounds), to investigate its hardness and other details, said Jun Suzuki, a Toshiba ESS group manager for the project.

"Until now we have only seen those deposits, and we need to know whether they will break off and can be picked up and taken out," Suzuki said. "Touching the deposits is important so we can make plans to sample the deposits, which is a next key step."

The probe will mainly examine the fuel debris' physical condition rather than its radioactive components or other details which require actual sampling and safe storage.

"We are taking one step at a time," said Tsutomu Takeuchi, a Toshiba ESS senior manager for the Fukushima decommissioning project. "First we'll find out if those deposits can be picked up." If the device is unable to lift anything, that's also a key finding, he said. In that case, they will need a cutting device to tear off a sample piece.

TEPCO and government officials plan to determine methods for removing the melted fuel from each of the three damaged reactors later this year so they can begin the process in 2021.

February 13, 2019

## TEPCO probes nuclear debris in containment vessel of No.2 reactor

### Tepco carries out examination of melted Fukushima reactor fuel by remote-controlled probe

<https://www.japantimes.co.jp/news/2019/02/13/national/tepcocompletesphysicalexaminationprobe-melted-reactor-fuel/#.XGXAEqBCeos>

Kyodo

The operator of the disaster-hit Fukushima No. 1 nuclear power plant said Wednesday it has completed its first attempt to use a remote-controlled probe to manipulate melted fuel accumulating at the bottom of one of the crippled reactors.

During the nearly eight-hour operation, Tokyo Electric Power Company Holdings Inc. inserted the probe that is equipped with a camera, radiation meter and tong-like grips **into the primary containment vessel of the No. 2 reactor.**

Of the six locations that were surveyed, the probe, which is 30 cm tall and 10 cm wide, successfully lifted several centimeters of deposits at five locations, a Tepco official said at a news conference. The deposits in many of those areas resembled gravel.

But in the remaining area, where deposits resembled clay, the probe could not pick up any of the deposited material, indicating it was relatively solid.

The findings from the operation will provide important information to help in the decommissioning of the Nos. 1 to 3 reactors at the plant that suffered core meltdowns in the nuclear crisis that began in March 2011, according to Tepco.

The No. 2 reactor was in operation when the crisis began and some fuel is believed to have melted through the reactor pressure vessel, a container that is supposed to hold the fuel, and accumulated at the bottom of the outer primary containment vessel.

In the latest examination, Tepco focused on checking the nature of the deposits and did not plan to remove samples. The extraction of samples is expected to be carried out in the second half of the fiscal year starting in April, the plant operator said.

The probe was inserted through a penetration hole that provides access to the primary containment vessel. It is capable of holding an object weighing up to 2 kilograms.

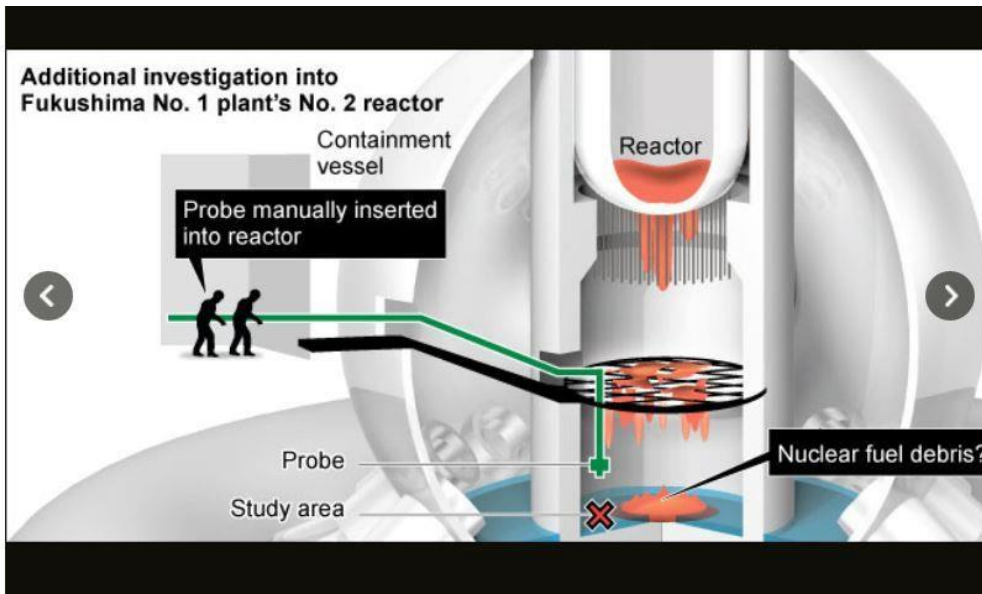
**The probe had to be remotely controlled due to the extremely high radiation levels inside the reactor.**

If the fuel debris is in an extractable condition, Tepco will have a better chance of removing the deposits. But if it is too hard to pick up, Tepco may have to consider developing tools capable of cutting the debris for removal.

**Under the decommissioning road map, Tepco and the central government will decide from which reactor to start removing fuel as well as the method for extraction within fiscal 2019. The actual removal is expected to start in 2021.**

February 14, 2019

## Probe lifts nuclear debris from bottom of No.2 for investigation



### 1st contact made with melted nuclear fuel at Fukushima plant

<http://www.asahi.com/ajw/articles/AJ201902140041.html>

By CHIKAKO KAWAHARA/ Staff Writer

A probe touched melted nuclear fuel debris in a destroyed reactor at the Fukushima No. 1 nuclear plant, a long-awaited milestone in the battle toward decommissioning, Tokyo Electric Power Co. said Feb. 13.

The rod-like probe, fitted with 3-centimeter-long claws, lifted pieces of the nuclear fuel debris during the eight-hour operation at the bottom of the No. 2 reactor at the plant, the utility said.

Data obtained through the investigation, such as the **hardness, temperature and radioactivity of the debris, will be used to develop equipment and containers for the eventual removal of the melted fuel.** The probe, which was recovered after the investigation, also took pictures of the inside of the containment vessel.

No debris was taken outside the reactor, according to TEPCO.

The retrieval process will start in earnest at one of the reactors in 2021, according to the plan drawn up jointly by the central government and TEPCO.

It was **the first physical contact with melted fuel** at the plant since the Great East Japan Earthquake and tsunami on March 11, 2011, caused the meltdowns of three reactors there.

**It took TEPCO years just to locate the melted fuel debris because of the high radiation levels in the reactor buildings.**

The utility said workers manually inserted the probe through a crack created early in the disaster on the side of the No. 2 reactor's containment vessel.

The probe, which resembles a prize-grabbing crane machine at a game arcade, was also equipped with a dosimeter and a camera. It can extend 15 meters and can lift pieces up to 8 centimeters in diameter and weighing 2 kilograms.

Workers remotely operated the probe from the operating room in a building close to the No. 2 reactor building, and lowered it to the bottom of the reactor's containment vessel.

The probe lifted pebble-like nuclear fuel debris and structural parts up to 8 cm in diameter at five spots in the 2,500-square-cm area that was investigated. It failed to pick up debris at one spot.

TEPCO said the probe could not lift clay-like debris likely because it had adhered to the bottom of the containment vessel.

The probe also touched nuclear fuel debris lying at several spots on the lattice-shaped scaffold for workers directly below the reactor's pressure vessel.

The previous investigation of the No. 2 reactor in 2017 located melted fuel debris on the scaffold. But a robot deployed for a further investigation broke down on its way to the debris.

In a survey last year, the utility used the rod-like probe to take images of the inside of the reactor.

TEPCO is expected to remove a small amount of nuclear fuel debris in the second half of fiscal 2019 as part of preparations for full-scale retrieval.

February 16, 2019

## Nightmare ahead

### **VOX POPULI: '1st contact' with melted nuclear debris points to nightmare ahead**

<http://www.asahi.com/ajw/articles/AJ201902160016.html>

Traffic safety classes are often held for the benefit of elementary school pupils. But one given earlier this month in Miyako, Iwate Prefecture, was of special significance.

Because of extensive damage done to the local railway system by the Great East Japan Earthquake of 2011, most of the children had never seen a functioning railroad crossing. But they were finally taught the basics of how to safely cross one, according to the Iwate Prefecture edition of The Asahi Shimbun.

"Never walk into the crossing while the alarm is on," warned a railway company worker. "Never cross the tracks where there is no crossing gate" was another crucial advice.

The Asahi story was accompanied by a photo of these children crossing the tracks with their hands raised.

The local train service will reopen between Miyako and Kamaishi on March 23, now that the tsunami-damaged train stations and tracks have been restored.

Eight years after the devastating earthquake and tsunami, life is finally regaining some normalcy in the affected areas. The passage of time reminds me of the grief that confronted the survivors for all those days and months.

But where the flow of time is concerned, an entirely different "world" exists for the Fukushima nuclear disaster and its aftermath.

Tokyo Electric Power Co., the operator of the Fukushima No. 1 nuclear plant, made the first physical contact on Feb. 13 with melted nuclear debris at the bottom of the plant's No. 2 reactor.

A rod-like probe, inserted into the reactor, reportedly picked up lumps of debris the size of small stones. The utility says the project will prove useful when retrieval work starts in earnest in 2021.

Images have been released of the reddish-brown amorphous mass. But its level of radioactivity is still unknown, which means that TEPCO has not even reached the earliest stage of its reactor decommissioning process.

I am acutely reminded again of the magnitude of this irreversible mess.

The technology we are left with is an out-of-control monster. And so long as nuclear power plants remain in operation, there is no guarantee that the same nightmare will not recur--even as we speak.

## 8 years on

<http://akiomatsumura.com/?p=2525>

### **Eight years on, Fukushima Still Poses Health Risks for Japanese and American Children**

*Akio Matsumura*

#### **High Radiation Levels Continue at Damaged Reactors**

On March 11, 2019, we commemorate the 8th anniversary of the Fukushima nuclear disaster. To an outside observer, this anniversary passes as a technical progress report, a look at new robot, or a short story on how lives there are slowly returning to normal.



A child inspected in Fukushima prefecture, Japan

Yet in Japan, the government has not figured out how to touch or test the irradiated cores in the three crippled reactors, which continue to contaminate water around the site of the melt down. The government does not know where it will put that radioactive material once it can find a way to move it. Meanwhile, the government and site operator are running out of room to store the contaminated water, which is filling up



more and more tanks. The cleanup is estimated to take forty years and the cost is estimated at \$195 billion.

The latest publicly released findings of radiation levels are from 2017, when Tokyo Electric Power Company had to use a remote-controlled robot to detect the levels in Reactor 2, since no human can approach the crippled reactor. The rates read 530 sieverts per hour, the highest since the March 2011 meltdown. We have no reason to believe that they have fallen since then. Remote-control robots are being used in the other reactors as well, indicating that radiation levels are similarly high there. Even using the robot, work can only be carried out for very short times, since the robots can only stand 1000 sieverts of exposure – less than two hours in this case.

This is an extremely high amount of radiation. After TEPCO published the rate, the *Asahi Shimbun* reported that “an official of the National Institute of Radiological Sciences said medical professionals have never considered dealing with this level of radiation in their work.”

The *Japan Times* quoted Dr. Fumiya Tanabe, an expert on nuclear safety, who said that the “findings show that both the preparation for and the actual decommissioning process at the plant will likely prove much more difficult than expected.”

### **Fukushima’s Children Need International Attention**

There have been many victims of this disaster. Thousands of people have been displaced from their homes. Local fishermen are worried that the government will proceed with its plan to dump the storage tanks of contaminated water into the ocean. Others worry that the flow of the radioactive wind and contaminated water are reaching North America and will continue to do so for the next forty years. Above all of these important issues, it is the children of Fukushima who most need our attention. They are at risk of higher rates of cancer because of their exposure to the contamination from the initial explosion. In Chernobyl, the only comparable case we have, more than 6,000 cases of thyroid cancer were found in children according to the UN through 2005.

There is evidence that thyroid cancer rates are higher among Fukushima’s children than the national population, but it is a latent disease: it is still too early to tell what the full impact will be. But it is clear the case needs action.

Scientists will always offer different opinions, swayed first by uncertainty, but also, sadly, by politics, money, and ambition. Some will claim that the evidence has been exaggerated, underestimated, or that perhaps we’re at too early a stage to be certain. Or that we need more time to clarify the results. I have seen many instances of these arguments at the United Nations and international science conferences. Why do we wait and make another mistake?

Helen Caldicott, a medical doctor and founding president of Physicians for Social Responsibility, part of a larger umbrella group that was awarded the Nobel Peace Prize in 1985, wrote: “The truth is that most politicians, businessmen, engineers and nuclear physicists have no innate understanding of radiobiology and the way radiation induces cancer, congenital malformations and genetic diseases which are passed generation to generation. Nor do they recognize that children are 20 times more radiosensitive than adults, girls twice as vulnerable as little boys and fetuses much more so.”

### **UNICEF Can Lead**

We face many complex challenges of climate change, poverty alleviation, and national security. The health and welfare of children must always be our top priority. They are our future; our deepest purpose is to care and provide for them. By deciding not to fully investigate the effects of Fukushima, we fail them. We all agree with that personally, but which institution is best positioned to carry out the mission? To me, UNICEF, the UN International Children's Emergency Fund, is the only answer. Indeed, putting children above national security is at UNICEF's core. Maurice Pate, an American humanitarian and businessman who joined UNICEF at its inception in 1947, agreed to serve as the Executive Director upon the condition that UNICEF serves the children of "ex-enemy countries, regardless of race or politics." In 1965, at the end of Pate's term, the organization won the Nobel Peace Prize.

To this day, its mission includes a commitment to "ensuring special protection for the most disadvantaged children – victims of war, disasters, extreme poverty, all forms of violence and exploitation and those with disabilities." The children of Fukushima deserve the protection of UNICEF.

## Removing the 566 fuel assemblies from No.3 reactor

### TEPCO training workers to shift spent nuclear fuel from March

<http://www.asahi.com/ajw/articles/AJ201902160021.html>

By CHIKAKO KAWAHARA/ Staff Writer

Tokyo Electric Power Co. has instituted a rigorous training program so technicians can proceed with the removal in late March of spent nuclear fuel from the No. 3 reactor of the Fukushima No. 1 nuclear power plant.

A reporter from The Asahi Shimbun was permitted to observe a session Feb. 15 that involved using a huge 50-ton crane to lift and move a container, simulating the conditions under which spent nuclear fuel would be recovered.

The No. 3 reactor has **566 nuclear fuel assemblies stored in the fuel pool on the top floor of the reactor building.**

Moving the spent nuclear fuel is considered an urgent task due to fears the crippled facility could be further damaged in the event of another major earthquake or tsunami.

Plans call for removing seven fuel assemblies in late March.

A new roof for the reactor building was completed last year to contain any radioactive fallout.

A hydrogen explosion blew the original roof apart shortly after the magnitude-9.0 Great East Japan Earthquake of March 2011 that generated towering tsunami, inundating the plant's cooling system and triggering the nuclear disaster.

March 2019

## Simply Info.org 2019 report on Fukushima



March 2019 | [www.SimplyInfo.org](http://www.SimplyInfo.org) | [info@simplyinfo.org](mailto:info@simplyinfo.org)

March 7, 2019

## Contaminated water and so many challenges



Nearly 1,000 water tanks are scattered across the grounds of the Fukushima No. 1 power plant. Some are over 10 meters tall, hold 1,000 to 1,200 tons and take seven to 10 days to fill. | POOL / VIA TOKYO PRESS PHOTOGRAPHERS ASSOCIATION

### **Eight years after triple nuclear meltdown, Fukushima No. 1's water woes show no signs of ebbing**

<https://www.japantimes.co.jp/news/2019/03/07/national/eight-years-triple-meltdown-fukushima-no-1s-water-woes-slow-recede/#.XIjHRLjjLyQ>

by Ryusei Takahashi

Staff Writer

This is the first in a series examining how the northeast and the nation are progressing with efforts to deal with the March 2011 earthquake, tsunami and nuclear crisis.

OKUMA, FUKUSHIMA PREF. - Nearly a thousand storage tanks are scattered across the Fukushima No. 1 nuclear power plant, holding a staggering 1.1 million tons of treated water used to keep its melted reactor cores cool while they rust in the sun.

Plant manager Tokyo Electric Power Company Holdings Inc., or Tepco, plans to build more of the gigantic tanks to hold another 0.27 million tons, which is roughly the equivalent of 108 Olympic-size swimming pools. The new tanks are expected reach full capacity in four or five years.

Each tank takes seven to 10 days to fill and holds between 1,000 to 1,200 tons of liquid, Tepco officials told reporters during a tour in February organized by the Japan National Press Club. It's been eight years since Fukushima No. 1 suffered three core meltdowns triggered by tsunami following the Great East Japan Earthquake, but the situation with the tanks may be a sign Tepco has yet to get the facility under control. "Space isn't a big issue at this point in time, but five or 10 years from now, after we've started removing the melted fuel debris, we're going to need facilities to store and preserve it," Akira Ono, president of Fukushima No. 1 Decontamination and Decommissioning Engineering Co., a Tepco unit overseeing the decommissioning process, said at a news conference in January.

**The water issue is eating up both space and resources,** but a solution is unlikely to emerge anytime soon.

The International Atomic Energy Agency published a report in November that said the physical constraints of the site "leave little room for additional tanks" beyond what Tepco has allocated.

The IAEA report went on to say it believes storing tainted water in "above ground tanks . . . can only be a temporary measure while a more sustainable solution is needed" and a "decision on the disposition path should be taken urgently."

Beyond 2020, Tepco has not allocated any additional space for holding treated water on the site and has no plans to do so at this time. The utility said the tanks will likely become a headache if they remain at the plant.

"At that point, we may need to rethink how we're using the space," Ono said.

Eight years ago when the monstrous tsunami hit, the entire plant lost power and reactors 1, 2 and 3 lost coolant, causing their cores to overheat. The fuel rods consequently melted, dripping molten fuel that burned through their pressure vessels and pooled in their primary containment vessels. Reactors 1, 3 and 4 then suffered hydrogen explosions.

Tepco must inject water into the reactors indefinitely to keep the melted cores cool, but water tainted by contact with the fuel and associated debris has been leaking from the damaged containment vessels and into the basements of the reactor buildings, where tons of fresh groundwater flows in daily through holes in their damaged walls.

The contaminated water is pumped out and passed through a filtration device called the Advanced Liquid Processing System — which is supposed to remove every radionuclide except for tritium — and stored in the tanks.

Tepco has taken steps to limit the amount of groundwater seeping into the reactor buildings, including wells to intercept and divert it and an underground ice wall around the buildings to block any inflow.

According to Tepco, however, about 83 tons of water are seeping into the reactor buildings each day.

Although this is an improvement from some 300 tons in previous years, Tepco must keep making more tanks.

At the moment, Tepco is waiting for a government panel's advice on what to do with the tritium-tainted water. The panel is considering five disposal methods: ground injection, sea discharge after diluting the tritium concentration, discharging it as steam, discharging it as hydrogen, and solidification followed by underground burial.

Tritium is a radioactive form of hydrogen that forms naturally and is a common byproduct of nuclear reactors. In large quantities, exposure can be dangerous, especially if ingested or inhaled. Processed adequately, however, tritium is believed to pose little to no health risk. For instance, tritium is present in regular tap water, but no ill effects have been confirmed, according to the Ministry of Economy, Trade and Industry.

Discharging treated tritium water into the ocean is a common practice at nuclear power plants around the world.

Thus some experts, including Toyoshi Fuketa, who heads the Nuclear Regulation Authority, think this is the best option for Fukushima.

“Prolonging the storage of water in those tanks will make decommissioning the power plant that much more difficult for Tepco. Limited resources are being used to use these tanks as storage, not just money but other resources as well,” Fuketa said at a news conference in September.

“The longer we store the water, the greater the influence it will have on the decommissioning of the Fukushima No. 1 power plant.”

But there are concerns about the impact an ocean discharge may have on fisheries still trying to recover from the nuclear crisis.

Fishing in the area has resumed on a trial basis and workers still perform radiation checks before shipping their hauls to fish markets. The waters off Fukushima Prefecture are at the confluence of two ocean currents — the Oyashio from the north and Kuroshio from the south — which make for the good fishing grounds that have been a vital part of the agrarian prefecture’s economy.

Eight years after the meltdowns, however, residents are still struggling to convince the world that fish from the area are safe to eat. Many believe public perception alone will cripple Fukushima’s fishing industry anew if the tainted water is expelled into the ocean — even if the tritium has been reduced to below international standards.

Trust issues continue to plague Tepco after it claimed ALPS was filtering every radionuclide from the cooling water except tritium. Last August it came to light that the allegedly treated water still contained other dangerous contaminants, including iodine, cesium and strontium. Some of the concentrations were above current safety limits.

This has further angered Fukushima residents and made it harder to get their approval for dumping the water held by the tanks into the sea.

During a public hearing hosted by METI in August, participants urged the government and Tepco to consider finding an off-site location to store the water instead of discharging it into the ocean.

“Without a national debate and without the understanding of Japanese citizens or the countries importing our products, as a fisherman of Fukushima Prefecture, I strongly oppose the plan to discharge the treated water into the ocean,” Tetsu Nozaki, chairman of the Fukushima Prefectural Federation of Fisheries Cooperative Association, told the hearing.

“To release the ALPS-treated water into the ocean, at this time, would deal a disastrous blow to the fishermen of Fukushima and rob them of their hard work and motivation,” he said.

Thierry Charles, deputy director-general in charge of nuclear safety at the Radioprotection and Nuclear Safety Institute in France, admitted it is a difficult problem to address, given the volume of water concerned and the tritium content.

Charles believes a controlled release into the ocean would be viable “under conditions to be defined.”

“In this respect, the societal acceptance of this solution should be based on the broad involvement of all stakeholders at the various stages of the process, by explaining the different options studied,” he told *The Japan Times*.

Meanwhile, the crippled plant faces other serious challenges — including how to extract the molten fuel. “How we remove the melted fuel debris from the reactors. That’s the most important point. . . . The water tanks are not a big problem,” said Hiroshi Miyano, a professor at Hosei University’s Graduate School of Engineering and Design and chair of the decommissioning committee of the Atomic Energy Society of Japan.

In February, Tepco inserted a remote-controlled probe into reactor 2 to make contact with material inside the containment vessel believed to be melted fuel. The machine — equipped with a camera, thermometer and dosimeter — was designed to poke and gently lift sediment to test its physical properties.

This was the first time a machine had touched melted fuel debris inside any of the crippled reactors at Fukushima No. 1.

The removal process at the plant is slated to begin in 2021. Before that part begins, though, research from the site will be used to make various remote-controlled probes capable of navigating the unique scenarios in each unit. Reactor 3, for example, remains largely submerged and requires an aquatic probe.

Miyano said Tepco and the government — with the help of scientists, nuclear physicists and engineers from around the world — are inventing new technologies as they devise a way to remove the debris.

He added that no country has ever attempted to use remote-controlled robots to remove melted fuel from the inside of a crippled nuclear reactor.

“This is the first time, so there will be many challenges.”

*Éditions de Fukushima*

## **Livres numériques édités**

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