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Possible nuclear fuel find raises hopes of Fukushima plant breakthrough

Operator says it has seen what may be fuel debris beneath badly damaged No 2 reactor, destroyed six years ago in triple meltdown

Material found below the damaged No 2 reactor at Fukushima nuclear plant, believed to be melted fuel, from footage taken on 30 January. Photograph: Reuters

Hopes have been raised for a breakthrough in the decommissioning of the wrecked Fukushima Daiichi nuclear plant after its operator said it may have discovered melted fuel beneath a reactor, almost six years after the plant suffered a triple meltdown.

Tokyo Electric Power (Tepco) said on Monday that a remote camera appeared to have found the debris beneath the badly damaged No 2 reactor, where radiation levels remain dangerously high. Locating the fuel is the first step towards removing it. The operator said more analysis would be needed before it could confirm that the images were of melted uranium fuel rods, but confirmed that the lumps were not there before Fukushima Daiichi was hit by a powerful earthquake and tsunami on 11 March 2011. (…)

If Tepco can confirm that the black mass comprises melted fuel, it would represent a significant breakthrough in a recovery effort that has been hit by mishaps, the buildup of huge quantities of contaminated water, and soaring costs. "This is a big step forward as we have got some precious data for the decommissioning process, including removing the fuel debris," a Tepco official said.

Using a remotely controlled camera attached to the end of a 10.5-metre-long telescopic arm, Tepco technicians located black lumps on wire-mesh grating just below the reactor's pressure vessel, local media reported. The company plans to send a scorpion-like robot equipped with cameras, radiation measuring equipment and a temperature gauge into the No 2 reactor containment vessel next month, according to the Asahi Shimbun. Three previous attempts to use robots to locate melted fuel inside the same reactor ended in failure when the devices were rendered useless by radiation.

Developing the means to remove the fuel – a task Tepco has said will become easier once it can gauge its condition – would be the biggest step forward in the mission to clean up Fukushima Daiichi since the removal of hundreds of spent fuel rods from a damaged reactor building in late 2013.

The delicate, potentially dangerous task of decommissioning the plant has barely begun, however. Japanese media said last week that plans to remove spent fuel from the No 3 reactor building had been delayed, while decommissioning the entire plant was expected to take at least 40 years. In December, the government said the estimated cost of decommissioning the plant and decontaminating the surrounding area, as well as paying compensation and storing radioactive waste, had risen to 21.5 trillion yen ($187bn), nearly double an estimate released in 2013. A government committee estimated that 2.4 trillion yen of the total cost would be passed on to consumers through higher electricity bills.

Justin McCurry in Tokyo, Monday 30 January 2017 20.19 GMT

Is it safe to dump Fukushima waste into the sea?

Japan has called for hundreds of thousands tonnes of irradiated water from the nuclear plant to be released into the Pacific Ocean. Karl Mathiesen looks at the potential impacts

A worker stands in front of storage tanks for radioactive water at the Fukushima Daiichi nuclear power plant. Photograph: Toru Hanai/AP

More than 1,000 tanks brimming with irradiated water stand inland from the Fukushima nuclear plant. Each day 300 tonnes of water are pumped through Fukushima's ruined reactors to keep them cool. As the water washes through the plant it collects a slew of radioactive particles.

The company that owns the plant – The Tokyo Electric Power Company (Tepco) - has deployed filtration devices that have stripped very dangerous isotopes of strontium and caesium from the flow. But the water being stored in the tanks still contains tritium, an isotope of hydrogen with two neutrons. Tritium is a major by-product of nuclear reactions and is difficult and expensive to remove from water.

Now, Japan's Nuclear Regulation Authority (NRA) has launched a campaign to convince a sceptical world that dumping up to 800,000 tonnes of contaminated water into the Pacific Ocean is a safe and responsible thing to do. NRA chairman Shunichi Tanaka has officially called on Tepco to work towards a release. The International Atomic Energy Agency (IAEA) last year also issued a call for a release to be considered and for Tepco to perform an assessment of the potential impacts. For its part, Tepco has said there are no current plans to

release the water. But the Associated Press (AP) reported that company officials are saying in private that they may have no choice.

According to Tanaka, Tritium is "so weak in its radioactivity it won't penetrate plastic wrapping". The substance can be harmful if ingested. According to AP, Tanaka had demonstrated the relatively tiny amount of tritium present in the combined Fukushima standing tanks – 57ml in total – by holding a small bottle half full of blue liquid in front of reporters.

A more useful measure of the amount of tritium is its radioactivity, which is measured in becquerels. According to the NRA, the tanks at Fukushima contain 3.4 peta becquerels (PBq) of tritium.

Despite the number of zeros in this measurement (there are 14), this is not a big number, said Ken Buesseler, a senior scientist at the Woods Hole Oceanographic Institution.

To put it in context, the natural global accumulation of tritium is a relatively tiny 2,200 PBq. The isotope has a half life of 12.3 years and is only created naturally on Earth by a rare reaction between cosmic rays and the atmosphere. By far the largest source of tritium in our environment is the nuclear weapons testing programme of last century, which dumped a total of 186,000 PBq into the world's oceans. Over time this has decayed to roughly 8,000 PBq. Another significant source of tritium are nuclear power stations, which have long dumped tritium-contaminated water into the ocean.

"I would think more has been put into the Irish Sea [from the UK's Sellafield plant] than would ever be released off Japan," said Buesseler. So far, the Fukushima disaster has seen 0.1-0.5 PBq leaked or released into the Pacific.

Even if all of the contaminated water were released into the ocean, it would not contain enough tritium to be detectable by the time it dispersed and reached the US west coast about four years later, said Simon Boxall, an oceanographer at the University of Southampton. "In the broad scale of things, if they do end up putting the material in the Pacific, it will have minimal effect on an ocean basin scale," said Boxall. "In an ideal world, we wouldn't be in this situation. But the question is, what is the safest way forward? In many ways this is a pragmatic solution."

But Boxall said there may be local effects – especially on the already heavily impacted fishing industry – as the contaminated water would take time to disperse. International maritime law prohibits the building of a pipeline to send the waste offshore. Therefore any release would need to be slow. Tepco did not respond to questions regarding the environmental impact study called for by the IAEA.

Despite harbouring few prima facie fears about the 3.4PBq of tritium stored at Fukushima, Buesseler said the lack of transparency surrounding much of the post-tsunami decommissioning process made it impossible to be definitive about the safety of any course of action. "Until you get the hard data, it's hard to say if it's a good idea or not. I want to have independent confirmation of what's in every tank, which isotopes, how much they want to release per day. You get more of 'don't worry, trust us'," said Buesseler

He notes that there have been minor differences between the official Tepco line that all leaks have stopped and Buesseler's own measurements of very low levels of caesium and strontium still entering the ocean from the plant. "It's easy to have conspiracy theories when no-one is independently assessing what is going on," he said.

The push for release will also be a blow to the hopes of US start-up Kurion, and their new parent company Veolia, which was awarded a $10m (£7m) grant from the Japanese government in 2014 to demonstrate that its tritium scrubbing technology could be scaled to meet the challenge of the Fukushima problem. The plan would create 90,000 tonnes of hydrogen gas, which Kurion said could be used to power vehicles. Neither Tepco, nor Kurion, responded to requests for cost estimates of implementing this technology at the site. Kurion's website calls it "cost-effective" and has said it could have its demonstration plant running within 18 months.

These costs are fundamental to the question of whether to release the material, because whatever they are, it is the price Japan seems unwilling to pay to fully clean up the lingering mess at Fukushima.

Karl Mathiesen, Wednesday 13 April 2016 14.43 BST

Decommissioning Nuclear Power Plants - Fact Sheets

This fact sheet explains the process of decommissioning a nuclear power plant after it is removed from service. This regulated process includes the removal and disposal of radioactive components and materials.

Key Facts

- Decommissioning is the process by which nuclear power plants are retired from service and terminate the operating licenses granted by the U.S. Nuclear Regulatory Commission. (…)
- To prepare for eventual decommissioning of a nuclear power plant, the NRC requires the companies that operate them to provide assurance that **funds will be available** to decommission the facility. (…)

Making the Transition From Operations to Decommissioning

After closure of a nuclear power plant, the licensee has to reduce the residual radioactivity to safe levels. (…) The site must be decommissioned within 60 years of the plant ceasing operations. The decommissioning process involves **removing the used nuclear fuel from the reactor, placing it into the used fuel pool**, and eventually into **dry** storage containers (which can be stored on-site or transported off-site); dismantling systems or components containing radioactive products (e.g., the reactor vessel); and **cleaning up or dismantling contaminated materials from the facility**. Contaminated materials can be disposed of in two ways: decontaminated on-site or removed and shipped to a waste-processing, storage or disposal facility. (…)

The companies that operate nuclear power plants can use one or both of two options[1] to decommission their facilities: SAFSTOR (Safe Storage) or DECON (Decontamination).

Generally, sites must spend no longer than 50 years in SAFSTOR to allow up to 10 years for decontamination. The entire process must be completed within 60 years.

In SAFSTOR, a nuclear plant is kept intact and placed in protective storage for an extended period of time. This allows the radioactive elements in components to decay to stable elements while the trust fund accrues interest. During this time, the main components of the plant remain in place, including the reactor vessel, fuel pools, turbine and other elements. All fuel is removed from the reactor vessel and placed in fuel pools or dry storage on-site. (…)

The plant is dismantled in a process similar to the DECON option once radioactivity has decayed to lower levels and the safety risk to workers is substantially reduced.

In DECON phase, the operator first decontaminates or removes contaminated equipment and materials. The removal of used nuclear fuel rods and equipment—which accounts for over 99 percent of the plant's radioactivity—lowers the radiation level in the facility and significantly reduces the potential exposure to workers during subsequent decommissioning operations. DECON can take five years or more.

(…)