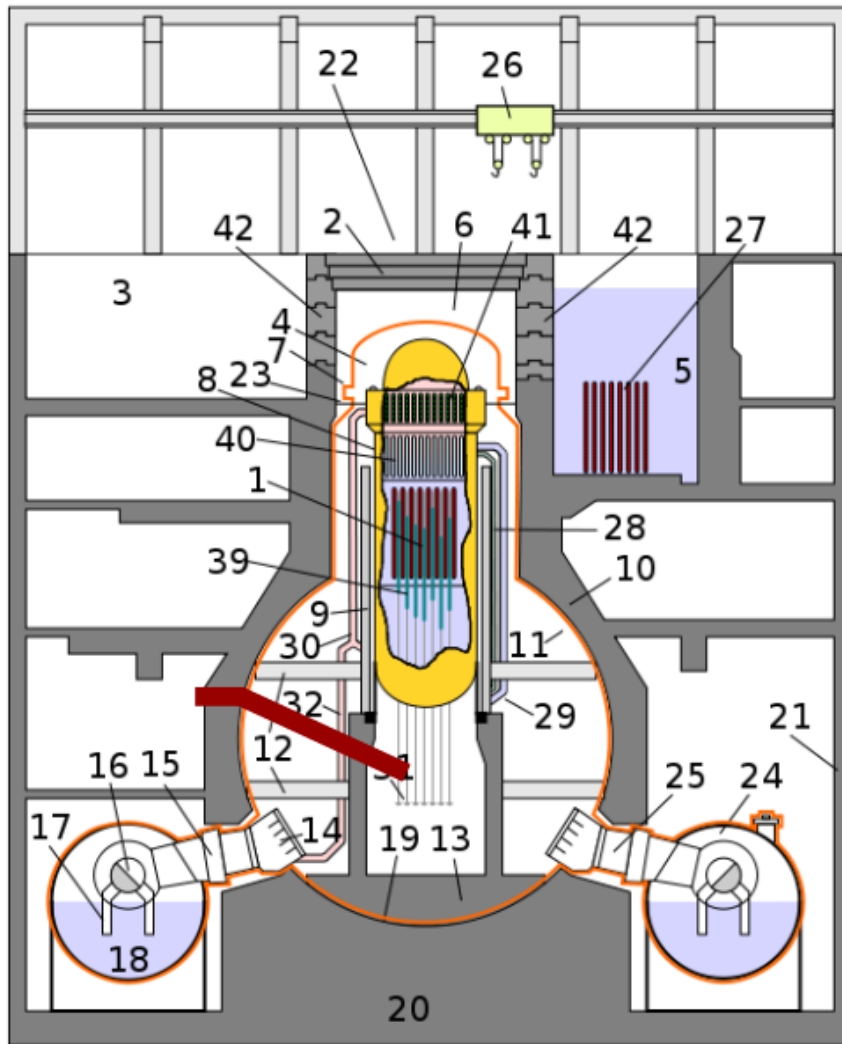


# Fukushima - the first observations inside reactor 2



Bilden tagen från Wikipedia: <http://tinyurl.com/pxo24gq>

Last week Tepco reported that for the first time a camera and measurement instruments had been inserted into the primary containment vessel (PCV) of reactor 2 at the Fukushima Dai-ichi nuclear power plant. Here are some comments about the observations, followed by links to pictures and other information.

## What has happened?

Tepco has cut a hole through the PCV of reactor 2 and

inserted a camera and measurement devices about 8 meters into an area directly below the reactor pressure vessel (RPV). The pictures from the camera show indications of that the reactor core, i.e., the fuel, has melted through the RPV and through the floor of the platform below the vessel. The floor consist of metal grating and in the pictures the different segments of grating are covered with deposits that probably are from the melted fuel and other materials. It is difficult to interpret in detail what is seen in the pictures but a hole is clearly seen where one segment of grating is missing. The drawing above ([the original is from Wikipedia](#)) has a red indication showing the approximate path that the camera and the instruments were inserted.

This is the first in a long series of investigations with the objective to localize the remains of the nuclear fuel and observe other conditions within the PCV. The purpose is to obtain enough information so that a strategy can be planned for how to take care of the fuel, followed by decontamination and decommissioning.

Most likely the parts of the nuclear fuel that melted through the RPV have continued straight down within the PCV. The hole in the grating is a clear indication of it having been destroyed by the hot fuel. A few meters below the grating is a concrete floor that is several meters thick, and is part of the PCV. The melted fuel has probably dissolved part of the concrete, this gives rise to chemical reactions that are both endothermic (which consumes energy and lowers the temperature) and exothermic (which releases energy and increases the temperature), the net effect though should be a cooling effect. Eventually the melted fuel may have gone through the metal lining of the primary containment vessel (indicated with an orange line in the figure) but there is no indication, and not very likely, that the fuel would melt through the entire depth of the thick concrete floor.

**As expected high levels of radiation was measured**

This is the first time an investigation has come this far into reactor 2, and thus it is the first time it has been possible to measure such high levels of radioactivity. The reason is that these areas within the PCV are where parts of the fuel may found. Dose rates up to 530 Sievert per hour have been recorded. This may seem like very much, but the dose rates within the RPV during normal operation are several orders of magnitude higher. Nevertheless, the radiation levels are so high that it is not possible to work there for a human. A full body dose of 5 Sievert will lead to acute radiation sickness, very likely with lethal outcome. This means that a human would suffer lethal doses within a minute at the position where the high doses were recorded. Normal doses to humans are in most countries 2-5 thousands of a Sievert over a year, i.e., 2-5 milli-Sievert per year, mainly from natural sources and with a minor contribution from medical examinations.

### **An important step in the recovery work**

The recorded levels of radiation were inside the PCV and have been anticipated, further investigations will most likely record even higher values. Some media reports may give the impression that there has been some sort of major leak out of the reactor, but the recorded values are from the inside of the PCV from the carefully planned investigation. Since the accident in March 2011 measurements of the air, water and the ground are performed continuously, and isotope analysis is regularly performed on taken samples. A new leak outside of the PCV would therefore be easily detected in the near surroundings. For the same reason a complete melt-through of the core down through the thick concrete floor would be clearly discovered, since isotope analysis may clearly identify the substances that would come from the damaged fuel.

The large releases from reactor 2 in March 2011 of Cesium and other easily dissolved elements, mainly in gas form,

have occurred through other routes during the event of the core meltdown. Which route is still not clear, but the increased pressure within the PCV during the meltdown probably lead to cracks somewhere, allowing the gases to be released. The substances that remain within the damages fuel are not as easily released as the more easily dissolved elements.

## **What next?**

The investigation of last week will be followed by others in a process that will take many years to perform, and meanwhile we should anticipate further reports about successes as well as failures. It should be pointed out that there are experiences of decontamination after other nuclear meltdowns, in particular the one at Three Mile Island (Harrisburg) in 1979, but the extent of the reactor failures in Fukushima is much larger which means larger challenges and a substantially longer time plan for completing the project. The high radiation levels are challenging, not the least because it damages the electronics in robots and remotely controlled instruments.

## **Links**

Tepcos press release and related material

- [Press release from 31 Januari 2017.](#)
- [Handout](#) (pdf) with pictures of normal conditions below the reactor pressure vessel (the tubes above are control rod drives that are inserted up through the reactor pressure vessel) and a few of the pictures taken during the investigation.
- [Handout](#) (pdf) with pictures and explanations about the investigation.
- [Link with photos from the investigation.](#)
- [Link with merged photos.](#)

Other links and comments

- [Video clip in news program at the TV channel NHK](#) (in Japanese).
- [A good explanation written by Azby Brown of Safecast.](#)
- [The Wikipedia page](#) where the picture above is taken from.