

Fukushima: A maximum-level accident in Unit 1

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We have suspected it for some time, but it is nevertheless staggering to see TEPCO, operator of the Fukushima nuclear reactor, admit it: **Unit 1's melted core has created holes in its pressure vessel in several places!** Or to express it with the operator's sense of understatement: "Holes have been created by melted nuclear fuel at the bottom of the No. 1 reactor's pressure vessel." [1] In short, **this is the maximum-level of accident that can occur in a nuclear reactor of this type.** The final barrier, in other words the pressurized vessel enclosing the nuclear fuel, the vessel meant to be the last rampart against radioactive emissions to the outside world - has been breached!

According to the Kyodo News press agency, TEPCO declared "it has found multiple holes adding up to several centimeters in welded piping." A situation which hardly surprised a welding specialist who told us to what degree he feared this phenomenon. We wish to express our thanks to him for explaining to us just why he had feared this type of major problem from the beginning. "The four reactors and the surrounding equipment are going to be reduced to sieves!" he predicted. In fact he worried about the reaction of the metals in the pressure vessel - and in various pipes - to the very high temperatures of the reactor meltdown, but also about how they responded when - as was the case - they were subjected to intensive corrosion, owing to the salt injected when seawater was used for cooling.

He especially drew our attention to how fragile **the stainless steels used at the Fukushima plant are.** This specialist did not see how the stainless steel used at Fukushima (304L, in specialist jargon [2]) would be able to withstand what had happened, especially in the "reactor casing itself - **the cracks are in the process of extending!**" He continued: "It's a problem very well known (and feared) by boilermakers the world over...the only stainless steel that can stand up to this (904L [3]) only had a real generalized boom in the industry after 1995, with limited use in the nuclear field, which cannot easily integrate these new materials; metallurgical studies are very extensive and require time."

The problem is even more disturbing in that this stainless steel is found elsewhere in the plant, especially in the fuel compartment assemblies (in the pools that have been very seriously damaged - especially in Units 3 and 4 - but also elsewhere, such as in the expansion bellows that apply pressure on the torus of the containment enclosure, the cruciform control rod equipment, etc.).

As if this were not enough, we learned yesterday from a Tokyo Reuters dispatch that a new leak of radioactive water into the sea "may have been found," coming from "Unit 3." An astonishing announcement, knowing that the highly contaminated water that had been poured into the ocean several weeks ago then came from another reactor, Unit 2; indeed the Unit 2 containment enclosure had clearly cracked very early on in the disaster, during an explosion not seen in images.

In short, by now the question is **whether all the reactors** (not only Unit 1 but perhaps also Units 2 and 3) **are in the process of "falling to pieces"** - their metal structures weakening increasingly, following the concrete structures being shaken and cracked during explosions happening at the start of the disaster. There is also question of how a cooling unit, one such as Areva has envisioned [4],

could indeed be linked up to these shaky structures. In fact 10 days ago this French company, represented by Technical Director Thierry Varet (AREVA Nuclear Site Value Development Business Unit), explained that it wanted to decontaminate the water [5] used so abundantly to cool the reactors and pools, and to install a closed circuit to re-use it. How can a closed circuit be created with one or more of the reactor pressure vessels turned into sieves? Especially, how is it possible to approach these extremely radioactive sites - given the many leaks everywhere - to try to "plug" the holes? Who is going to go near them?

Two months after the catastrophe, there is still yet another question: how many months (years?) will it take to cool down the site while more contaminated water is continually being accumulated? Does this mean the water will have to be thrown "voluntarily" into the ocean again, as was already done for over 10,000 tonnes (then called "slightly contaminated" water) a few weeks ago?

A nightmare situation with no end in sight today.

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P.S.

* <http://deciphering-fukushima.blogs.sciencesetavenir.fr/>

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Footnotes

[1] <http://english.kyodonews.jp/news/2011/05/90715.html>

[2] The stainless steel (called austenitic stainless steel) cannot withstand ions of sodium chloride (the chemical formula being NaCl).

[3] The "DUPLEX" (904L): an austeno-ferritic stainless steel, an alloy with two crystalline structures.

[4] <http://www.newscastwire.com/fr/org/areva?event=175>.

[5] We do not know exactly how many tens of thousands of tonnes (90,000? 100,000?) of water currently needs to be contaminated, by coagulating radioactive particles to separate them out from the water to "purify" it. Water which can then be re-used.