The corium of Fukushima II (english)

The article on the corium, "The corium of Fukushima," published in this blog in two parts in August 2011 caused many reactions and leads to various comments. First, it should be noted that this presentation was not intended to be fixed in stone, but to contribute to the dissemination of knowledge of a subject in recent history, very difficult to define because continually changing. This new section will try to summarize, point by point, the main criticisms that have been made and, opening the debate again, will try to change our representation of the magma elusive. (From le blog de Fukushima)

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1. Main criticisms

The criticism was contained in the comments that followed the two parts of the article and in other sites that have taken over all or part of the original text. Thank you to the authors for participating in a constructive way to changing this. The main complaints, questions and answers primers:

1.1. Decrease of activity
There is no mention of decrease of activity, so intrinsic cooling. The decay heat removal of fission products is extremely fast: 6 months after reactor shutdown, the residual energy is divided by 40. The decay usually observed in the reactors is arrested the first 4 days and then almost 8 after 5 days and 20 after the first month. But with regard to Fukushima, it seems difficult to draw a picture of decay even without knowing the quantification of the estimated coefficient of criticality.

1.2. Power
Each tablet is supposed to deliver as much energy as one ton of coal, yes but only when the fission reaction occurs there is to say, under the usual conditions of operation of a reactor. There could have sustained chain reaction in a corium. The energy of a corium could come from products: radioactivity and spontaneous fission (spontaneous fission is of 0.22 microwatt per ton of fuel). You can not put a tie between energy produced when burning the fuel in the reactor and the energy of the corium.

1.3. Temperature
The temperature of a corium is not homogeneous: all the mass is not at the same temperature, the center may be around 2900-3000 °C, but not the periphery.

1.4. Amount
The formation of a corium does not automatically lead to the merger (the chemical sense) of all fuel, because the temperature is often below the melting oxides of U and P (2730 °C).

1.5. Boiling
Just because we get to the boiling point of a body that it inevitably starts to boil because the environment interferes: the pressure, the saturation vapor pressure of the body above the mixture X. The composition of the mixture, the chemical potentials of species in the mixture, the presence of physical barriers, etc.

1.6. Stratification
A corium is not a liquid like water, there is a stratification and formation of a crust and an outer film of gas on the periphery, it retains a large number of compounds in the corium, especially neutron-absorbing compounds.

1.7. Oxidation of metals
The corium, if it forms a single mass, can not draw a lot of heat from the oxidation of metals by chemical reactions with the hot atmospheric oxygen or water vapor. In this case, the exothermic oxidation in the periphery of the corium only a very small part of the total thermal energy. However, in some configurations, a large corium oxidation can occur when one is in pieces, with a lot of steam in the case of a steam explosion, there may be an oxidation of these particles corium but it remains somewhat exothermic, in any case lower than that of zirconium.

1.8. Corrosion
It would not be a phenomenon of corrosion that would govern the interaction tank / corium and concrete / corium - even if there is indeed redox phenomena in the periphery - it would be 95% of the thermal interaction: the heat flow would cause a breakthrough, and the impact of corium jets when the heart background: it flows like a candle.

1.9. Stability
The article suggests that the corium is stable. In fact, the dangers mentioned in the article concerned only the first few hours of the accident, when their hearts are not cooled.

1.10. Dilution of radioactivity
Saying that "the further away from the source, the more radioactive particles and gases are diluted in the atmosphere and are safer" is generally true, but at a level of generality that could certify the official theses - found in all the arguments of the IRSN - according to which, due to the dilution, there is nothing to fear in France after Chernobyl.

1.11. Nuclear explosion
Asserting that "a runaway chain reaction, however small, can lead to a nuclear explosion but energy levels comparable to that of conventional explosions" is questionable. Prof. V. Nesterenko, a nuclear physicist who was directly responsible for the consequences of the Chernobyl disaster, said that 1400 kg of uranium-graphite mixture in contact with water is a mass may cause an atomic
An explosion of power from 3 to 5 megatons between 50 and 80 times the power of the Hiroshima explosion if sufficient Corium, who had already broken through the reactor vessel, had pierced the concrete slab that separated water bodies contained in the sub-soils of the reactor.

1.12. Thickness of the raft

The thickness of the concrete slab beneath the reactor Fukushima would not be 8 m. For Flamanville EPR, it is 4 m from the IRSN. It is unlikely that in the past we do better: between 1.30 and 1.50 m in Fessenheim. This is the same which had led to the sacrifice of the miners who have cast 300 m3 of concrete under the slab of Chernobyl.

2, additional information from contributors

2.1. Judgement of the fission

The fission reaction was stopped by the insertion of control rods, the power of "fuel" immediately afterwards falls to about 7% and about 1.5% after one hour, etc..

2.2. Natural reactor

There is a historical example of corium active for probably several hundred years. This is the "natural reactor" Oklo, Gabon. Radioactive decay of the corium would have taken more than 100 000 years. The local times of fissions, quickly negated by the strong heating of the water around - then the neutrons lose their statistical power of fission - generated each time new fission products. However, the temperatures measured at 400-1000 °C are not related to the temperature of formation of corium in the reactor of Fukushima (2500-3200 °C).

2.3. Thermolysis of water

The temperature of thermolysis of water begins at 850 °C, is safer to 2000 °C and is complete at 2500 °C. We should not imagine the "cracking" of large-scale water after contact with the corium corium in Fukushima since the surface is cooler.

3. New data available

Here are several new features to report, to be added to the file corium, as they provide additional knowledge:

3.1. Political history of the corium

Article of 31 October 2011 on the use and perception of the word corium in the literature and politics, written by Francis Chateauraynaud specialist in the sociology of controversies and conflicts. A remarkable study, to read and make known to all those interested in the dissemination of knowledge.

For a political history of the corium (The meaning of the irreversible part III)

3.2. The non-battle of Fukushima
3.3. The China Syndrome

Issue published October 21, 2011 by Sebastien Verdier, of the Institute of major risks (association working in the information on the natural and technological hazards).

This is an interview with Gregoire Deyirmendjian, Division of Lyon ASN, around the movie "The China Syndrome", released in 79.

The show is in two parts:
http://www.risques.tv/video.php?id_DTvideo=203
http://www.risques.tv/video.php?id_DTvideo=204

The first part is devoted to the decryption of the nuclear accident, the second part deals with thorny issues, including the person who said, "Yes, there the film takes place in the 70 and highlights a falsification of radiographs welding, and many problems falsification of radios welds, these are things that can still be seen in 2011."

Also, read this article about a China Syndrome in Fukushima inevitable:

3.4. Where Could Fukushima's corium be?

Video on the corium of Chernobyl: a good summary of what happened 25 years ago at Chernobyl and about us yet. The mixture of molten fuel and sand created a lava that flowed and eventually solidified on site but is still radioactive and dangerous today.

3.5. At the heart of the corium

The CEA has published a dossier in September 2011 written by Abu Claire in "The challenges of the CEA" No. 163, entitled "At the heart of the corium." In this article on the corium, touted the research needed to increase safety. But what the article does not say is that the experiments can not reach the temperatures and masses of fuel involved in the accident in Fukushima.

3.6. Core melt and fission products

IRSN has made a film about the little known about the meltdown. We learn, among other things during experiments conducted in a research reactor, the heart is melting faster than the theoretical calculations were not established and it is impossible to contain radioactive iodine gas because of the porosity of the concrete of containment.
The debate remains open. And especially to all lovers of nuclear physics because it must be said, the corium is a key subject of research for the future of the planet. The designers of the EPR had already understood this issue as they expected a recovery corium, supposed to bring more security. However, before continuing to engage in this crazy energy that will inevitably economy and tranquility of our descendants for its waste, it should already think about the past control the corium (Chernobyl) and this (Fukushima) not to mention the next corium which are likely to appear on earth in the coming years. The nuclear world is aging, many reactors are operated beyond the initial term - it is good to remember that just allow Fukushima Daiichi-1 to resume the service for 10 years - and there are so many candidates for the next accident: the United States continue to maintain more than 20 reactors identical to those of Fukushima while history has demonstrated its greatest weaknesses. Number of reactors are installed on seismic faults, while the earth is entering a period of telluric activity marked by numerous earthquakes. The central Metsamor (Armenia) is a typical representative of the imminent dangers: old Soviet-designed plant, highly seismic region and conflict between management and staff ... all the conditions are now ripe for a new hell. In France, the future is not rosy either: IRSN has given its approval for any of the 58 reactors would close, despite the recognition of great uncertainty (possibility of floods, earthquakes and so on. that would affect the cooling system). Post Fukushima, as noted by just a reader of this blog, seems marked by an increased number of nuclear incidents in the world: Fort Cahloun flood, fire near Los Alamos nuclear complex, fire station Tricastin explosion at Marcoule nuclear complex, pollution with iodine-131 in Europe, fire in a laboratory located near Idaho Falls ... The majority of politicians and scientists today seem oblivious to the dangers they are real turn the world's population, also asleep. The beast "corium" unfortunately still has a bright future ahead of her. You decide whether to live with it or whether to fight it.