Prevention of Severe Accident

Lessons learned from Fukushima-Daiichi-Accident

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Lessons learned from Fukushima-Daiichi-Accident

- Causes of the accident and the expansion -

- Insufficient tsunami countermeasures
- Insufficient measures against severe accidents
- Insufficient emergency measures

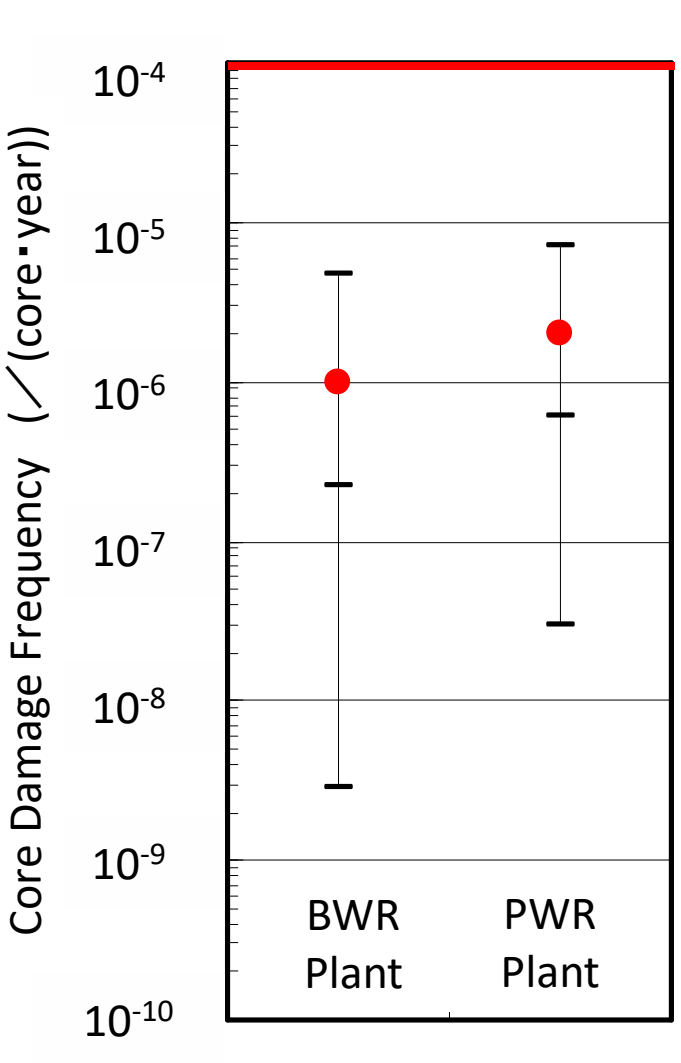
Why tsunami measures were insufficient?

- Both TMI and Chernobyl accidents were caused by internal factors.
- Most people believed probability of earthquakes was larger than that of tsunami.
- Estimation of natural disasters contains large uncertainties.

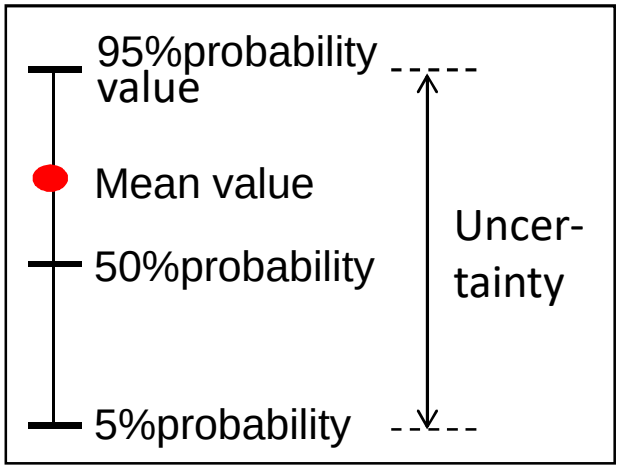
Though IAEA INSAG-10 demanded preparations not only for internal events but also for external causes.

We always used to worry about earthquakes, but ・・・

Trial Results of Seismic PRA



- Introduced at NSC Earthquake-resistant design subcommittee(2004.10).
- The CDF mean value was 10^{-6}/(core･year).
- Uncertainty was 10～1000.
- They were only tested results, not representing the typical ones.



Lessons learned (1)

- In the safety analysis, deterministic/probabilistic, we must take every possible event in consideration. The large uncertainties cannot be the reason to exclude the event from the consideration.
- Tsunami countermeasures were not discussed widely. (The concern of TEPCO and NISA was not informed to NSC.)

Do not be afraid of only the experienced natural disaster.

Do not waste time for finding a reason not to measure.

Why severe accident measures were insufficient?

- Severe accidents were studied widely in Japan, but there were no regulatory requirements.
- Few people believed severe accident would actually happen (safety myth).
- Some people believed that the recognition of severe accidents would be misinterpreted as non-satisfaction of DBA-based regulation.
- They claimed, “litigation risk is higher than actual accident risk.”

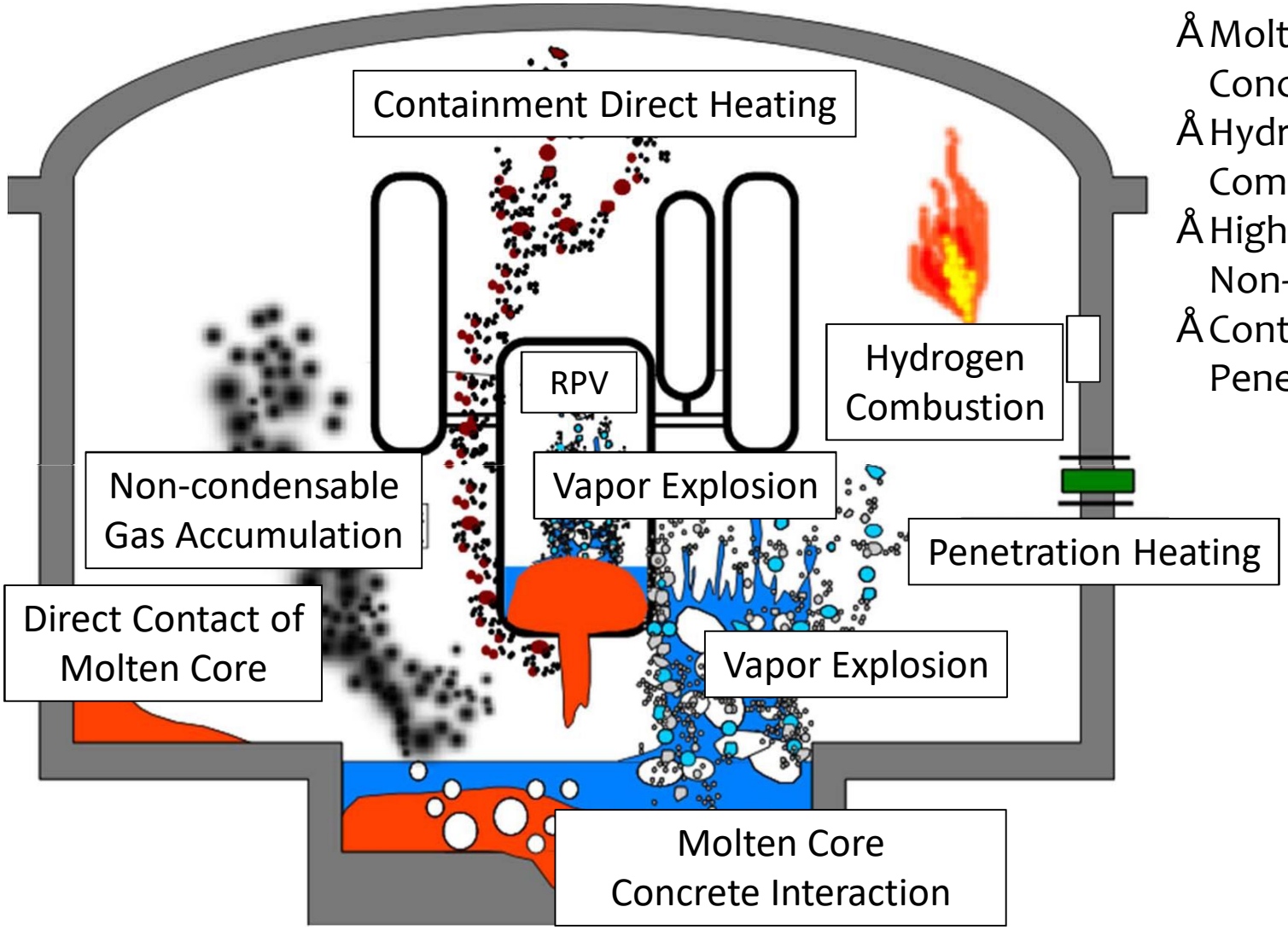
DBA-based regulation fulfilled the law

- “Adequate prevention of disasters” does not necessarily mean “adequate safety.”
- If requirements for adequate safety were presented, then this problem could have been easily solved.

Litigation risk was low,
if the requirements
for adequate safety were presented !

Severe accidents

- Vapor Explosion
- Containment Direct Heating
- Molten Core Concrete Interaction
- Hydrogen Combustion
- High Pressure by Non-condensable Gas
- Containment Penetration Heating



M. Kajimoto, J. AESJ Vol. 48, No. 8, 571 (2006).

Severe accident studies in Japan

- Examples -

- PCV behavior experiments (ALPHA program)
  - molten fuel coolant interaction experiment/analysis
- Fission products releasing experiment (VEGA program)
  - fission product aerosol evaporation and condensation
- Verification tests on behaviors during severe accidents
  - fission product behavior during severe accidents
- ...

Lessons learned (2)

- We should have improved the regulation system with making use of the research results (research for research was meaningless).
- The disaster occurs any time, so I had to make regulation changes as soon as possible.
- I tried my best to change Japanese safety standard so as to satisfy the international obligations.

- Could you please teach us what we could do. -

Lessons learned (3)

- Before worrying about the litigation risk, NSC should have presented the requirements for adequate safety.
- The severe accident researchers' knowledge was not utilized unless the decision makers' comprehension. It is important to build up a system for advising their knowledge to the decision makers.

- It is too late to regret, but … -

Why emergency measures were insufficient?

- The measures against simultaneous natural disaster and nuclear accident were ignored in Japan.
- Precautionary Action Zones (PAZs) were not predefined in Japan. The former head of secretariat of NSC took office as the director of NISA, and pressured the predefinition.

It was tabooed to consider the possibility of severe accident in Japan.

Lessons learned (4)

- Independence of NSC from NISA was not enough.
  - resolved after the accident -
- The countermeasures against simultaneous natural disaster and nuclear accident should have been considered so as to be included in emergency drills.

Summary

- Appropriate regulatory system and the enforcement are the key factors for preventing severe accidents.
- Severe accidents were studied widely in Japan, but we did not make use of the results in regulation.
- Perhaps Japan wasted time for finding a reason why it was not necessary to measure against severe accidents.
- In order to avoid confusion, having a minimum knowledge about severe accidents is my last desire.

Extra Summary

- The only measure to prevent severe accident is the prior preparation.
- The root cause investigation why Japan ignored the possibility of severe accident is still insufficient.
- Japanese culture in which apologizing people are exempted from cross-examinations is in the background.
- The investigation committees which removed the persons concerned could not function.