Toward Fuel Debris Analysis
~ The Path from PCV Internal Investigation to Fuel Debris Retrieval ~

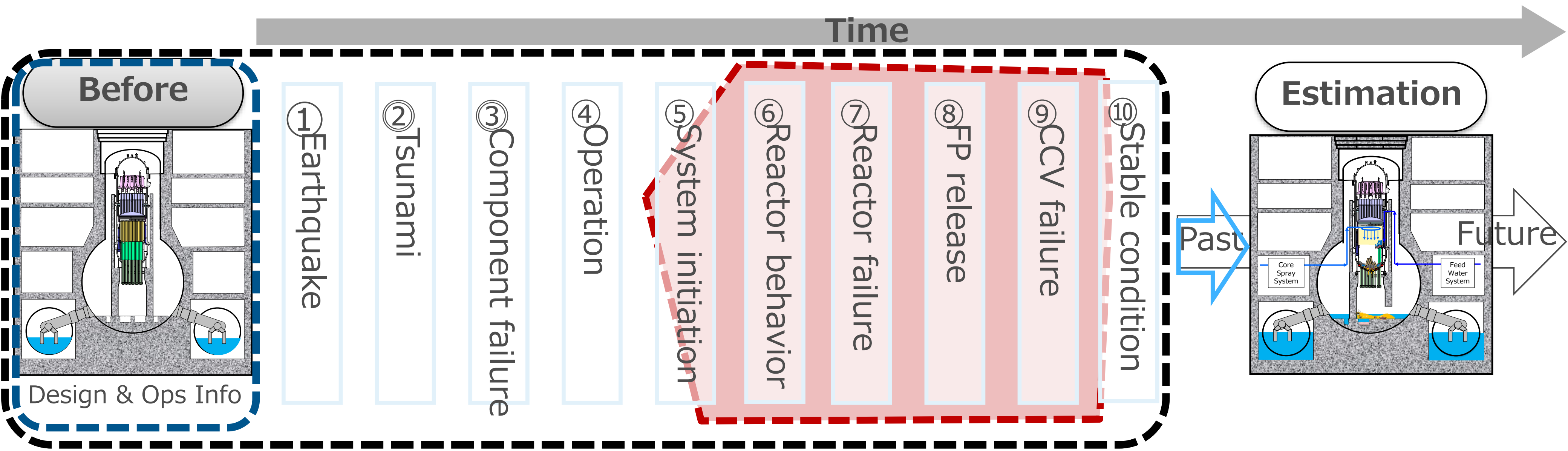
August 29, 2022

Shinya Mizokami

Fuel Debris Retrieval Program Dept.
Fukushima Daiichi Decontamination and Decommissioning Engineering Company,
TEPCO Holdings

1. Assessing conditions inside reactors based on accident progression analysis (before internal surveys were introduced)

TEPCO



Based on the analysis of accident progression conducted in 2013, it was assumed that the proportions of fuel debris that fell were greater in the order of

Unit 1 > Unit 3 > Unit 2

2. Internal surveys conducted so far and the results

TEPCO

Muon Measure-ment Mar. 2015

Unit 2 PCV internal survey (Jan. 2017)

Unit 1 PCV internal survey (Mar. 2017)

Unit 3 PCV internal survey (Jul. 2017)

Unit 2 fuel debris touching survey (Feb. 2019)

Unit 1 PCV internal survey (from Feb. 2022)

Unit 2 trial retrieval of fuel debris to start in 2022

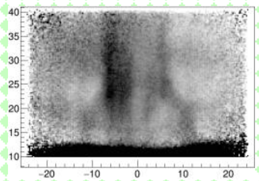
Retrieval via step by step approach

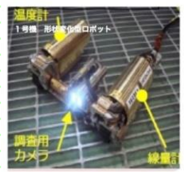
Further expand retrieval scale

Partial submersion - Side entry method

Partial submersion - Top entry method

Submersion - Top entry method

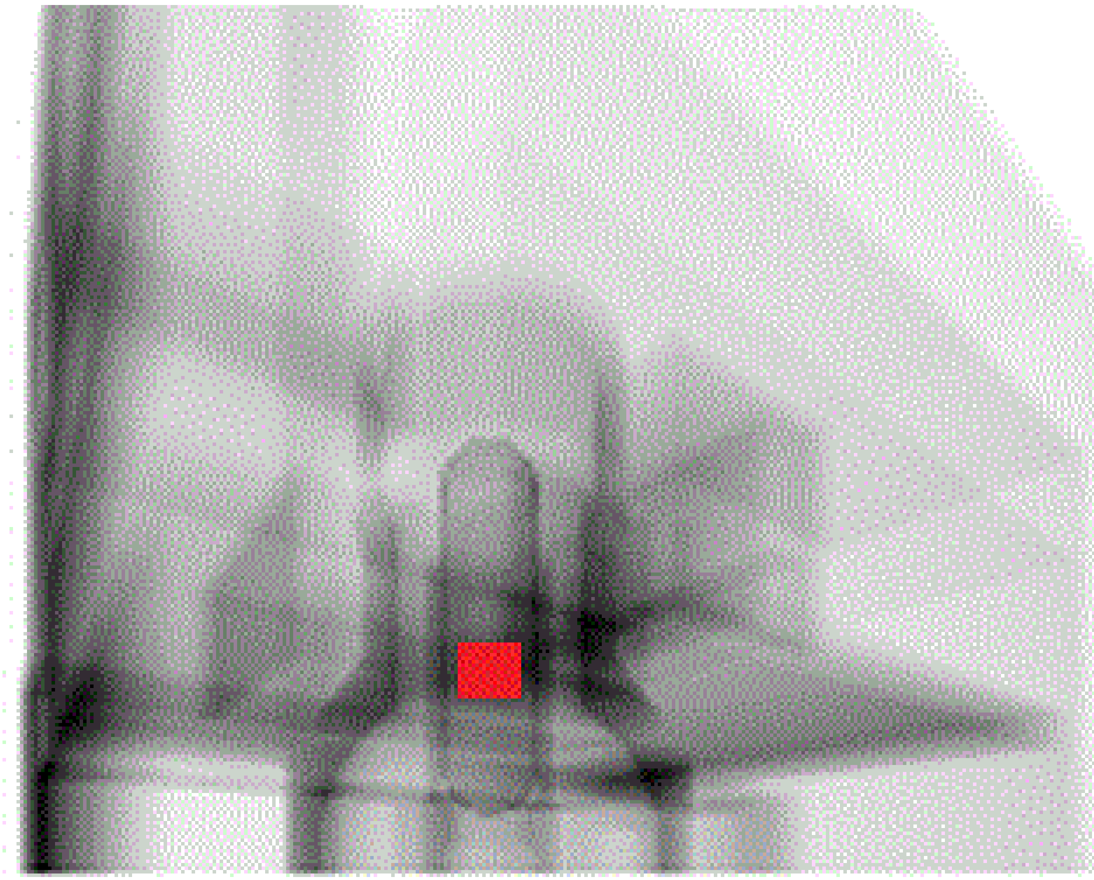




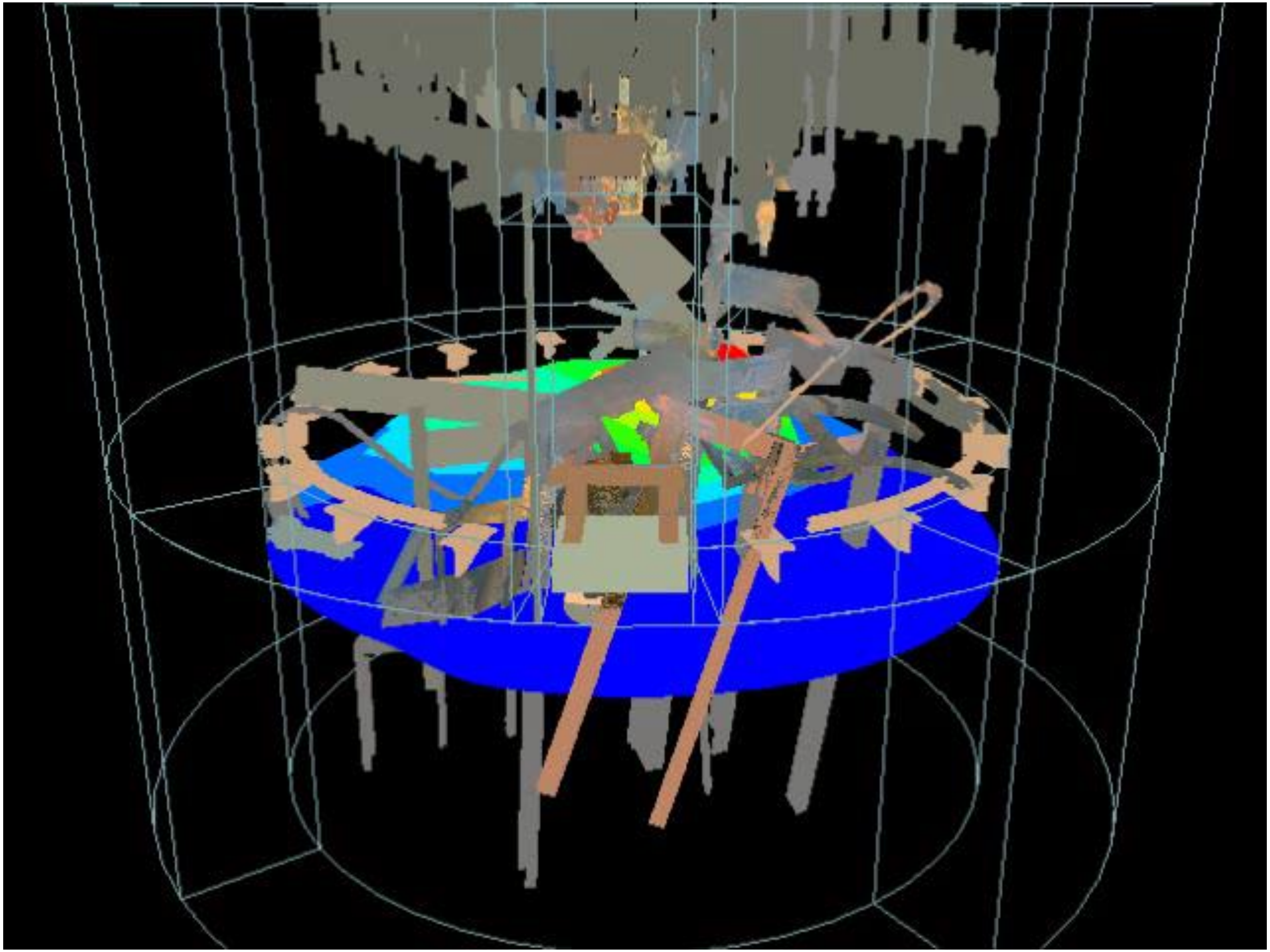
- Starting with Muon measurement conducted in 2015, surveys to assess conditions inside reactors have been conducted.
- Information on deposits inside PCVs has been obtained. In addition, through a touching investigation, fuel debris has been found to be movable at Unit 2.

Information from actual investigation results has been added to assessment using analysis code

3． Assessment of fuel debris distribution inside the reactor at Unit 1 using Muon measurement method



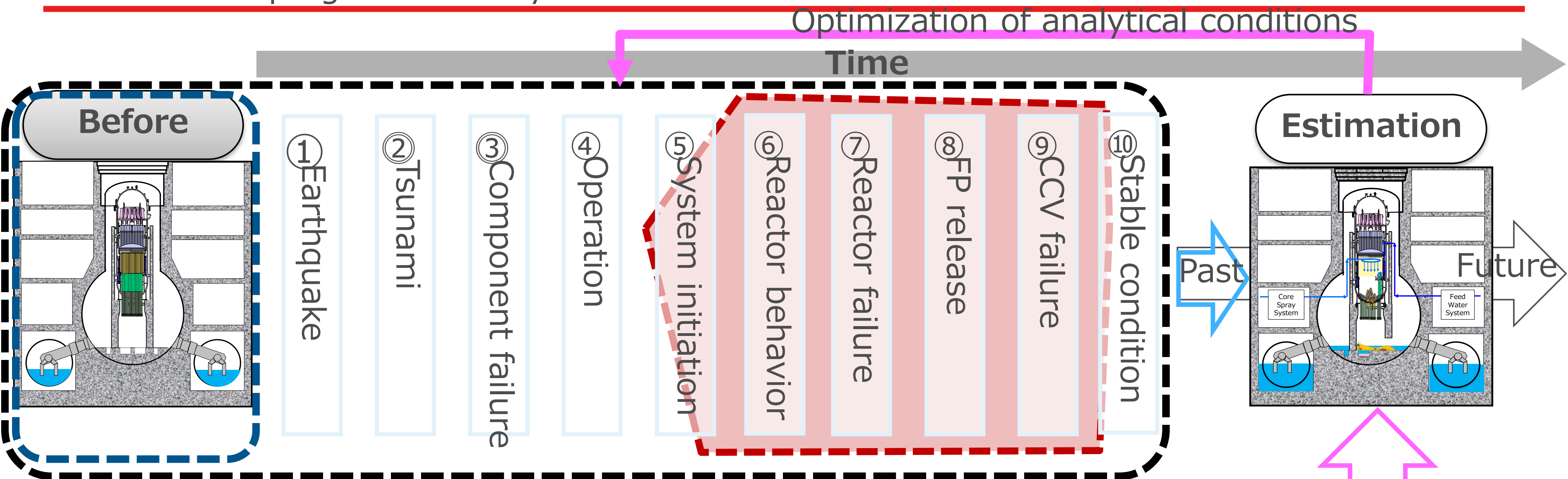
4． Reconstruction of 3D distribution image based on the results from PCV internal investigation at Unit 3



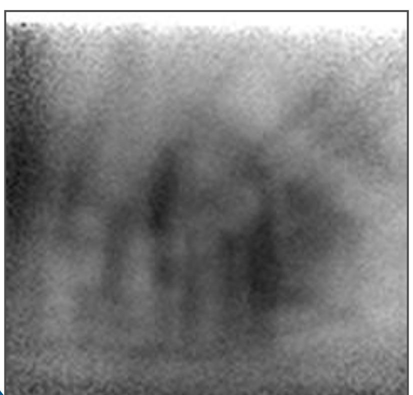
5.　Touching investigation into fuel debris deposits inside PCV at Unit 2

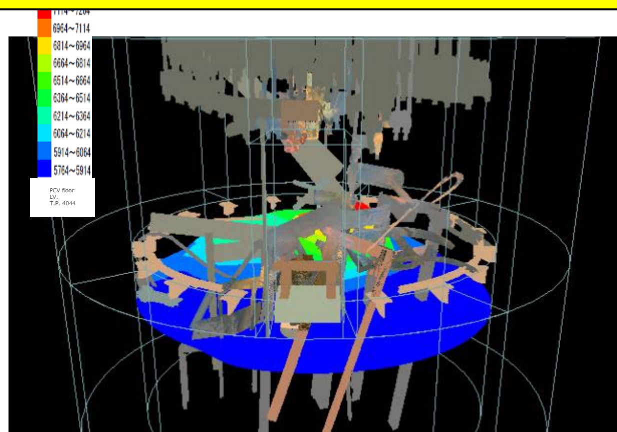
6. Assessing conditions inside reactors by combining internal investigation results & accident progression analysis

TEPCO



Information obtained at the Fukushima Daiichi decommissioning site



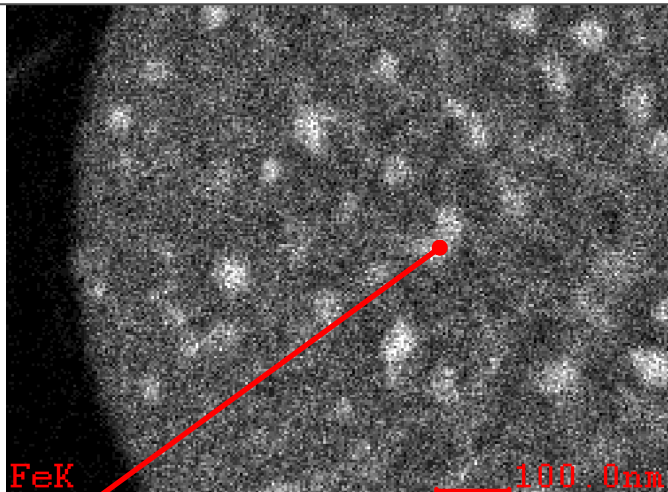


Accuracy of the past estimation proven & Info on concrete distribution added

7． Results from analysis of particles sampled from Unit 2 refueling floor

TEPCO

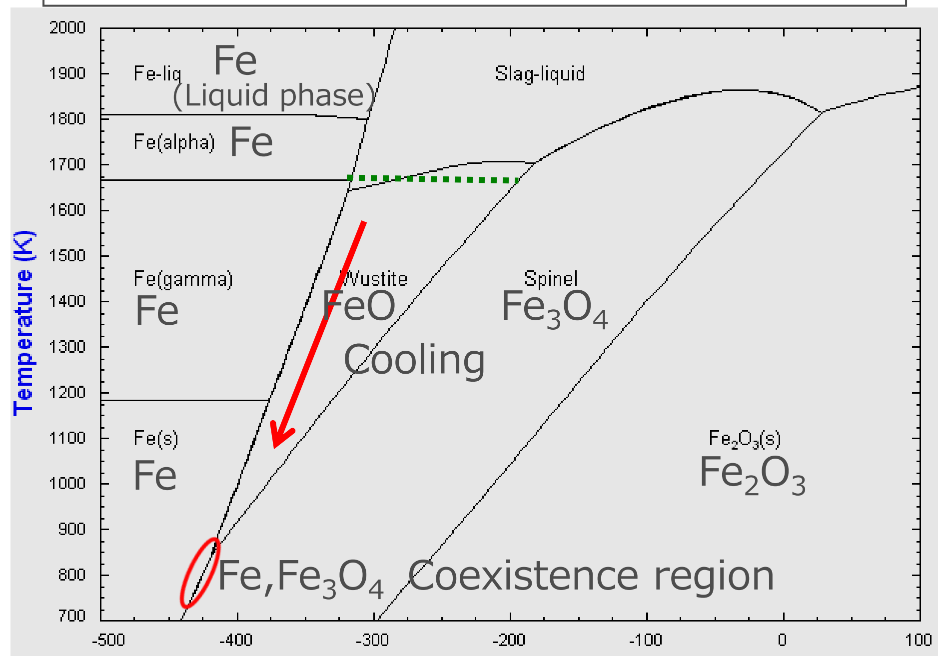
Crystal structure analysis shows existence of BCC (pure Fe) and spinel (Fe_3O_4)



Pure Fe precipitation

Fe distribution

Coexistence of Fe and Fe_3O_4

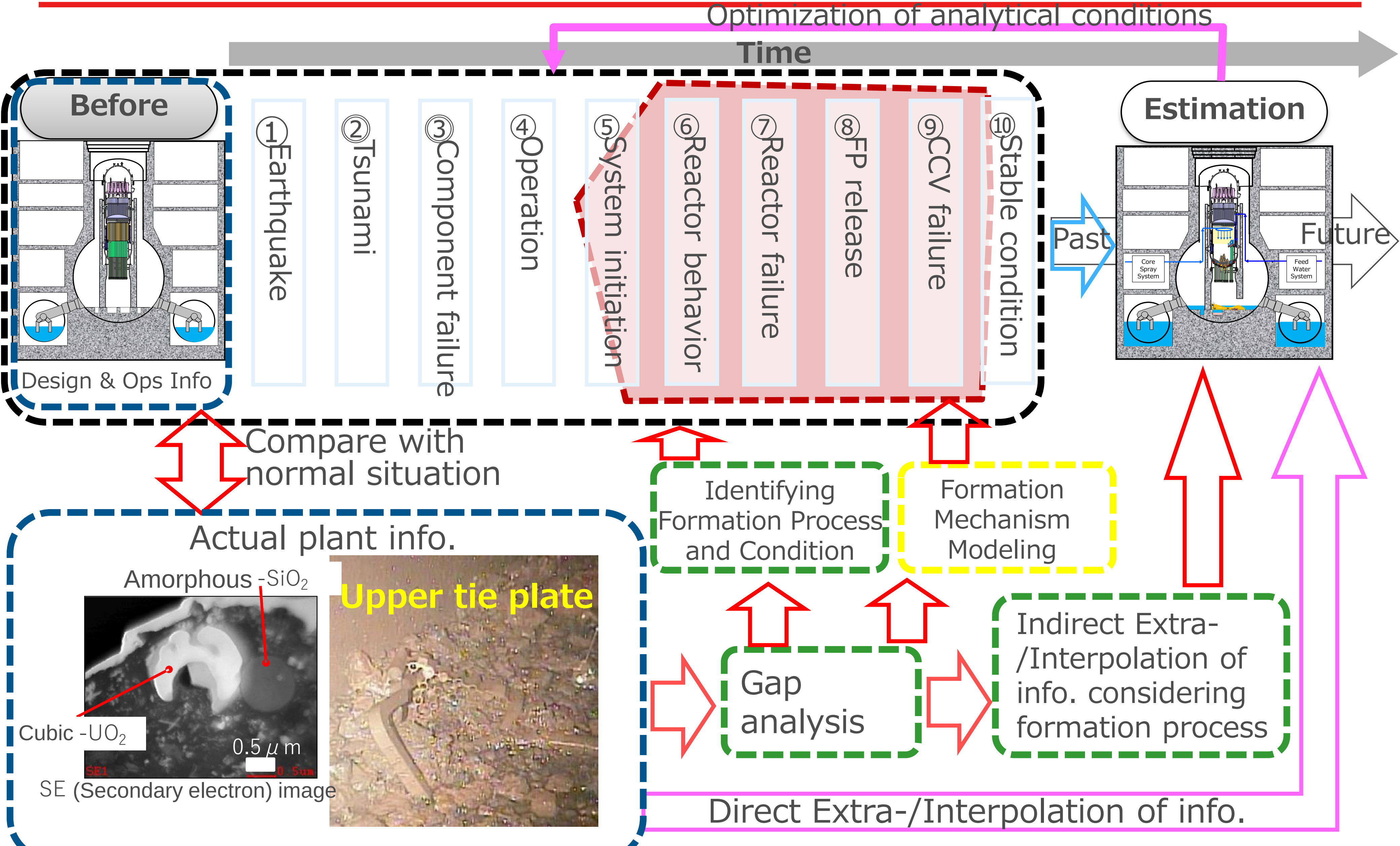


- It was confirmed that U is contained up to 10% in a particle with a unique microstructure that mainly consists of pure Fe and Fe_3O_4.
- Spherical shape is assumed to be formed from evaporation & condensation process
- This particle was generated as an FeO particle under high temperature and Fe and Fe_30_4 phases were separated during the cooling process.

- Reflects the situation where the fuel (U) melted, involving in-core structures (Fe).
- The samples may be identical to the fuel debris inside the pedestal at Unit 2 that is assumed to contain a good amount of Fe specific to fuel debris.

8. Assessing conditions inside reactors through synergetic effect between internal investigation results & accident progression analysis

TEPCO



9. Summary

TEPCO

- The analysis results for the fuel debris have enabled us to understand its properties and distribution, providing more information on its composition and mechanical characteristics etc.

- If analysis can allow us to ascertain information as to how the fuel debris was formed at the time of the accident, an estimation of what has not been observed so far will become possible.

- Considering the limited number of analyses as compared to the vast amount of fuel debris, assessment of the fuel debris formation mechanism is essential.