JASMiRT 設計基準を超える地震随伴事象に対する
リスク評価に関するワークショップ
Oct. 21, 2016, Tokyo

シビアアクシデントに関する総論
国内動向

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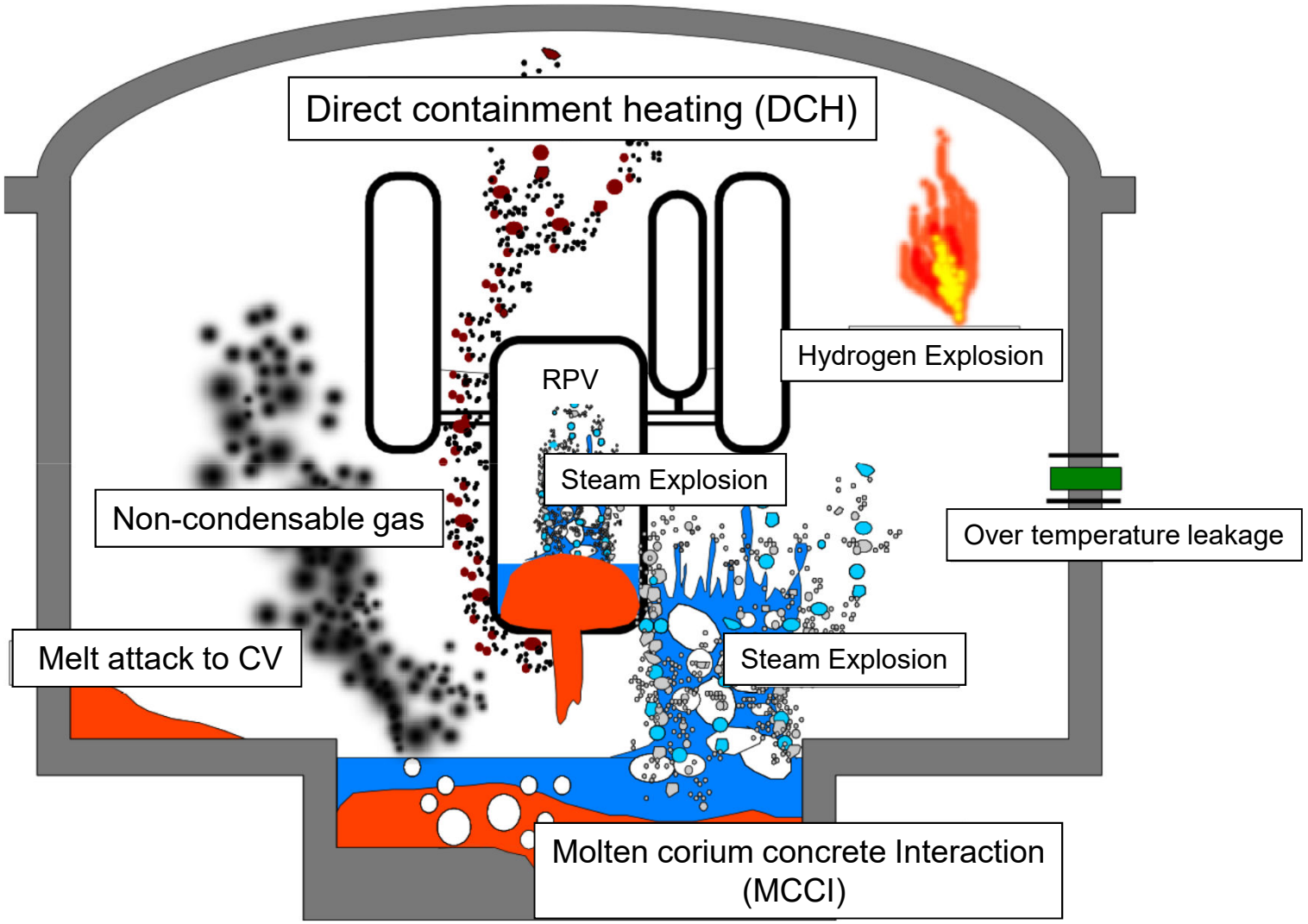
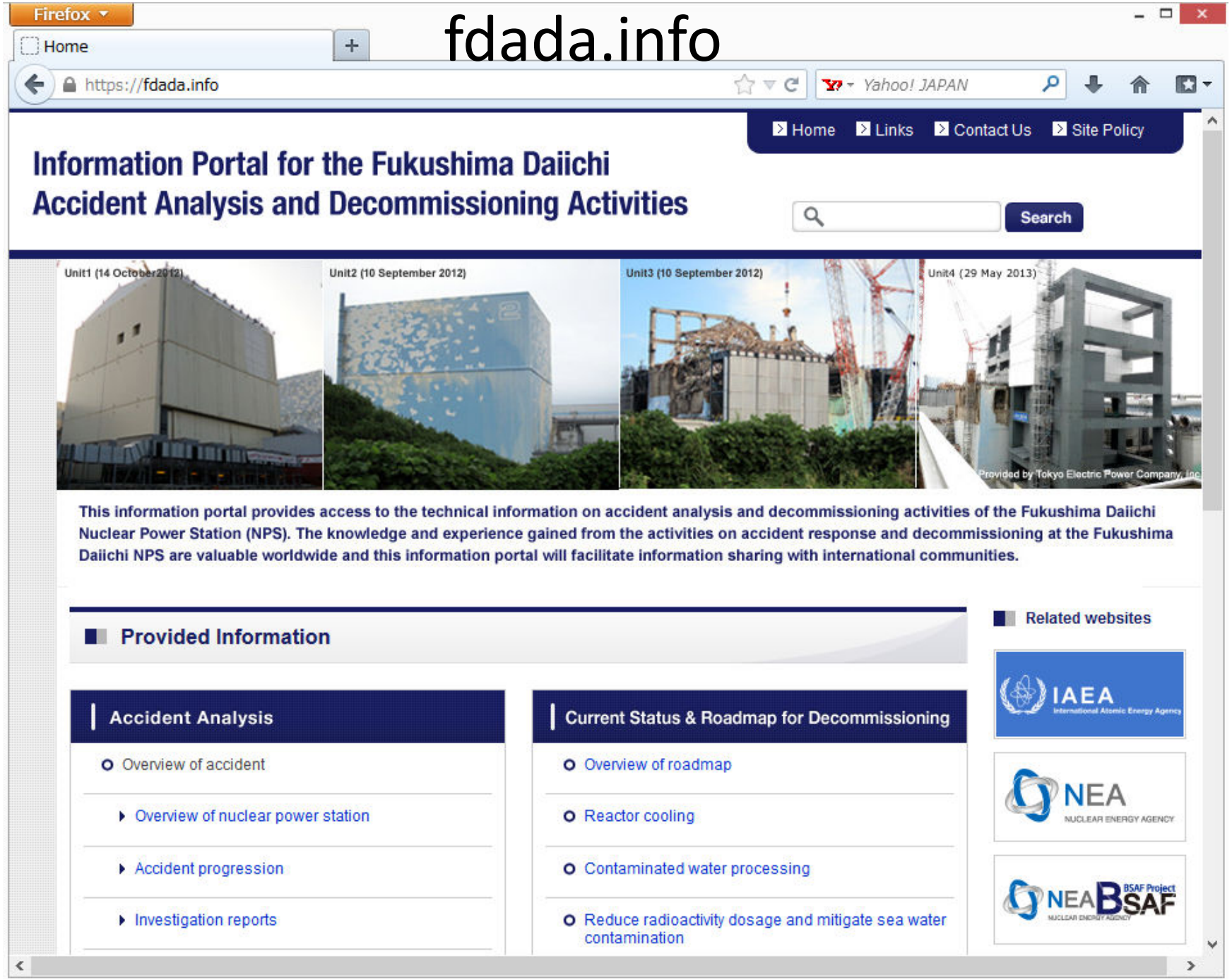
Severe Accident Phenomena



fdada.info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Information Portal for the Fukushima Daiichi Accident Analysis and Decommissioning Activities
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Unit1 (14 October2012)
Unit2 (10 September 2012)
Unit3 (10 September 2012)
Unit4 (29 May 2013)
Provided by Tokyo Electric Power Company, Inc.
This information portal provides access to the technical information on accident analysis and decommissioning activities of the Fukushima Daiichi Nuclear Power Station (NPS). The knowledge and experience gained from the activities on accident response and decommissioning at the Fukushima Daiichi NPS are valuable worldwide and this information portal will facilitate information sharing with international communities.
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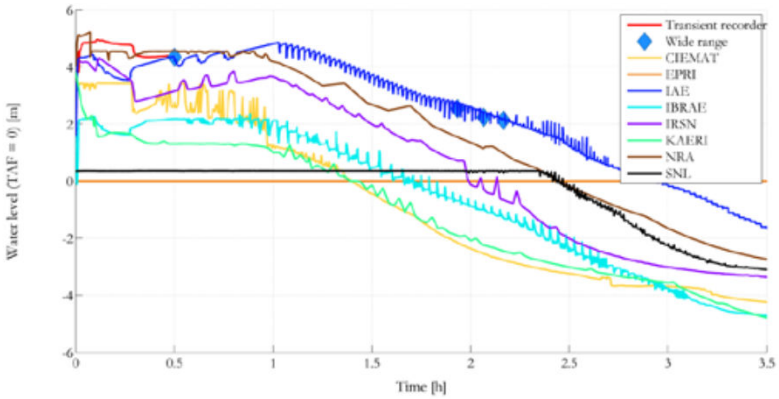
OECD BETTER POLICIES FOR BETTER LIVES

Joint projects

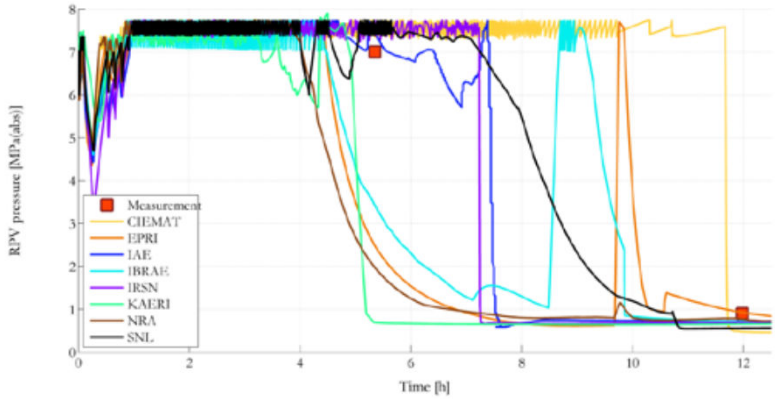
NEA Benchmark Study of the Accident at the Fukushima Daiichi Nuclear Power Station (BSAF) Project

The Benchmark Study of the Accident at the Fukushima Daiichi Nuclear Power Station (BSAF) Project was established in 2012. The objective of the project is to improve severe accident (SA) codes and to analyse the accident progression and current status of units 1 to 3 of the Fukushima Daiichi nuclear power plant (NPP), providing useful information for the decommissioning of these units.

Common results for Fukushima-Daiichi Unit1



Water level



RPV Pressure

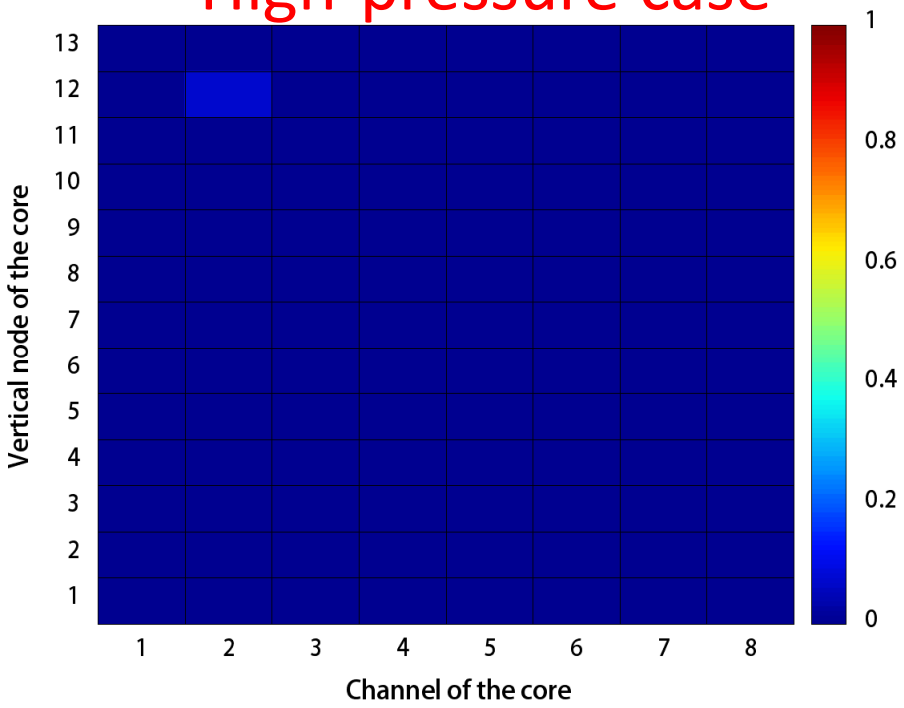
http://www.oecd-nea.org/nsd/docs/2015/csni-r2015-18.pdf

Sample Simulation results by SAMPSON

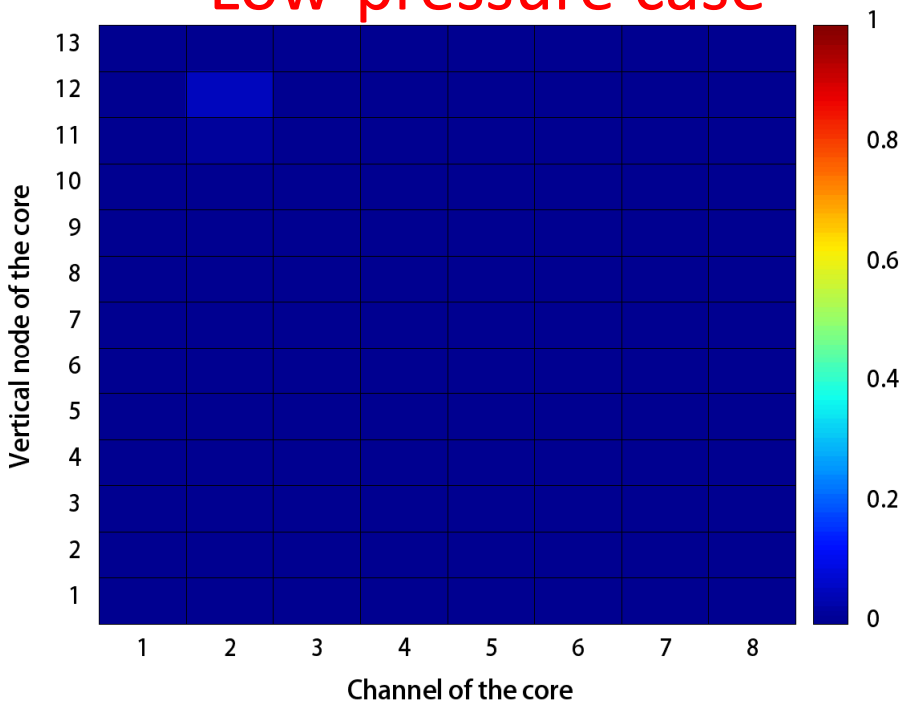
Debris void fraction distribution in the core for Unit#1

- ❖ High-pressure case:
  keep 8MPa and cooling stops (same as Fukushima)
- ❖ Low-pressure case:
  depressurize first and cooling stops (SAM strategy)

High-pressure case



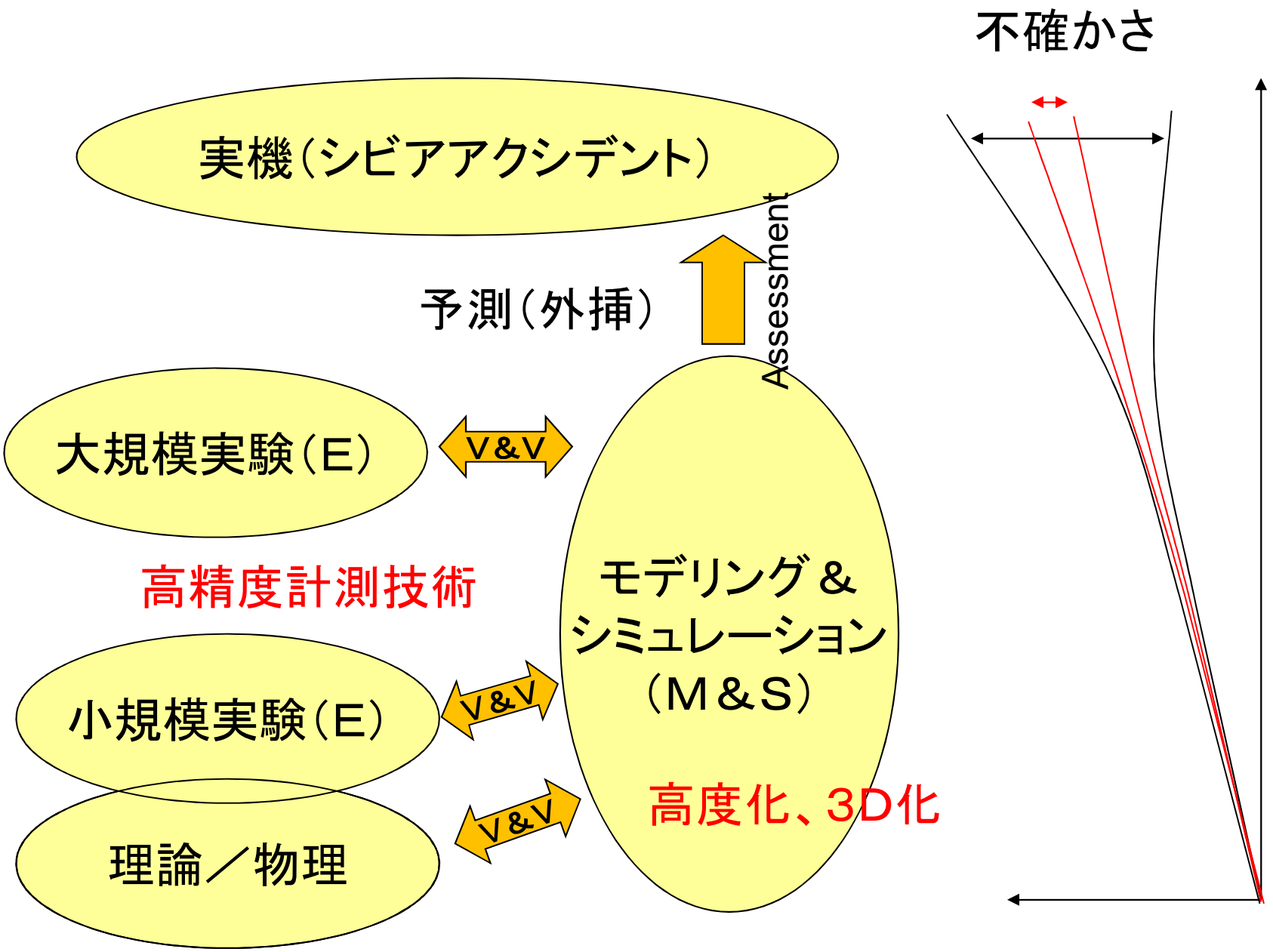
Low-pressure case



Current status of SA code for Fukushima

- Huge uncertainty on the simulation
  - Uncertainty for Boundary conditions
    - Amount of water/sea-water supply, depressurization process, heat removal by Tsunami flooding, etc.
  - Uncertainty for Modeling
    - Fuel melting/solidification model
    - Mass/Energy transfer between fuel and structure and so on.
  - Uncertainty for Simulation Model
    - Mesh dependency, Multi-phase/dimensions, Radiation, etc.

Uncertainty for Debris Locations
Uncertainty for Source Term



V&Vにより、不確かさを低減し安全を確保

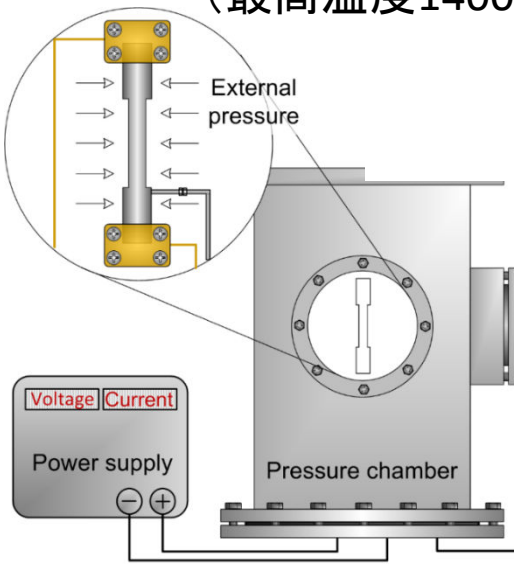
シミュレーションコードの役割

- 数値原子炉としてのSAコード
  - アクシデントマネジメントの高度化
  - リスク評価の不確かさ低減(レベル2PRA)
  - 福島第一廃止措置へ不確かさ低減

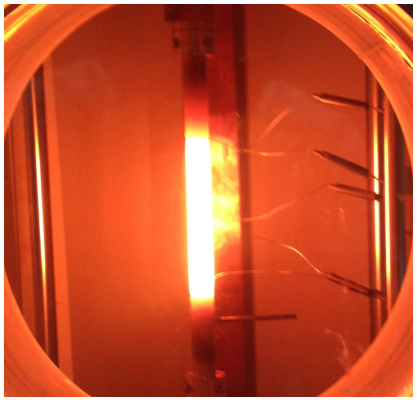
- 基礎的事象のメカニズム評価
  - 複雑現象のメカニズム解明
  - 物理モデルの不確かさ低減

Creep buckling at extra high temperature

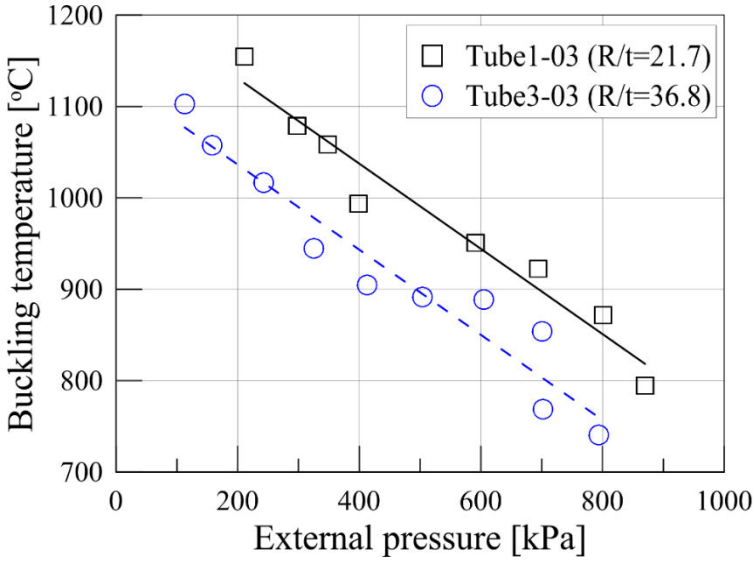
高温外圧座屈試験装置
（最高温度1400℃）



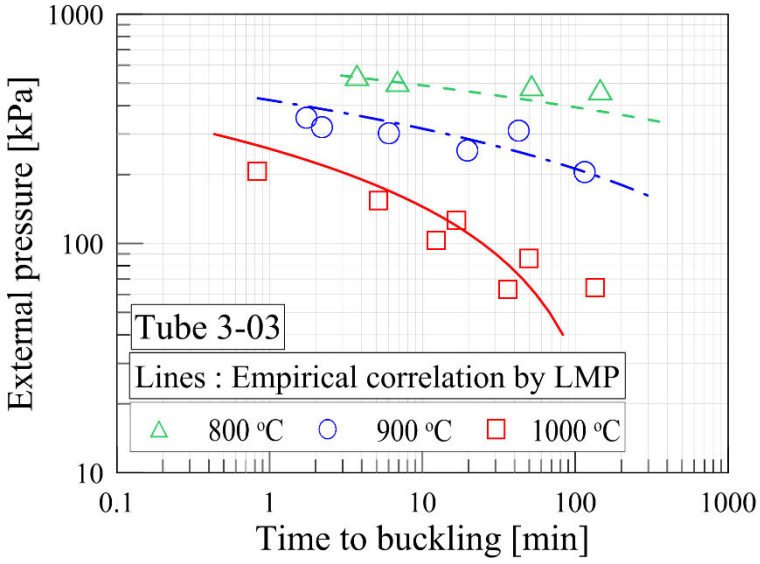
加熱試験片
可視化例



外圧による座屈試験結果

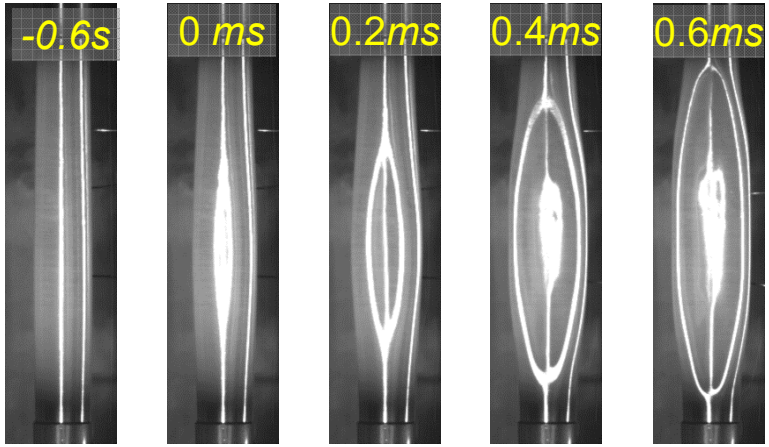


外圧によるクリープ座屈試験結果

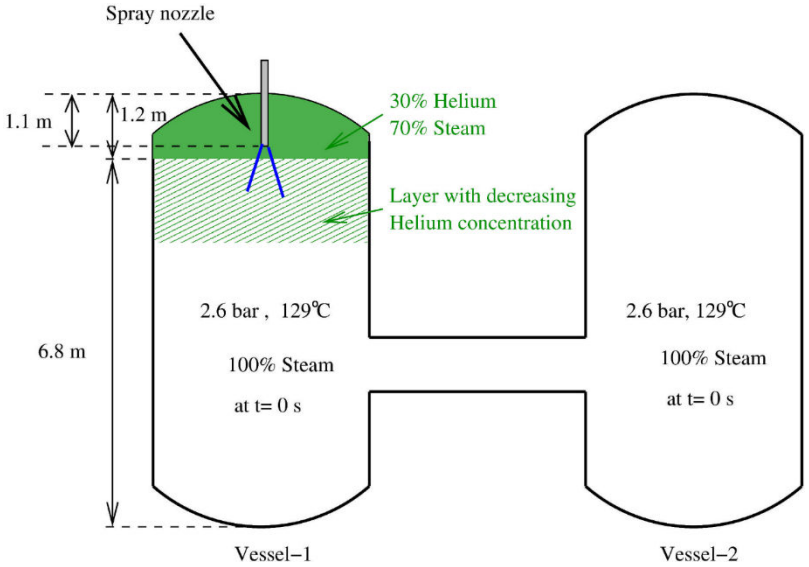


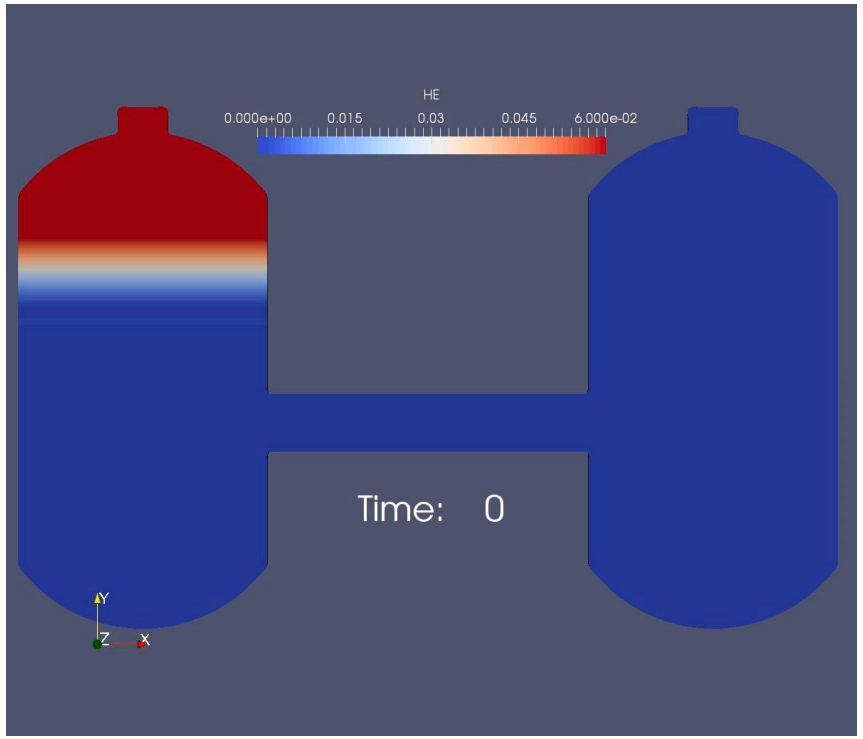
外圧座屈
高速度撮影

SUS304
950℃
P=650kPa



PANDA (PSI-Switzerland)
Spray Experiments
[*Erkan et al. 2011*]

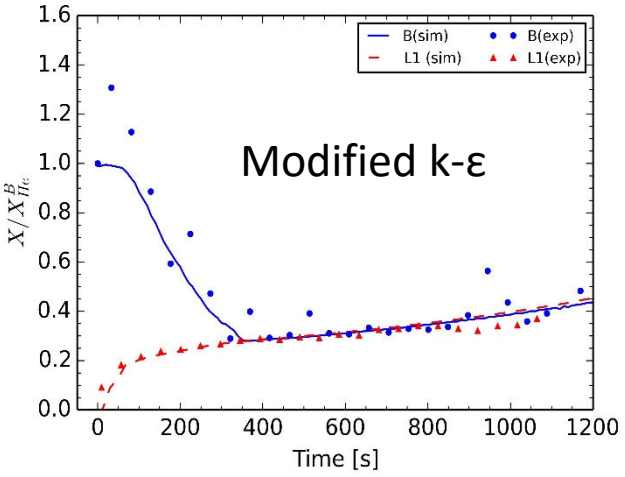




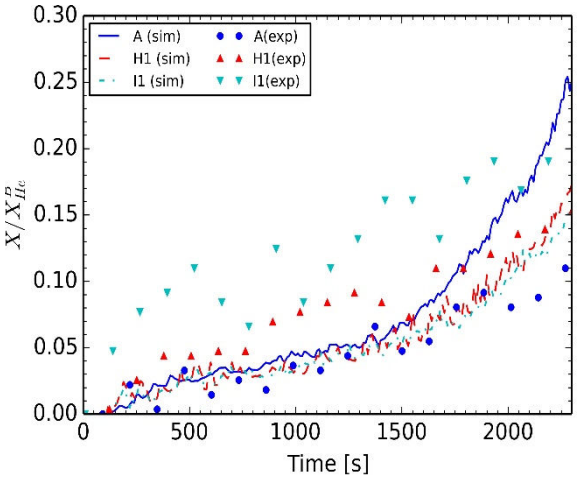
Experiment: ST3_1
(Steam and stratified Helium layer)

N. Erkan et al. (2011), Nuclear Eng. Design, 241(9):3935-3944

Vessel 1 Stratification



Vessel 2 Concentration



Fukushima-Daiichi PIRT papers

- N. Sakai, H. Horie, H. Yanagisawa, T. Fujii, S. Mizokami & K. Okamoto, "Validation of MAAP model enhancement for Fukushima Dai-ichi accident analysis with Phenomena Identification and Ranking Table (PIRT)," J. Nucl. Sci. Technol., Vol.51, pp.951-963 (2014)

  Sakai et al., JNST (2014)

- S. Suehiro, J. Sugimoto, A. Hidaka, H. Okada, S. Mizokami & K. Okamoto, "Development of the source term PIRT based on findings during Fukushima Daiichi NPPs accident," Nuclear Engrg. and Design, Vol.286, pp 163-174 (2015)

  Suehiro et al., NED (2015)

SA Challenge

- 炉内溶融燃料挙動
  - 流路閉塞、共晶反応、酸化被膜、塩
- 構造材変形挙動
  - 流路閉塞、コリウム物性変化、崩落の有無
- 下部プレナム容器破損
  - 計測系配管、CRDM損傷、ドレイン配管
- 塩化ナトリウム
  - コリウム物性への影響、MCCIなどへの影響
- 原子炉容器下部構造物との相互作用
  - コリウムがCRDMなどに引っかかっている？
- 3次元MCCI挙動評価
  - ドレンピット、ドレンライン、水冷却とガス
- ペデスタル内コリウム挙動
  - スプレッド、シェルアタック
- CFD応用
  - 格納容器内事象の総合的な評価