Overview on ATF R&D in Japan

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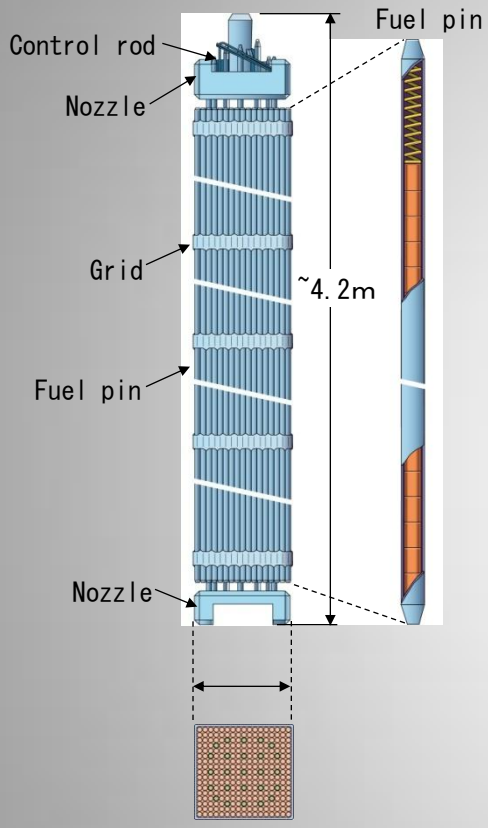
Various ATF-concepts in Japan



PWR fuel assembly

SiC

Fuel cladding (PWR, BWR), Channel box (BWR)

TRISO

Advanced fuel well compatible with SiC clad.

Austenite
ODS-Ferrite

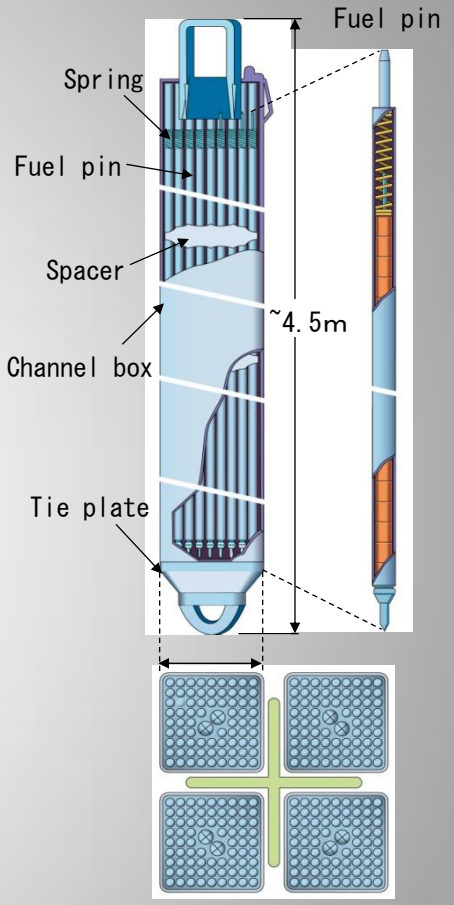
Fuel cladding (PWR, BWR)

Advanced
Control Rod

Control rod (PWR), Control rod blade (BWR)

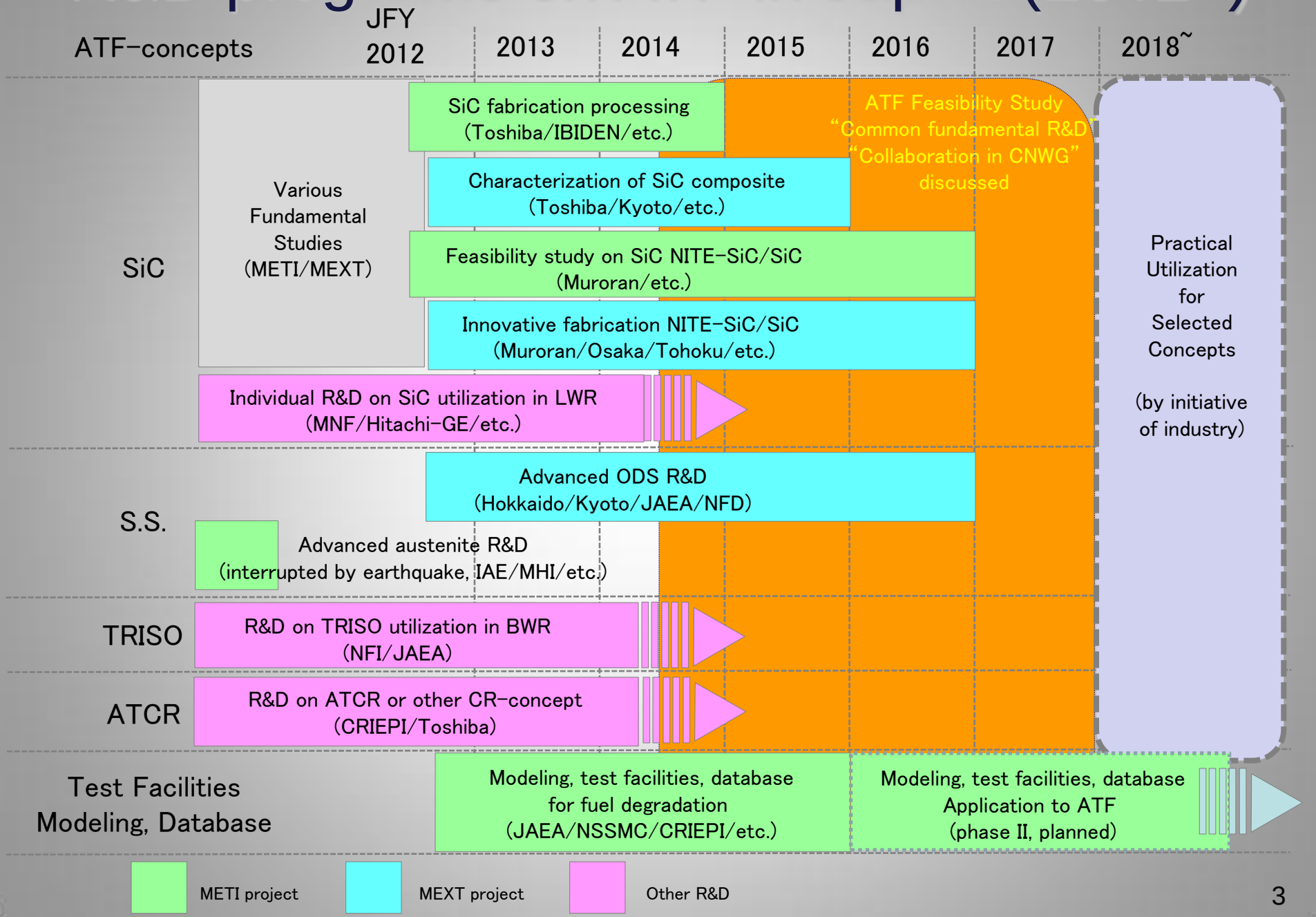
Other Resources

Test facility, Database, Modeling, Quantification



BWR fuel assembly

R&D programs on ATF in Japan (2012~)



ATF feasibility project (plan-1)

- Preliminary evaluation on quantifiable improvements in reactor coping time by introducing each ATF-concept
  - Technology Readiness Level (TRL) evaluation
  - ATF metrics quantification
  - Core accident modeling/ Fuel degradation modeling

    (by collaborating institute/university/industry)

Core accident modeling

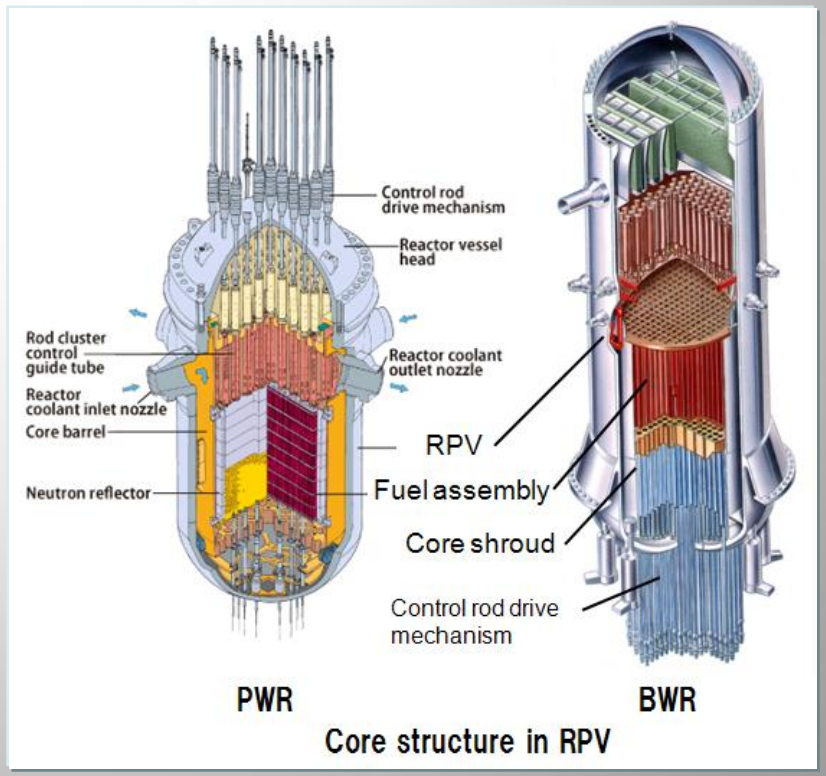
1. Analytic model & DB construction of ATF element technology (SiC, ODS, TRISO etc.)

   Oxidation, high temperature strength etc.
2. SA analysis code modification

   Candidate SA code: MAAP, SAMPSON etc.

3. Quantitative analysis and evaluation of safety improvement

   Ex) risk reduction of hydrogen explosion



Core structure in RPV

ATF feasibility project (plan-2)

- Feasibility study on accident tolerant fuel and core component for utilization in LWR
  - SiC, ODS-ferrite, TRISO, ATCR, and etc.

- Common or synergetic fundamental R&D for:
  - Material development
  - Fuel performance modeling
  - Databasing, especially under irradiation condition
  - Material testing of candidates under normal or off-normal conditions

- Preliminary screening of individual ATF-concepts
- Identification of key-technology for practical utilization in LWR

ATF feasibility project (plan-3)

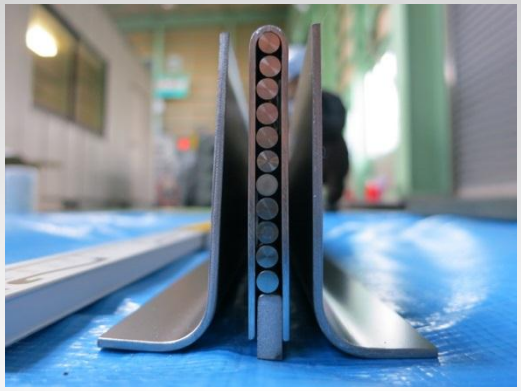
- Identification of test method, test facility, and other resources
- Preliminary evaluation of each ATF-concept using listed resources

- Development of test facilities, for example, for high temperature steam test

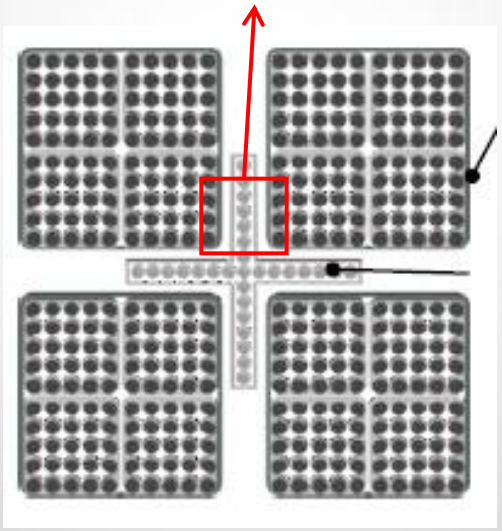
- Three test facilities already under being developed in other MET-project for "Advanced modeling and databasing of fuel degradation"
  - Fuel rod/control rod degradation test facility
    (max. temp.: ~2800K, steam atm., temp. increase: >8K/s, etc.)
  - Control blade degradation test facility
    (max. temp. gradient: 1800~1300K, test piece: ~1.2m length, etc.)
  - Degraded fuel stratification test facility
    (max. temp.: ~2800K, reductive or oxidized atm.)

Ex) Control blade degradation test facility

Prototype test facility
(for Ar atmosphere)

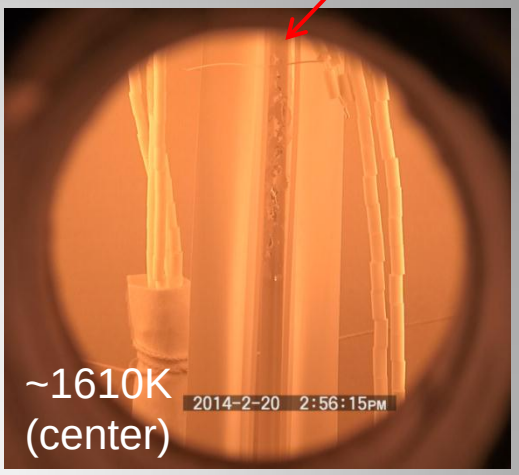


Cross section of sim-blade

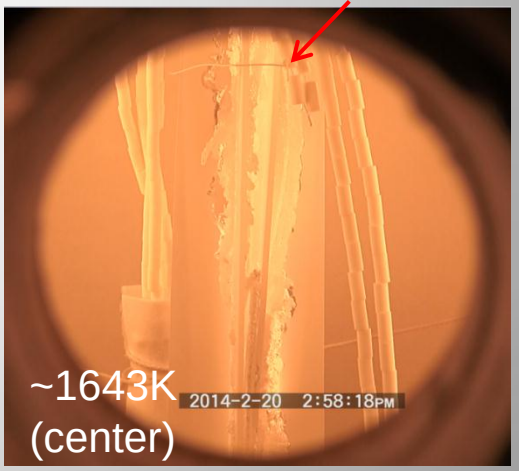


Cross section of BWR
fuel assembly

Liquefied S.S./B_4C



Reaction with Zry



Visual inspection of degradation

⇒ Test facility for steam condition being designed and manufactured in 2015.
⇒ Stm test using Zry cladding is performed in 2014.

Summary

- Fundamental study for ATF-elemental technology had been continued mainly by initiative of universities in Japan before Fukushima accident.
- In 2012, several projects (METI/MEXT) were launched for various ATF-concepts. Also, industries in Japan started their own R&Ds for utilization in their BWR/PWR.
- Feasibility study for common and synergetic R&D planed in 2014, in which collaboration among institutes, universities and industries discussed.
- Industries consider projects for practical utilization of individual ATF-concepts (launched after common feasibility study).
- Several test facilities, models, databases being developed.