DEVELOPMENT OF HIGH TEMPERATURE CAPSULE FOR RIA-SIMULATING EXPERIMENT WITH HIGH BURNUP FUEL

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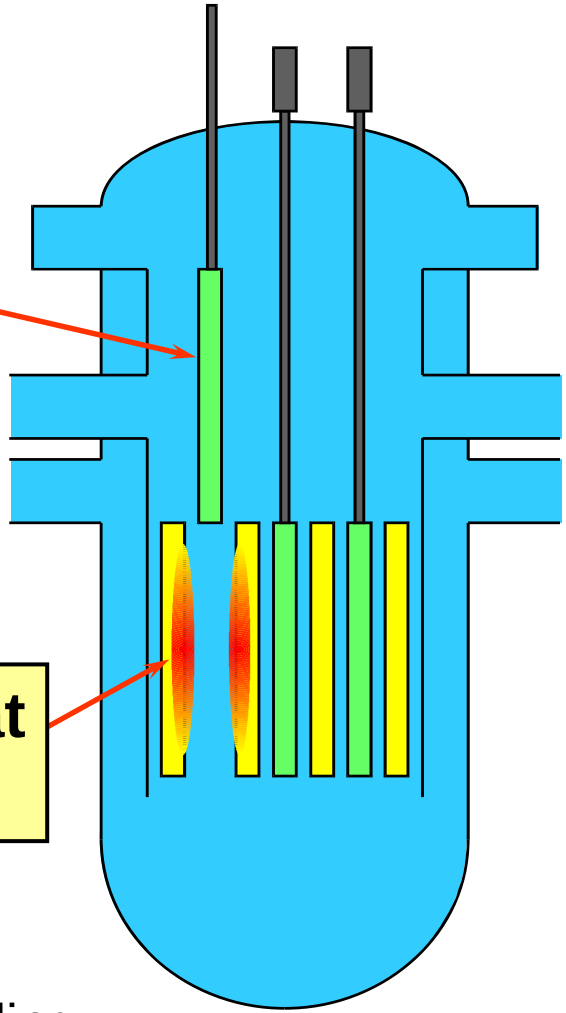
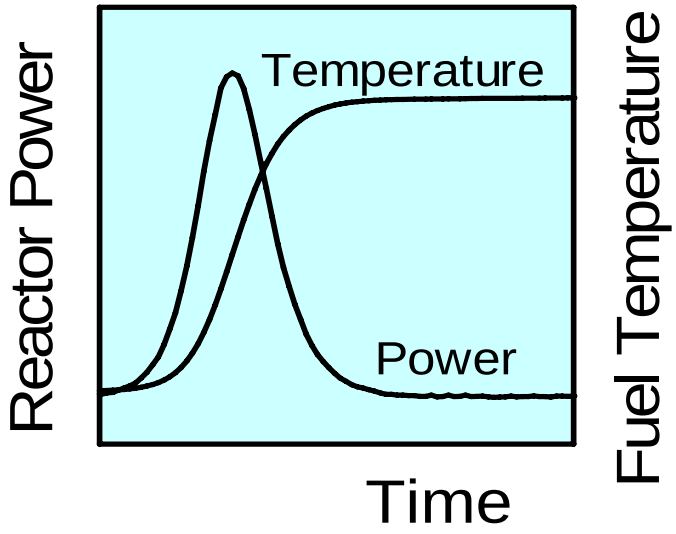
Reactivity Initiated Accident (RIA)

Control Rod Ejection



Power Burst & Fuel Temperature Increase

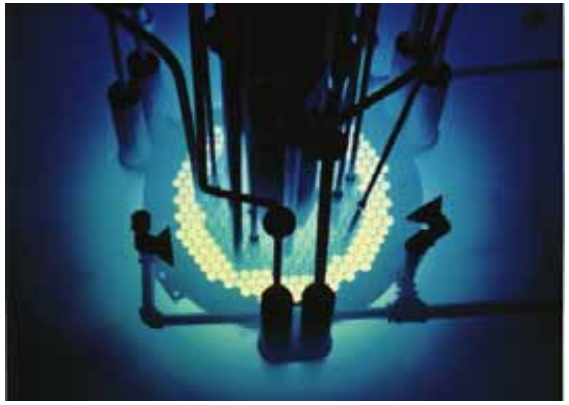


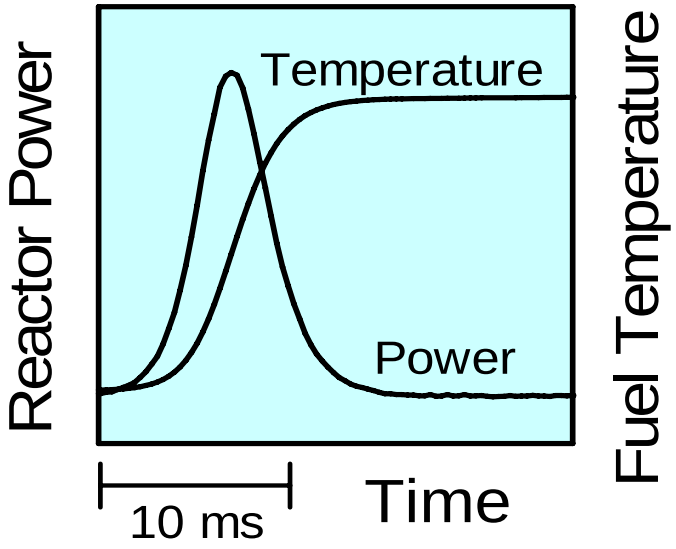
Fuel Overheat & Failure

- PCMI failure
- Burst failure
- Melting of cladding

NSRR (Nuclear Safety Research Reactor)

Modified TRIGA-ACPR (Annular Core Pulse Reactor)





For the study of fuel behaviour during an RIA

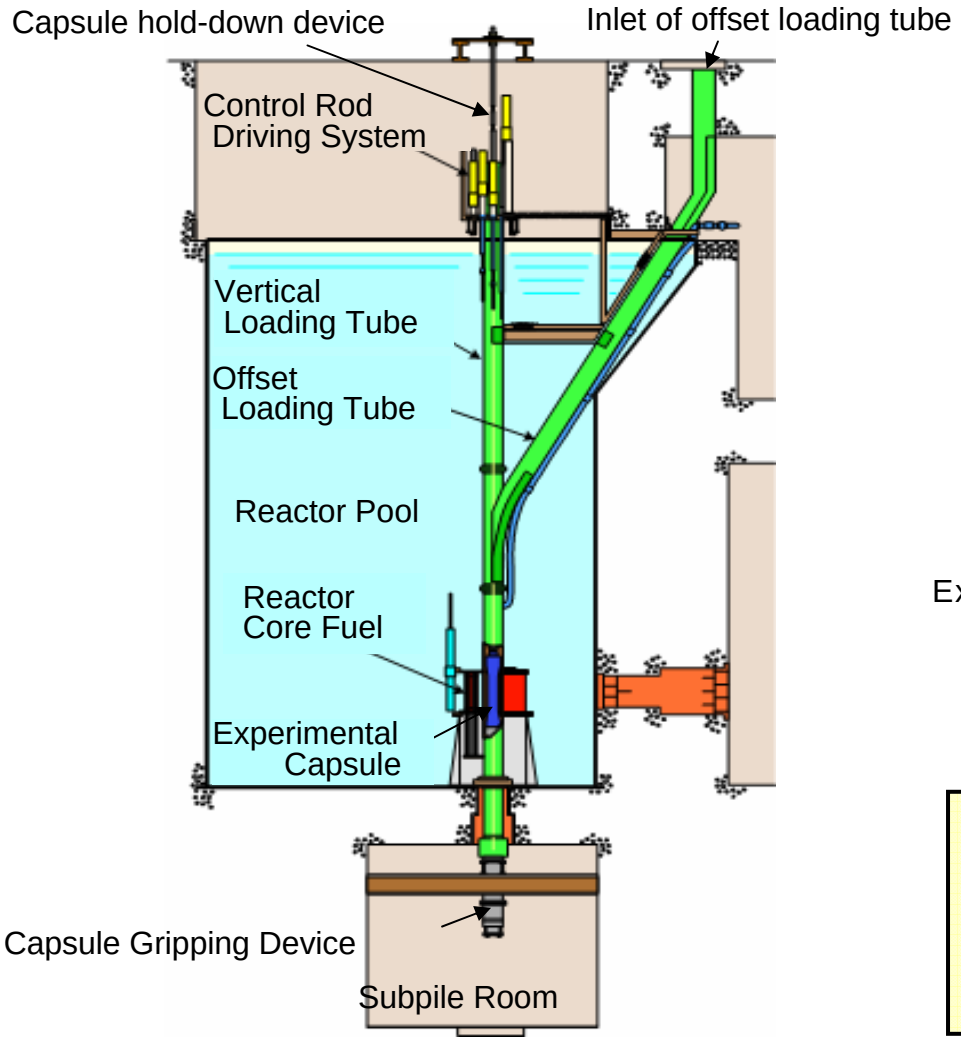
Pulse operation

- Inserted reactivity: Max. $4.7
- Maximum pulse,
  - ✓ Peak power: 23 GW
  - ✓ Integrated power: 130 MJ
  - ✓ Pulse width: 4 ms

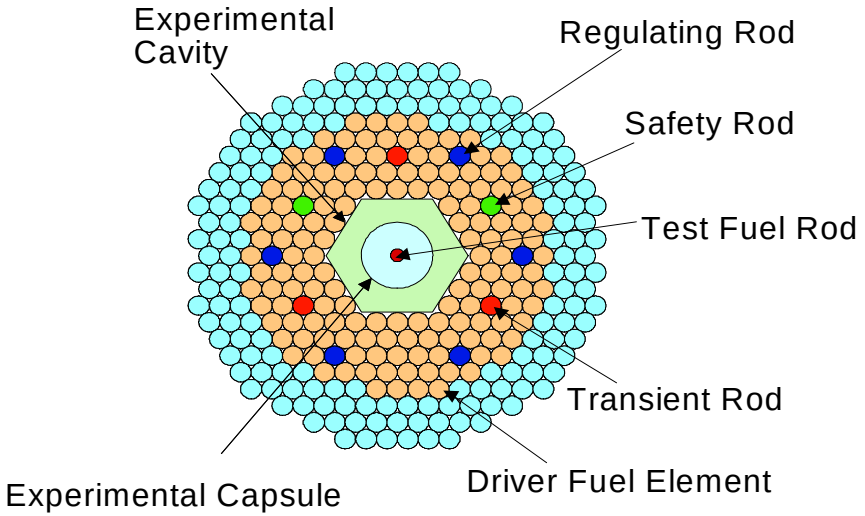
Normal operation

- Reactor power: 300 kW

NSRR (Nuclear Safety Research Reactor)



Vertical Cross Section of NSRR

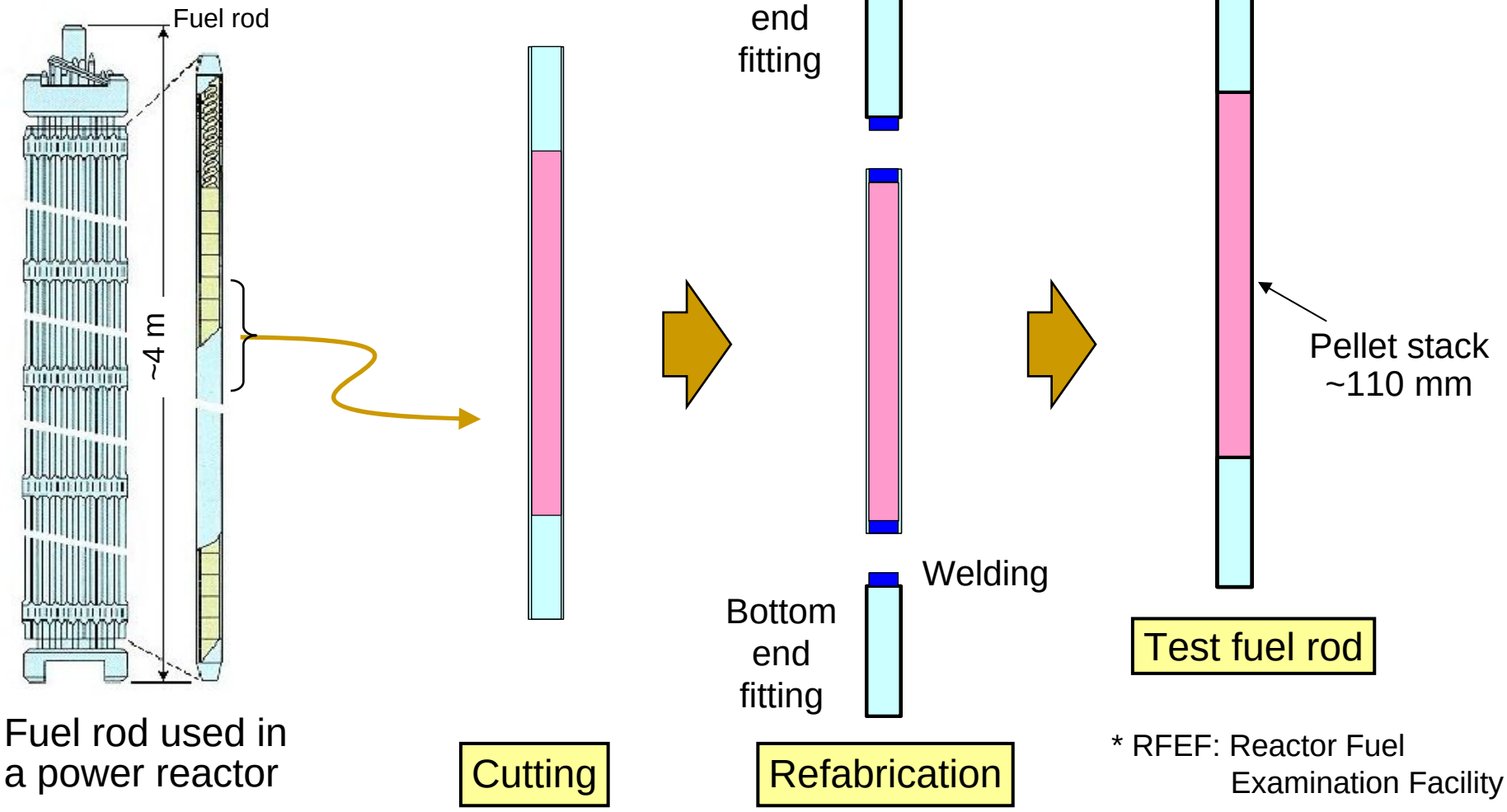


Horizontal Cross Section of NSRR

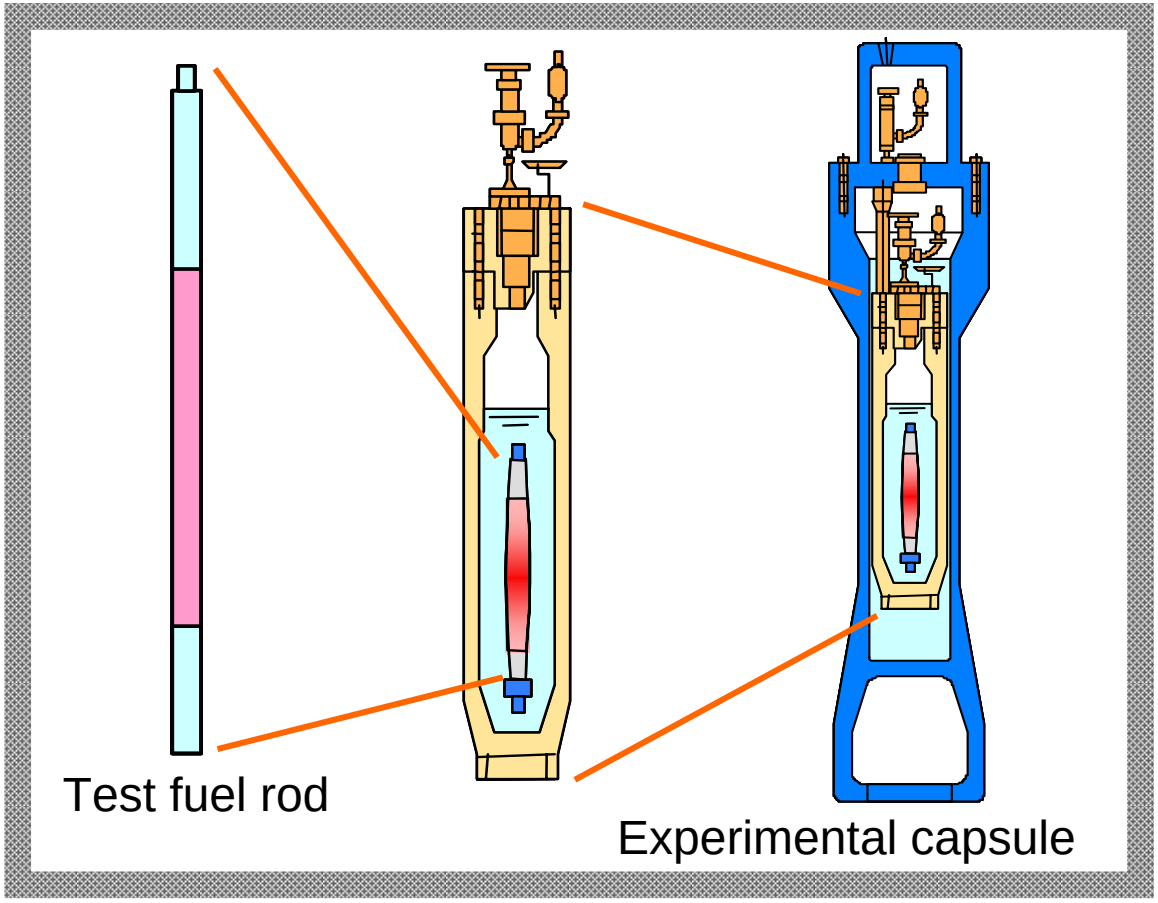
Reactor vessel: 3.6W x 4.5L x 9H m
Reactor core:

Effective height	38 cm
Equivalent diameter	63 cm

Test Procedure (1/2)



Test Procedure (2/2)



Hot cell in NSRR

Instrumentation and capsule assembling

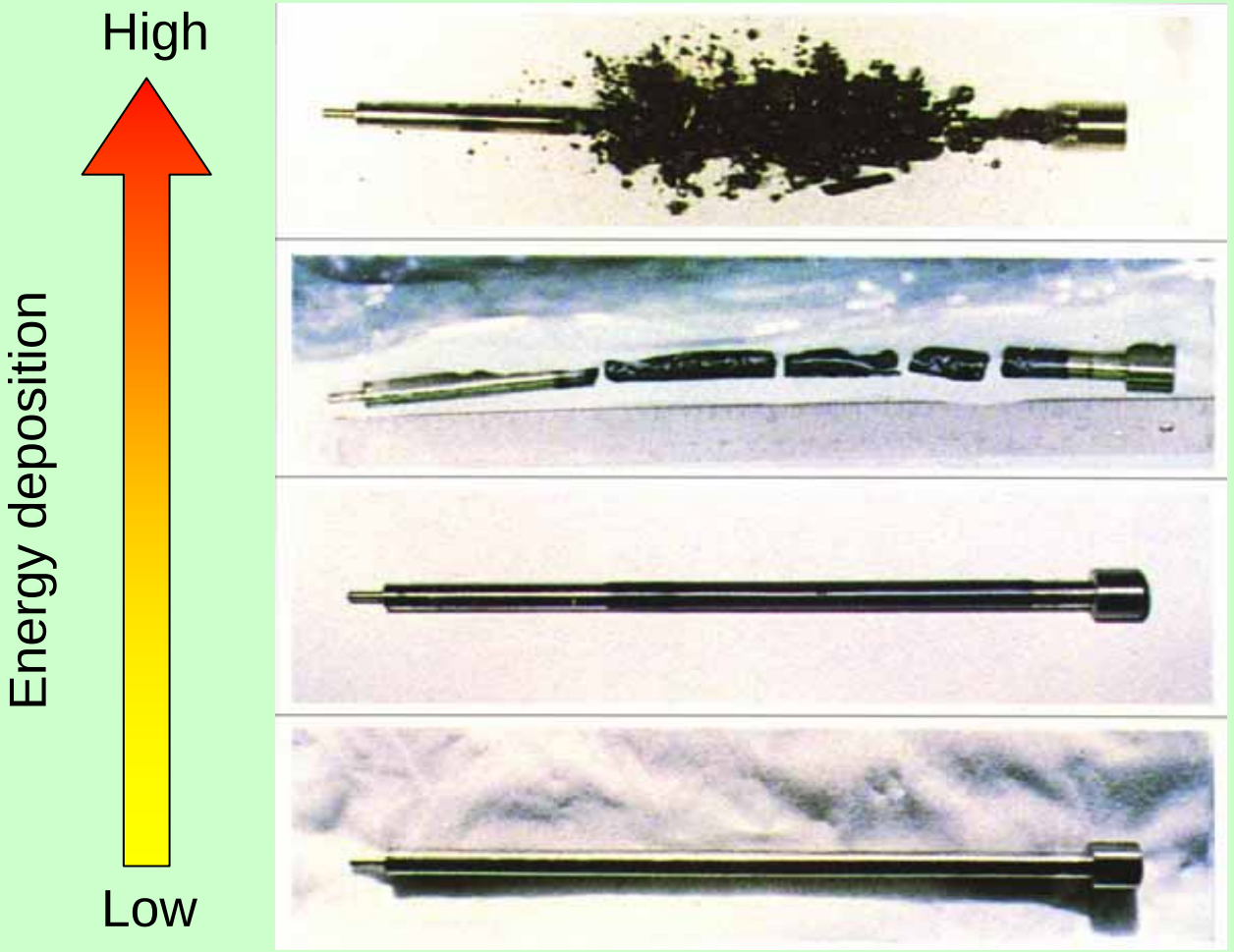
Pulse irradiation

- Room temperature
- Atmospheric pressure

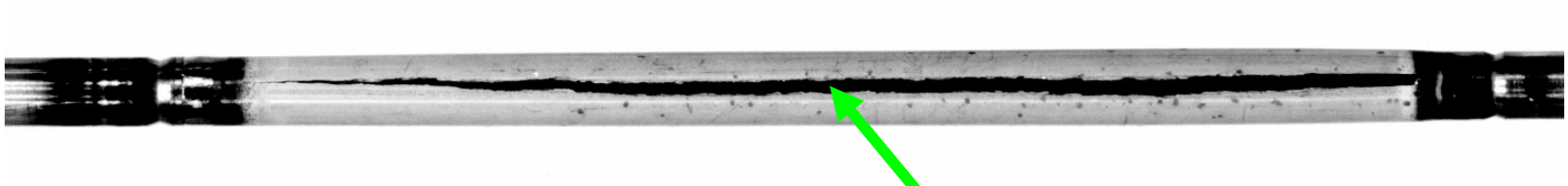
Detailed post irradiation examinations at RFEF*

* RFEF: Reactor Fuel Examination Facility

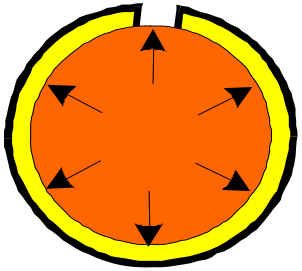
Experiments with fresh fuel rods



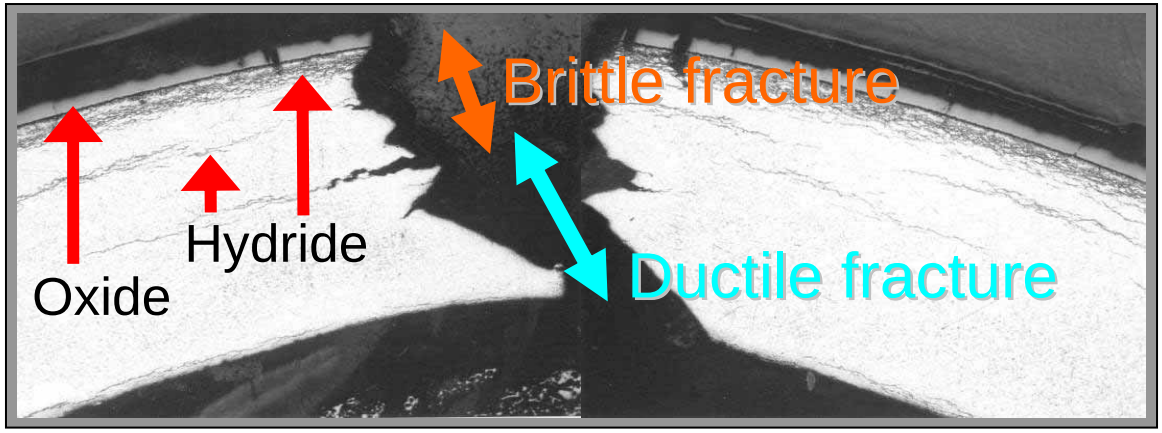
Result with Irradiated Fuel (PCMI Failure)



Long Axial Crack



PCMI Failure
(Pellet/Cladding
Mechanical Interaction)



Cross section of cladding

Development of High Temperature Capsule

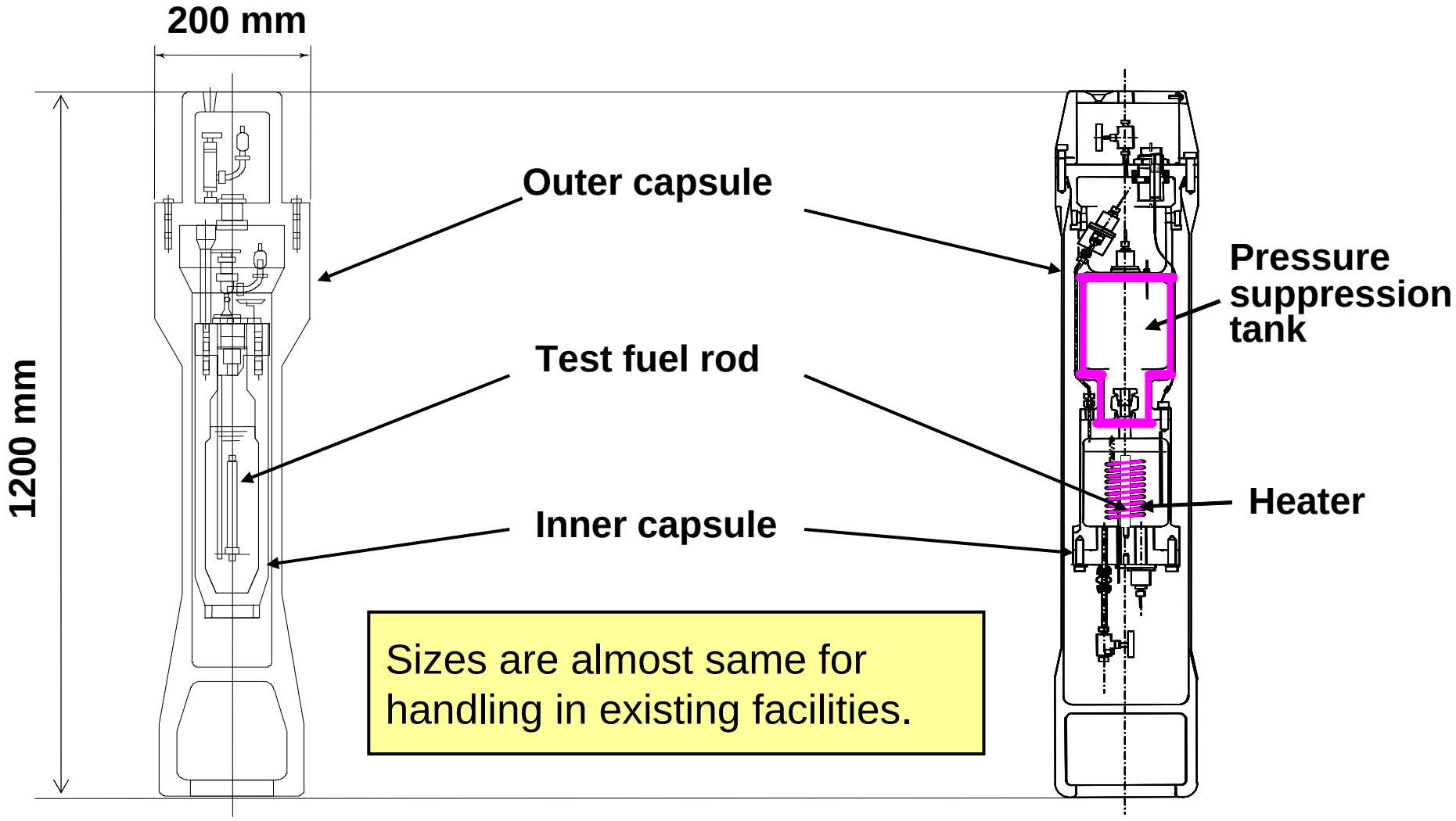
Recent results with high burnup fuels show;

- ✓ The occurrence of fuel failure is influenced by cladding temperature.

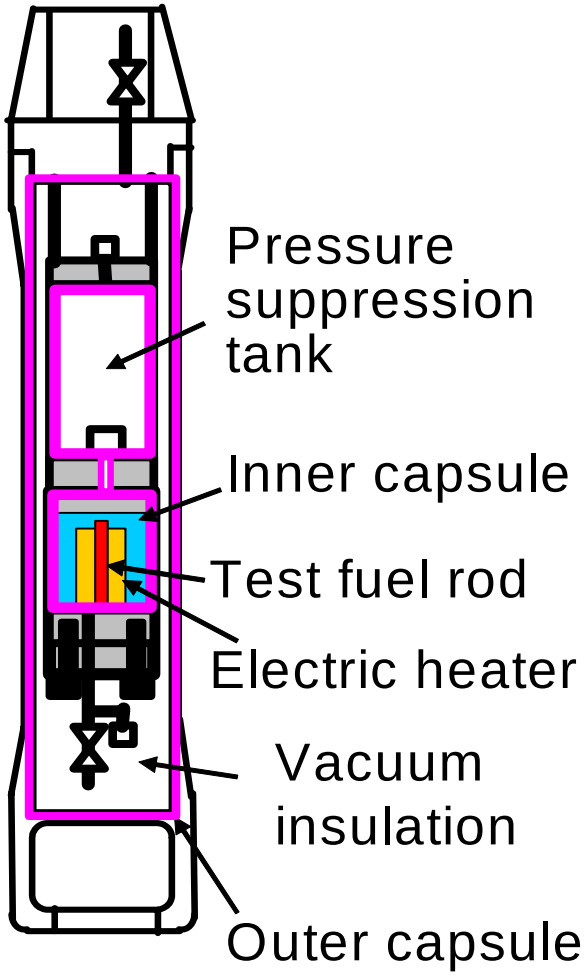
In order to clarify the temperature effect on fuel failure, new capsule which achieves high temperature condition was developed. The target temperature is 280 ^{o}C.

(New capsule should be able to be handled easily.)

Design requirements (1/3)

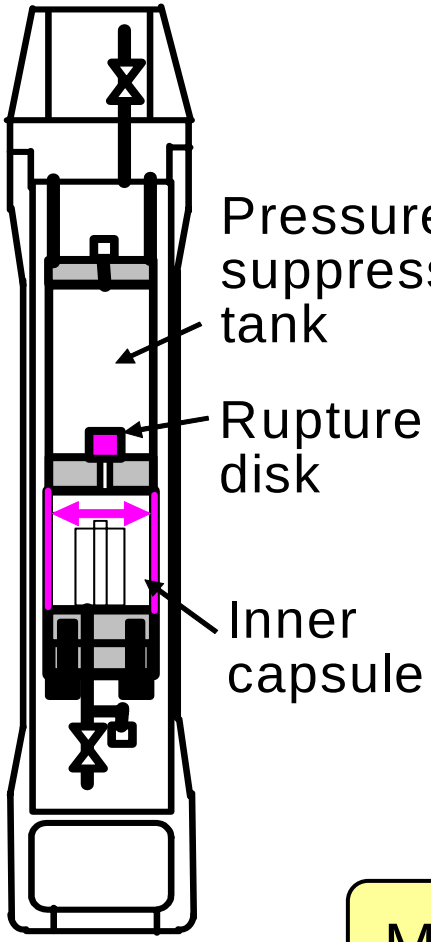


Design requirements (2/3)



- No leakage of fuels
  - ✓ Capsule is a doubly sealed structure.
- Achievement of high temperature condition
  - ✓ Electric heater is equipped.
  - ✓ Free space of outer capsule is vacuumed for heat insulation.

Design requirements (3/3)



- Pressure resisting
  - ✓ Pressure resisting design assumes a possible pressure increase.
  - ✓ Rupture disk breaks by abnormal pressure increase of inner capsule.
- Effective neutron irradiation
  - ✓ Thickness of capsule-wall was optimized.
  - ✓ Diameter of inner capsule is as large as possible for moderation of fast neutrons penetrating the wall.

Manufacture of new capsule was completed!!

Summary

- New capsule, which achieves high temperature condition, was developed.

An NSRR experiment with a high burnup fuel was successfully performed with the high temperature capsule.

The temperature effect on fuel failure will be clarified with experiments using the high temperature capsule.