

# Utilization of research reactors for fundamental studies in university related activities in Japan

IAEA International Conference on Research Reactors  
Safe Managements and Effective Utilization  
Sydney, Australia, 5-9 November, 2007

**Tatsuo Shikama**

Institute for Materials Research,  
Tohoku University

2-1-1 Katahira, Aobaku, Sendai, 980-8577 Japan  
shikama@imr.tohoku.ac.jp

**The Oarai Branch( International Research Center for Nuclear Material Science), Institute for Materials Research, Tohoku University**

- A facility placed in the Oarai Nuclear Conglomerate
- A Facility for utilizing research reactors sited in JAEA(Japan Atomic Energy Agency) -Oarai, namely, JMTR, JOYO, HTTR and JRR-3 in JAEA-Tokai
- A Facility open to university researchers for their fundamental studies utilizing reactors
- Operated by Institute for Materials Research of Tohoku University under close cooperation and collaboration with JAEA

# A variety of research interests of university researchers, which should be coped with by the Oarai Branch

## – Material Science

- Fundamental studies on radiation effects in materials
- Development of nuclear materials (Next generation fission reactors, fusion reactors)
- Reactor safety issues (degradation mechanism, evaluation of life time)
- Utilization of radiation effects on development of new materials
- Actinide science

## – Nuclear Engineering and Technologies

- Back end technologies
- Radioactive analysis

## – Geological and Cosmological Science

## – Biological Science

## A role as an effective interface between the reactor operating organization and users

Regulatory Board



Reactor operating organization



**Interface functions (effective utilization of RRs with appropriate safety)**

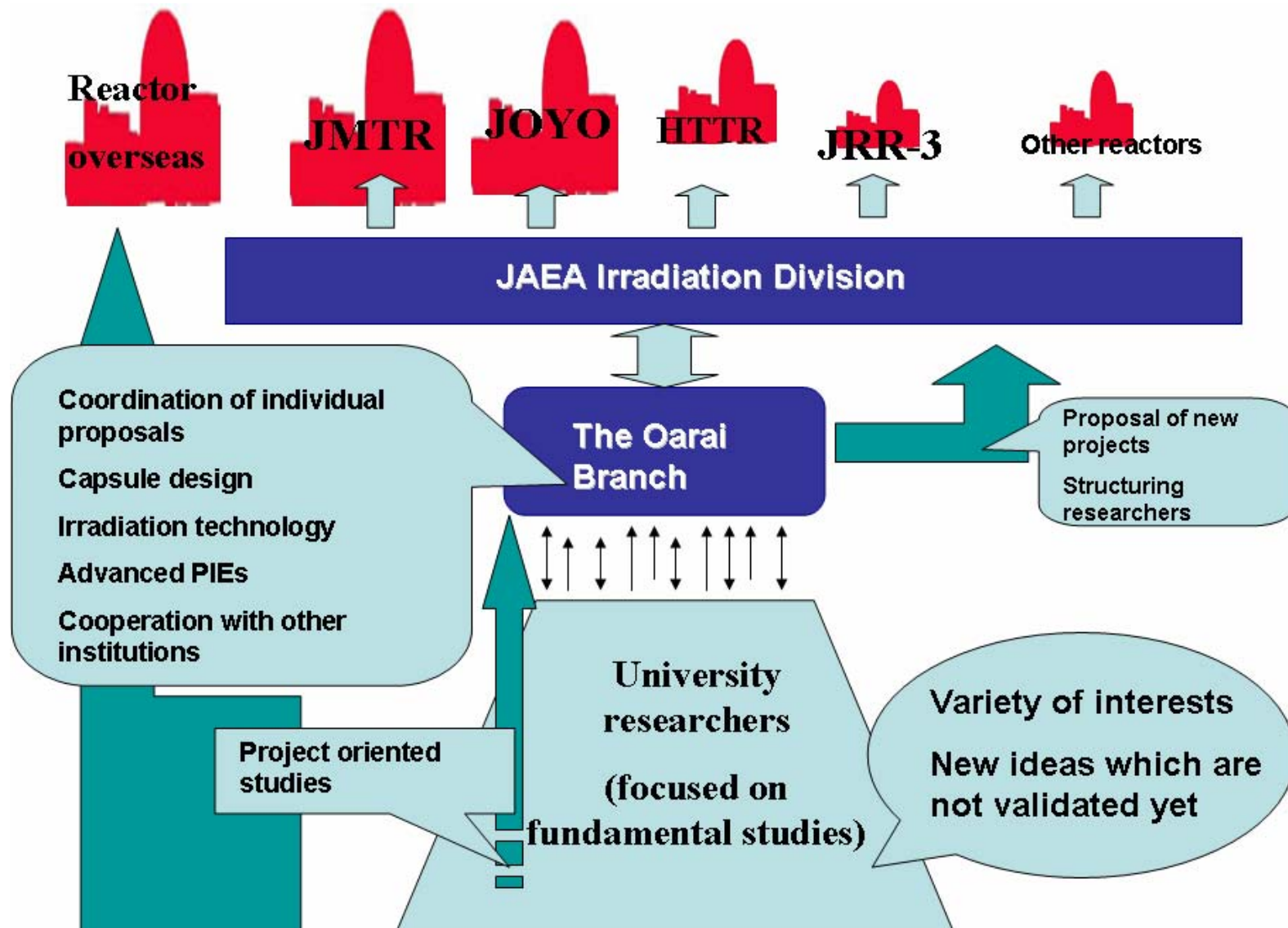


Users

Usually disinterest in motivations of individual researchers  
Keen to regulatory board  
Reluctant in bridging between regulatory issues and users' demands

Variety of interests (cf. project type irradiation)  
Disinterest in regulatory and safety issues  
Usually unfamiliar with reactor technologies and related restrictions

## Relationship among the Oarai Branch, university researchers, and research reactors mainly operated by JAEA



# Oarai Nuclear Conglomerate



Tokai area

International collaboration  
HFIR (ORNL)  
BR-2 (MOL)

IMR as the international COE for materials research



NDC

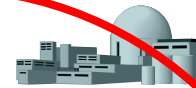
Reactor linkage



NFD



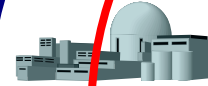
AGF



JMTR



JMTR HL

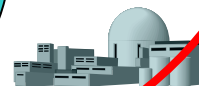


HTTR



MMF

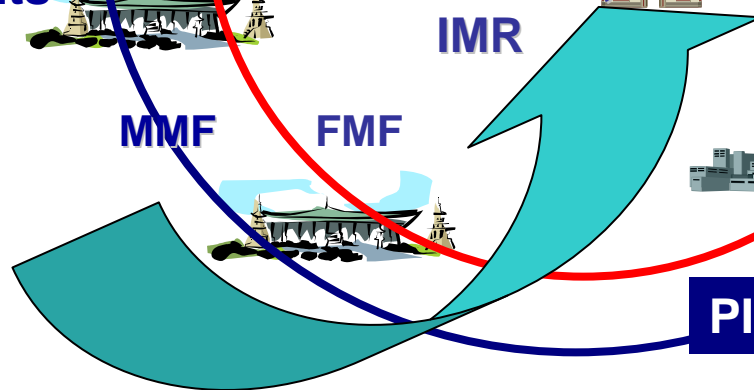
FMF



JOYO

PIFs linkage

Research collaboration with universities and education of post graduate students



The Oarai Branch, IMR





The Pacific Ocean

Fast reactor  
JOYO


JOYO-HLs

Light water  
cooled JMTR

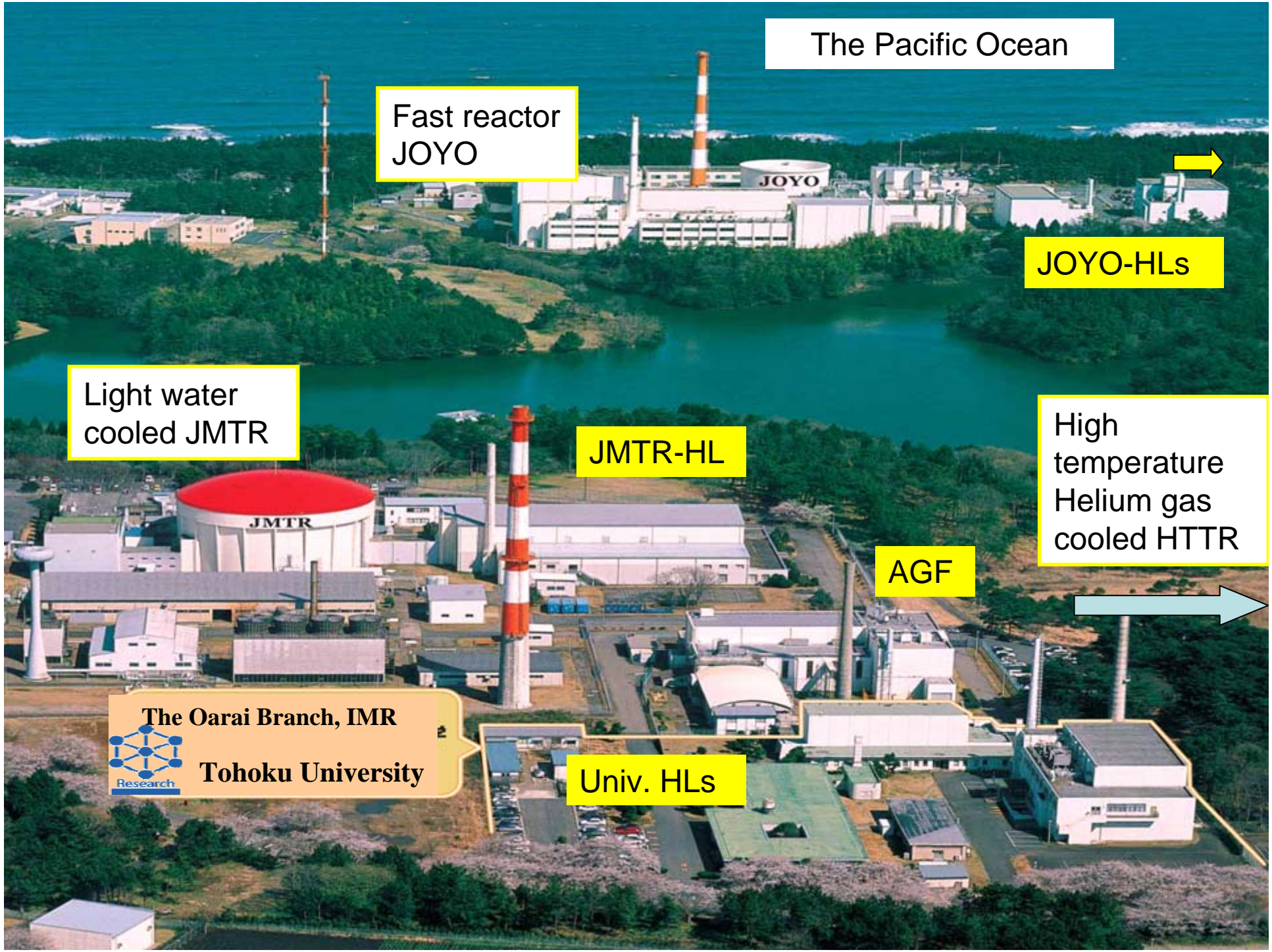
JMTR-HL

High  
temperature  
Helium gas  
cooled HTTR

AGF

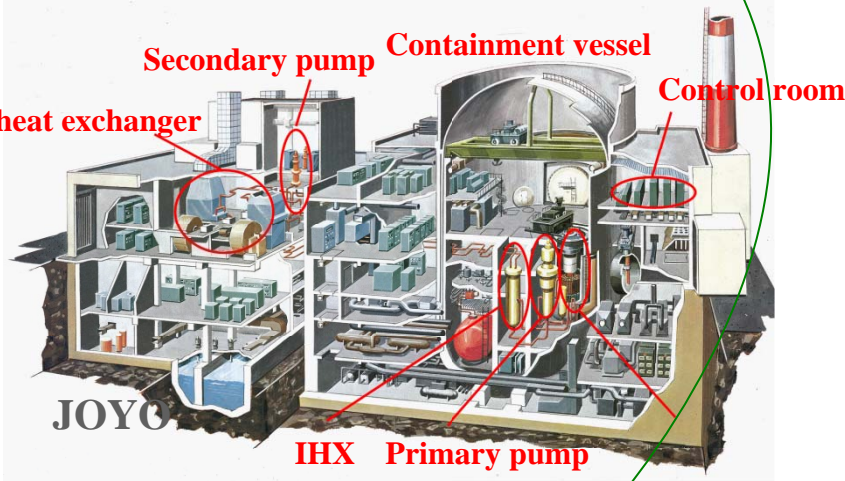
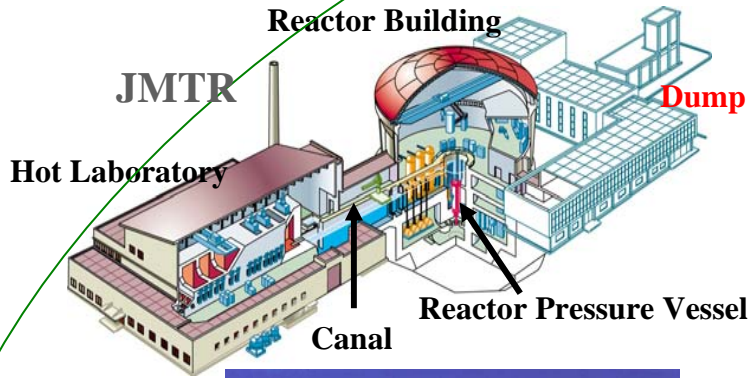
The Oarai Branch, IMR  
 Tohoku University

Univ. HLs



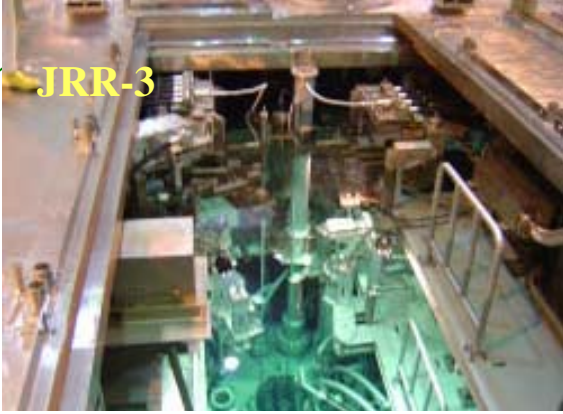
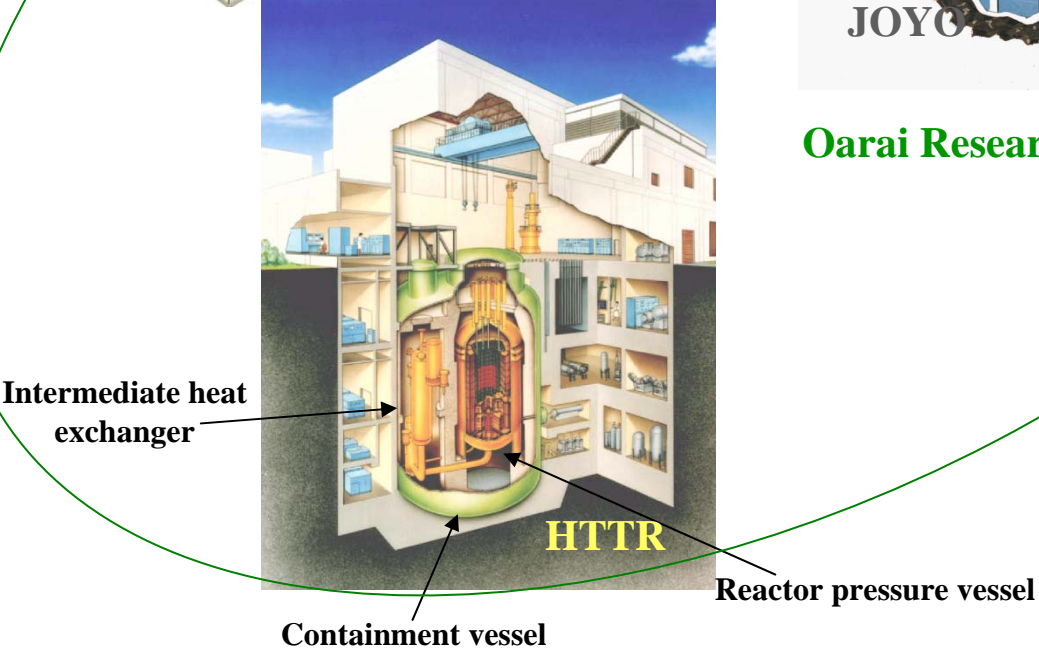


# Research reactors of JAEA



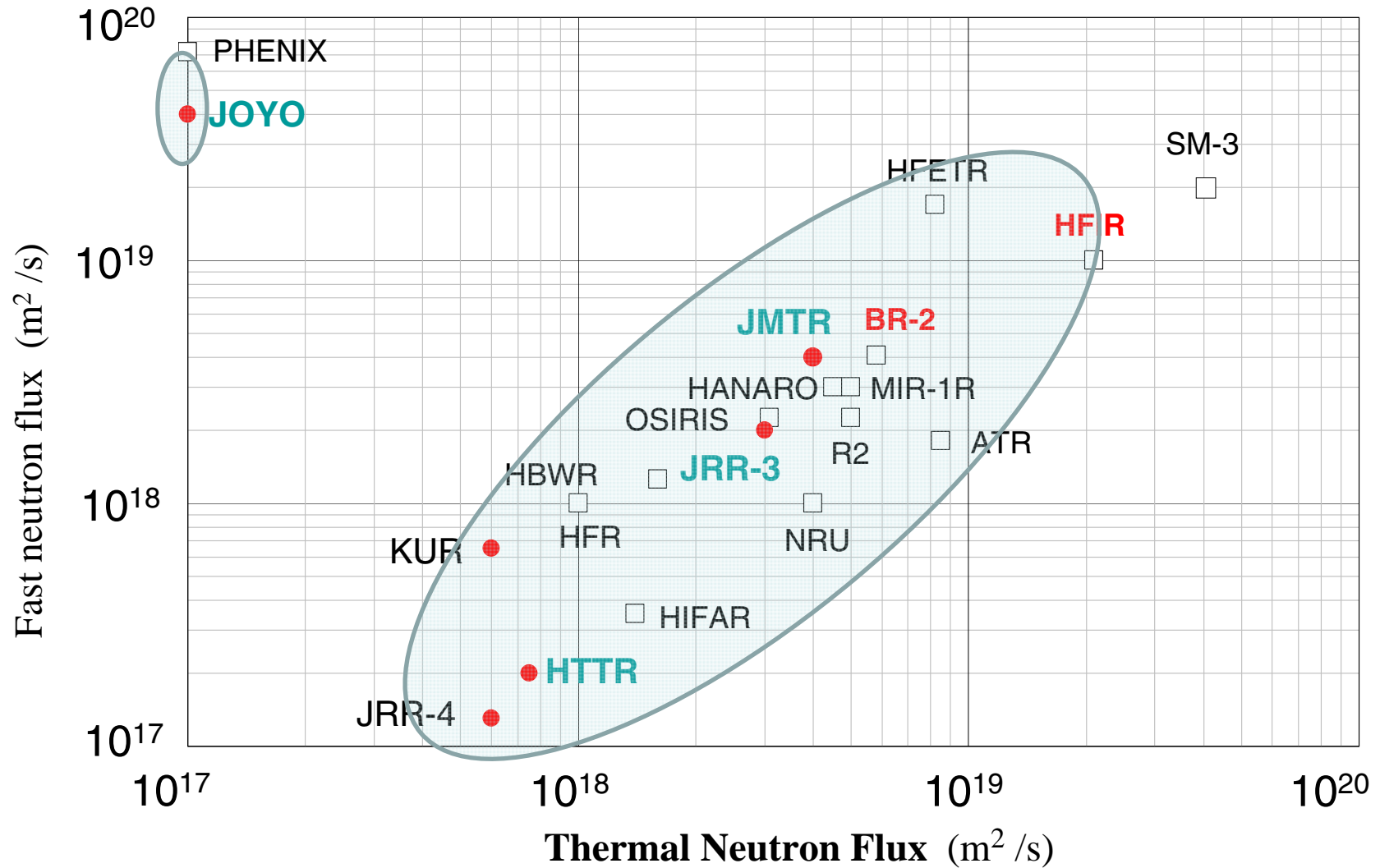
Oarai Research and development center

Tokai site





# Research Reactors in Japan and World



# Main activities of the Oarai Branch

Development of radiation resistant materials for advanced nuclear systems

Evaluation of life of structural materials in LWRs

Utilization of radiation energy and RI

New analyzing techniques, new functional materials utilizing radiation energy

Fundamental studies

mechanisms

Interaction between materials and radiations

Irradiation and instrumentation technologies

Temperature regulation

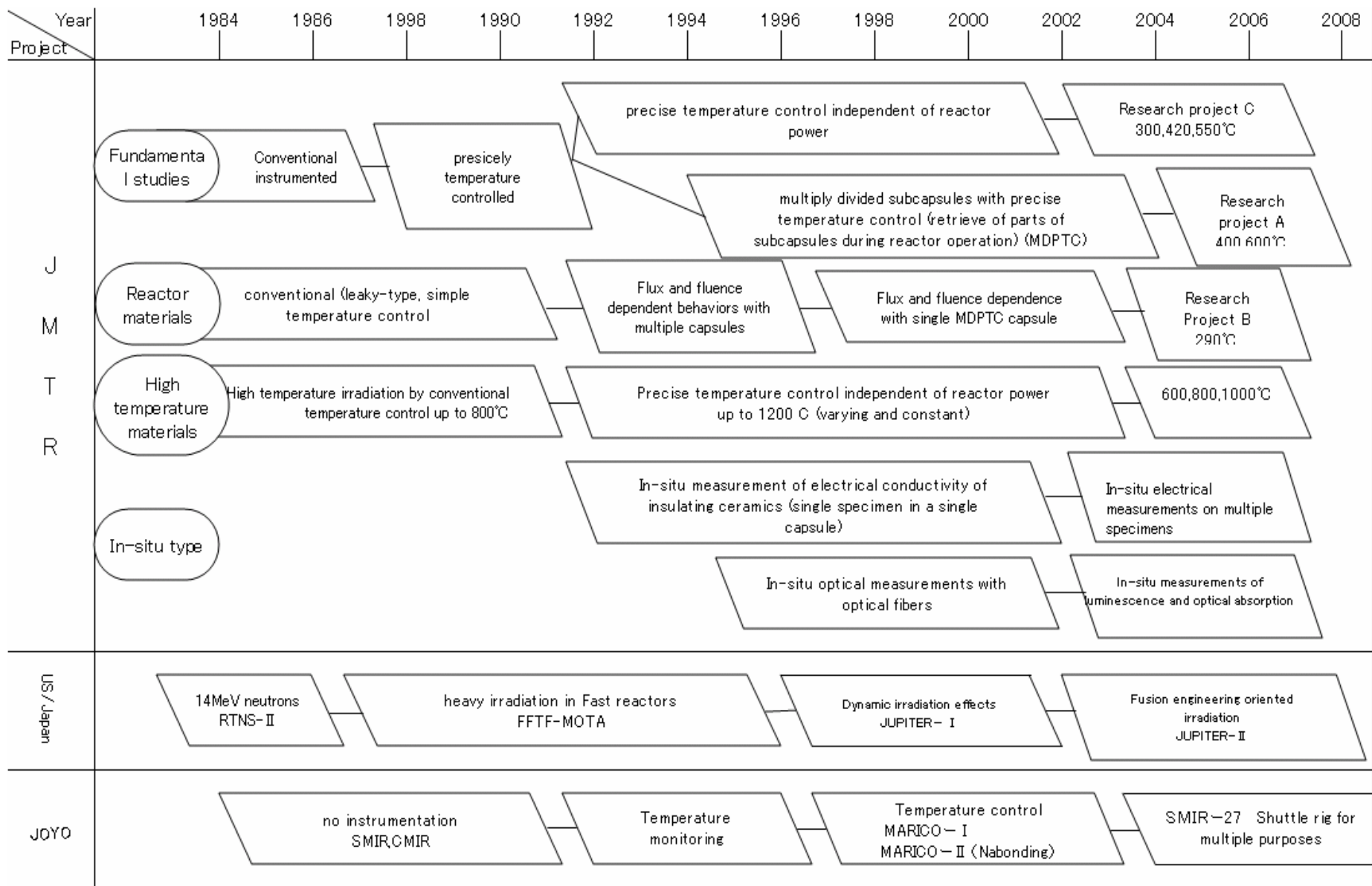
In-situ measurements

Multi-layers multi-divided

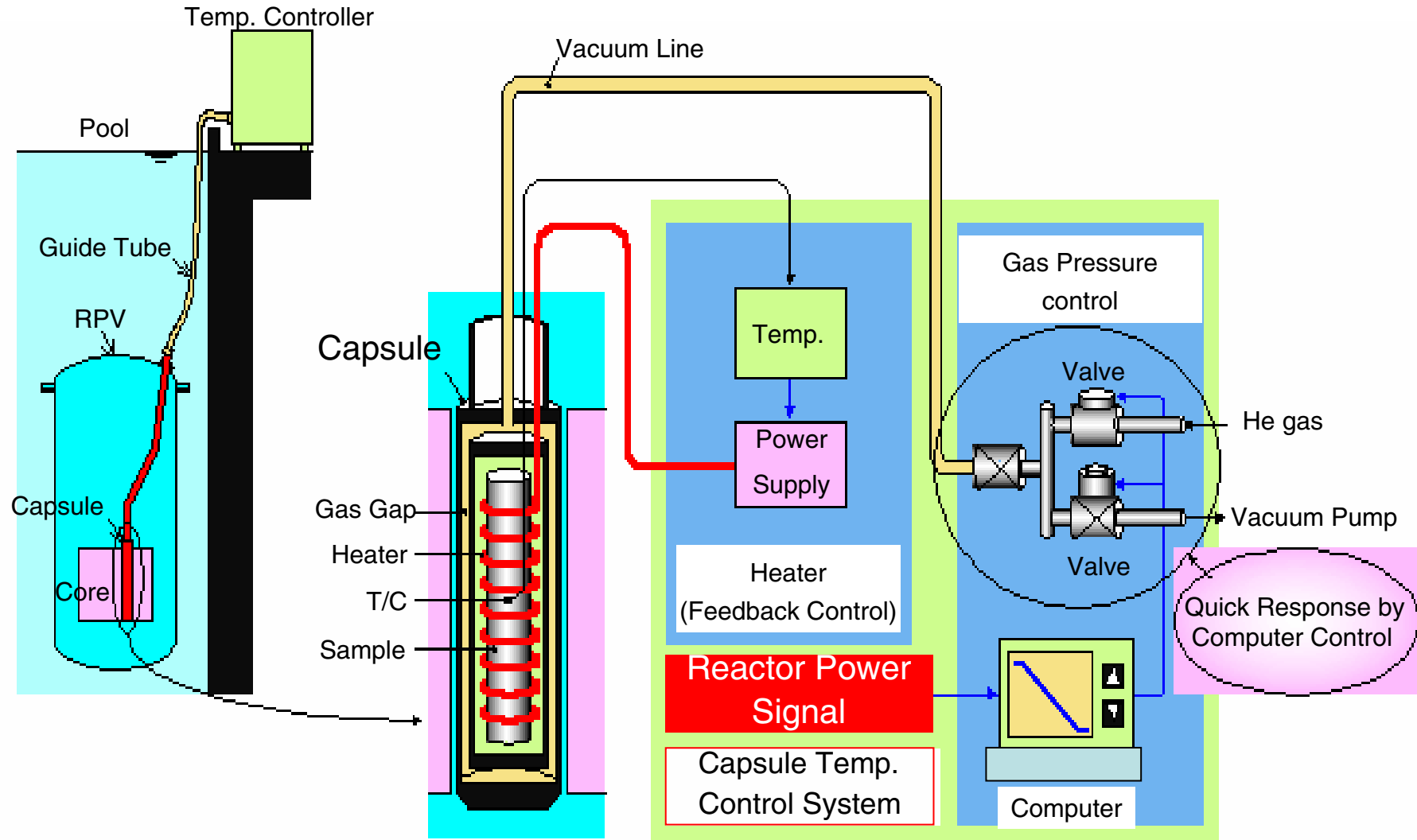
Advanced PA and 3DAP

Optical in-situ measurements

# History of development of irradiation capsules for university researches

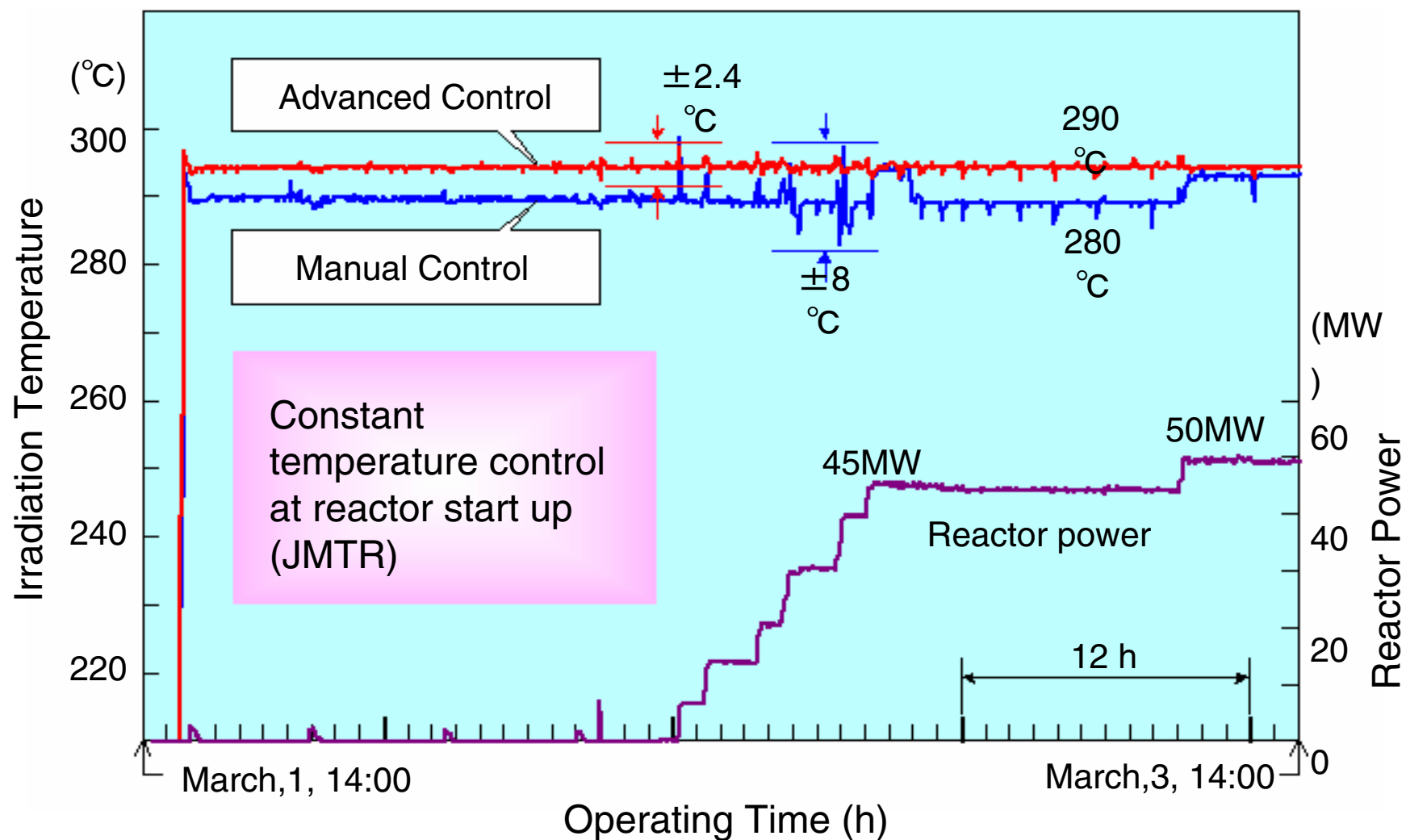


# High-accuracy Temperature Control System (Reactor irradiation being competent with advanced material science)





# A Result of High-accuracy Temperature Control



# Irradiation parameters survey in single capsule (fluence and temperatures)

Multi divided and multi temperature control rig for JMTR

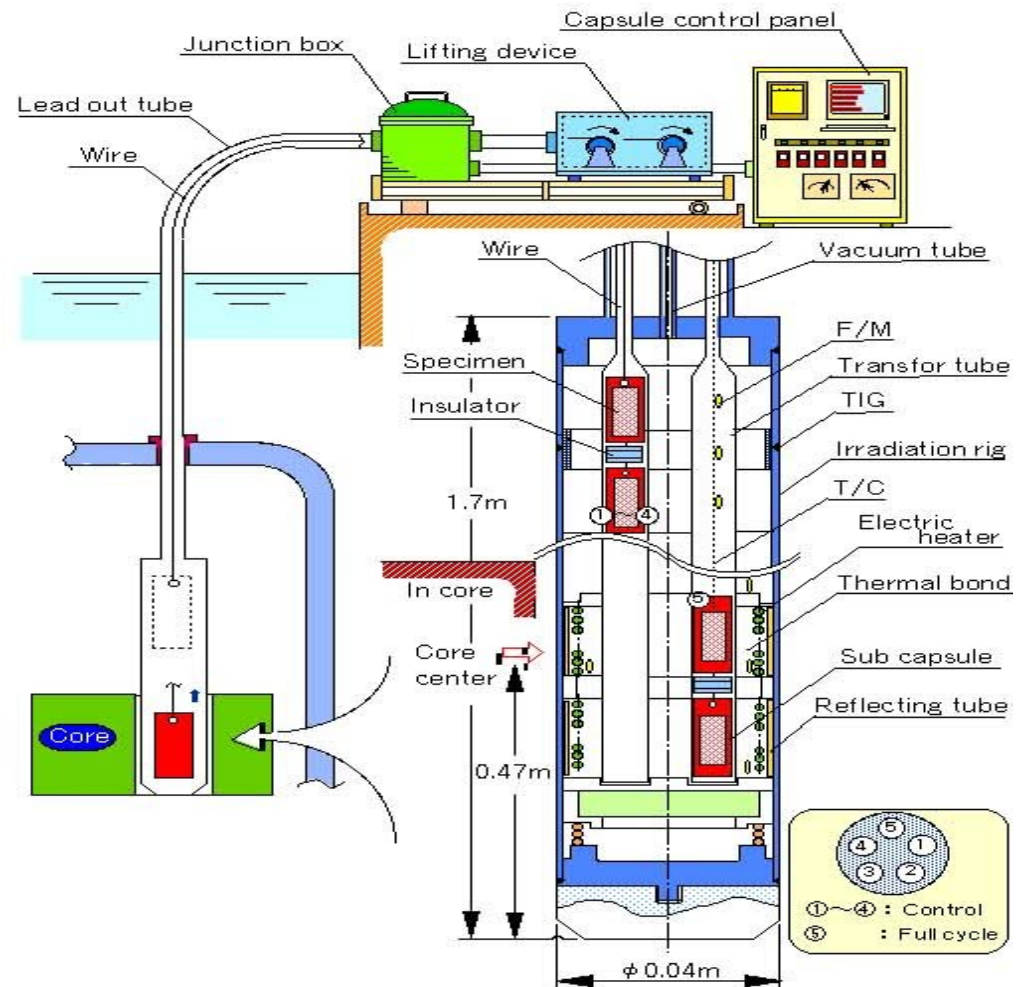
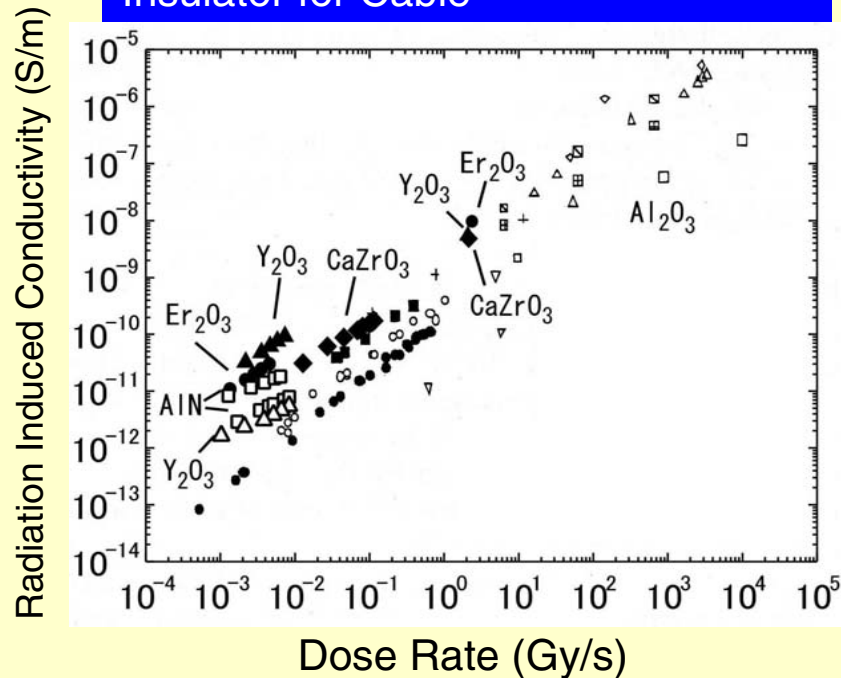


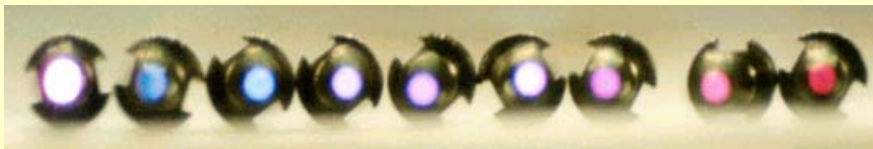
Fig.1 Schematic view of pseudo-shroud irradiation rig developed for controlled fission reactor irradiation

# In-situ Measurements Techniques

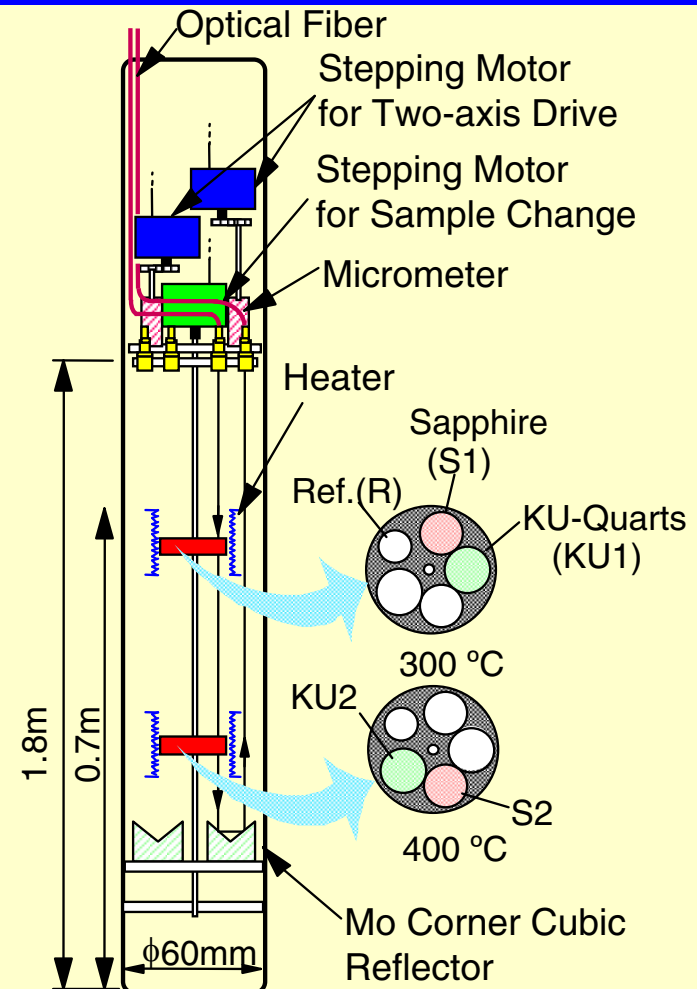
## Electrical Properties of Ceramics as Insulator for Cable



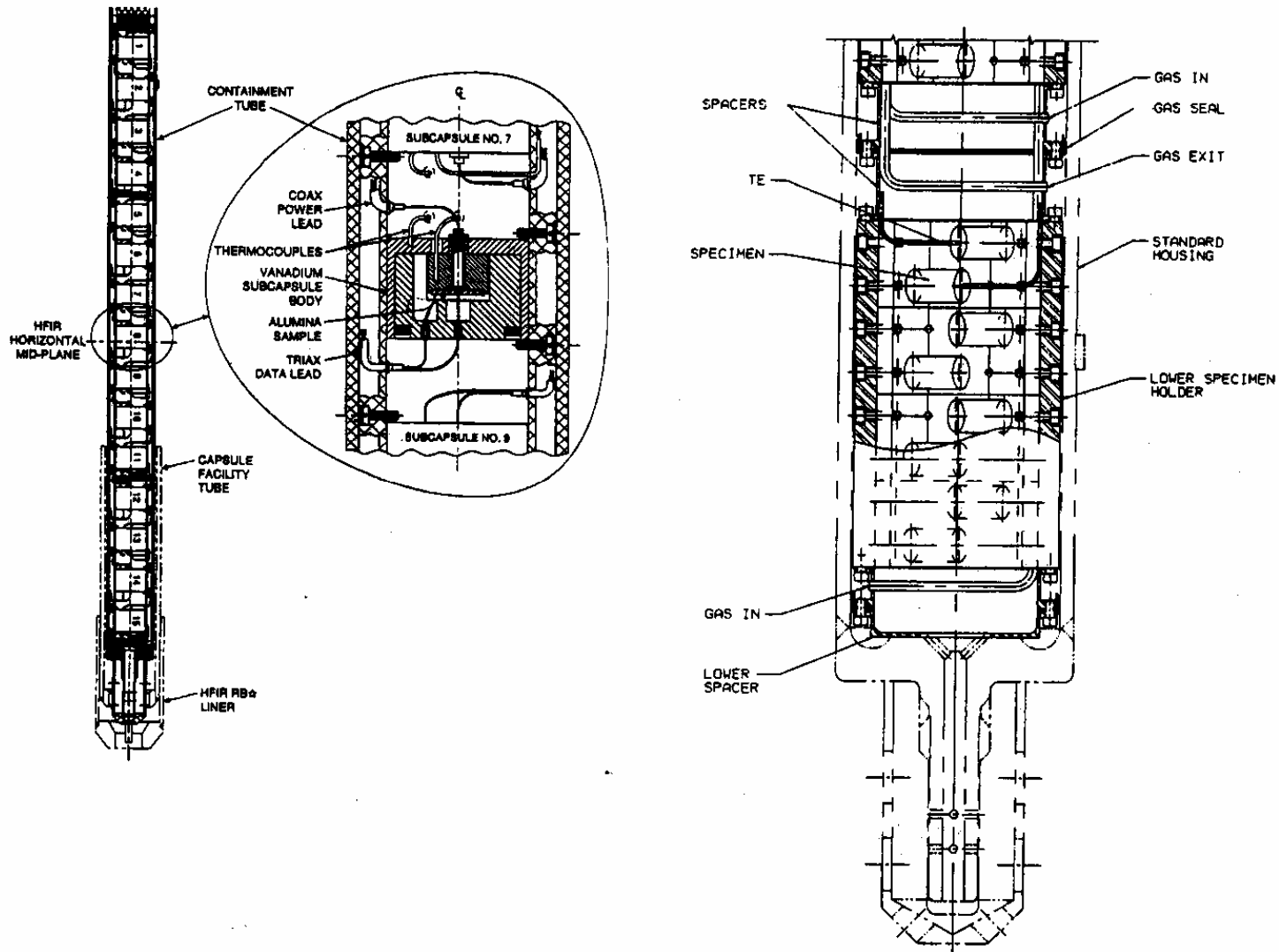
## Development Radiation-resistant Optical Fiber as New Instrument



## Optical Property Measurement of Diagnostic Windows for Fusion Reactor

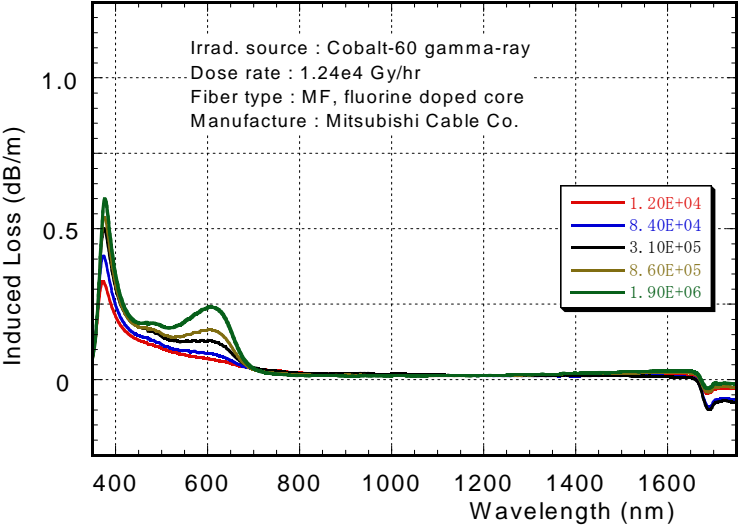
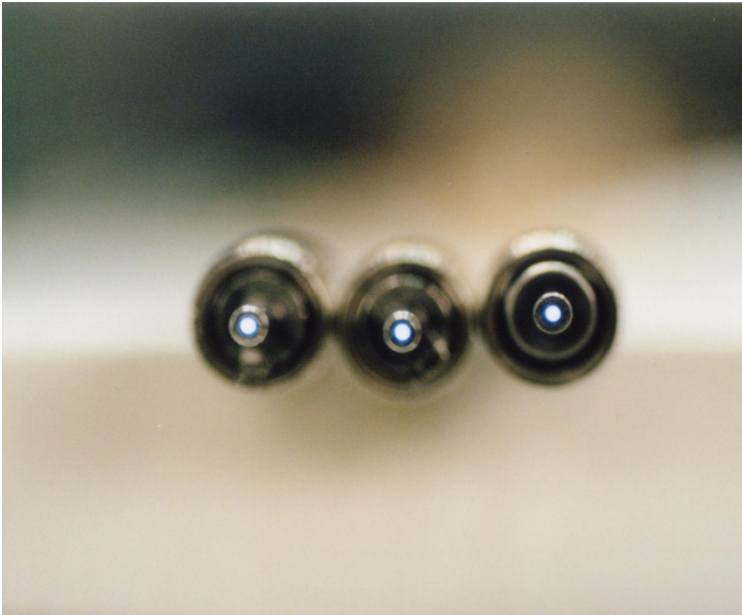
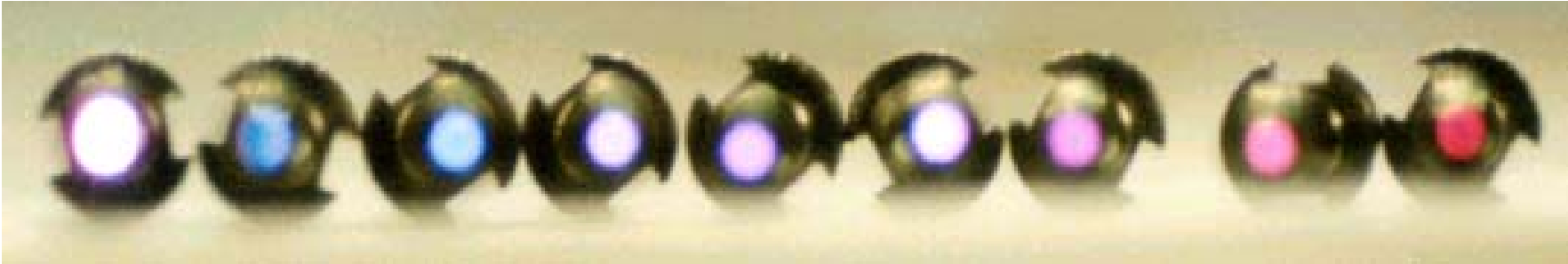


# Irradiation rigs for measuring electrical conductivity and thermal conductivity in-situ in HFIR (Japan/USA collaboration JUPITER)





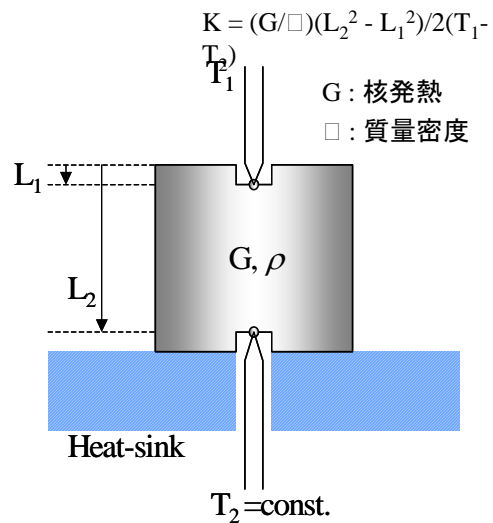
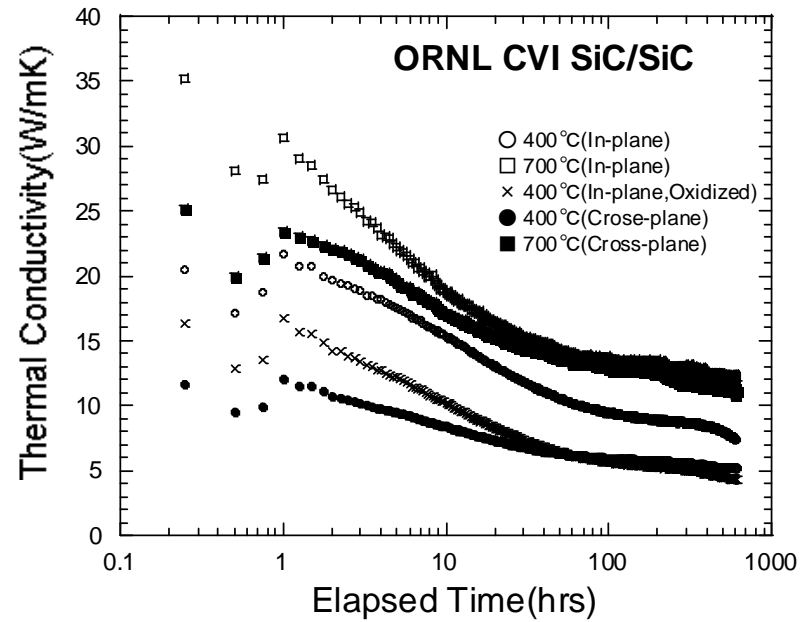
# Optical Measurements with Radiation Resistant Optical Fibers



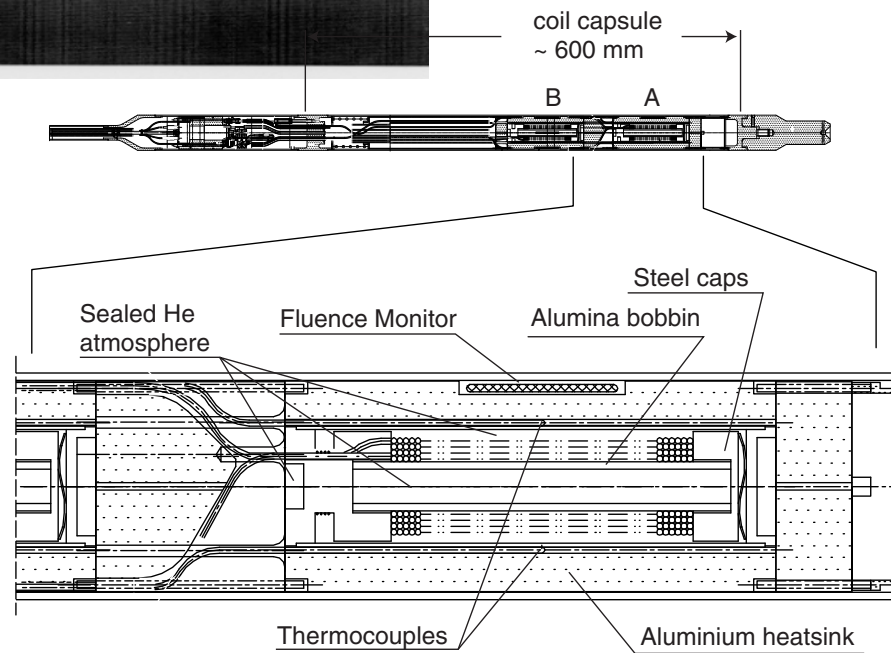
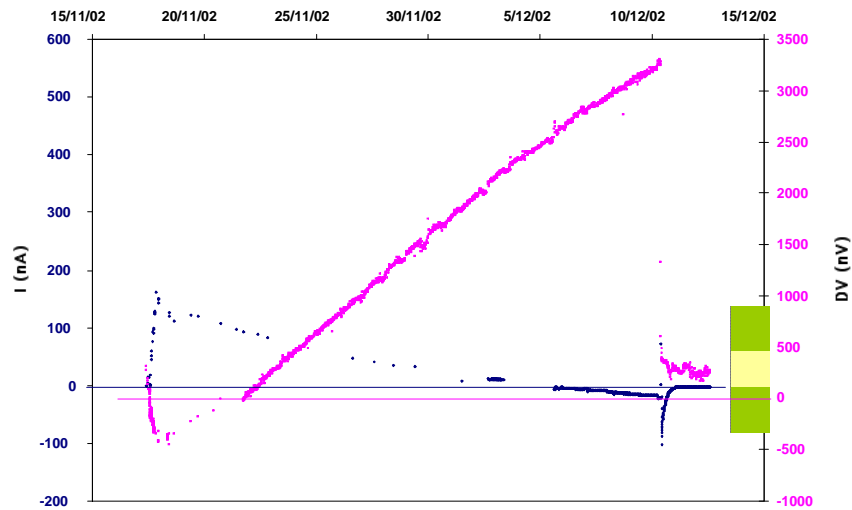
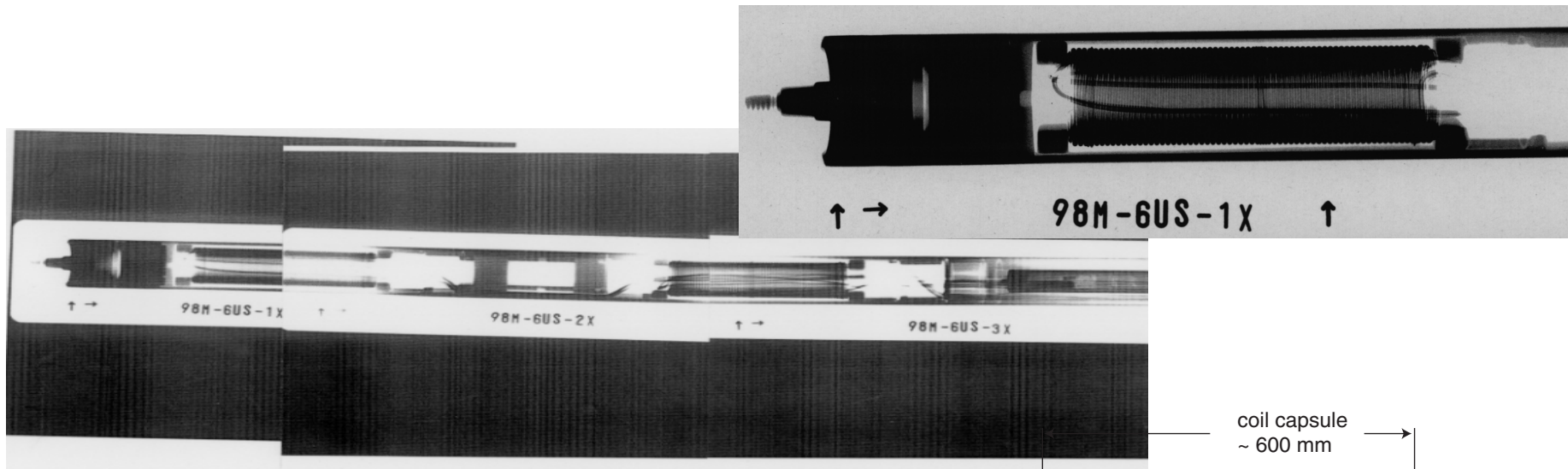
Observed optical absorption of fluorine doped core fiber, type MF manufactured by Mitsubishi Co. Ltd., JPN

- Absorption of visible wavelength range and NBOHC were increased with the exposure dose.
- Radiation hardening effect was not appeared in the large exposure dose.

# TRIST-Thermal conductivity measurement under JUPITER collaboration (USA/Japan Collaboration)



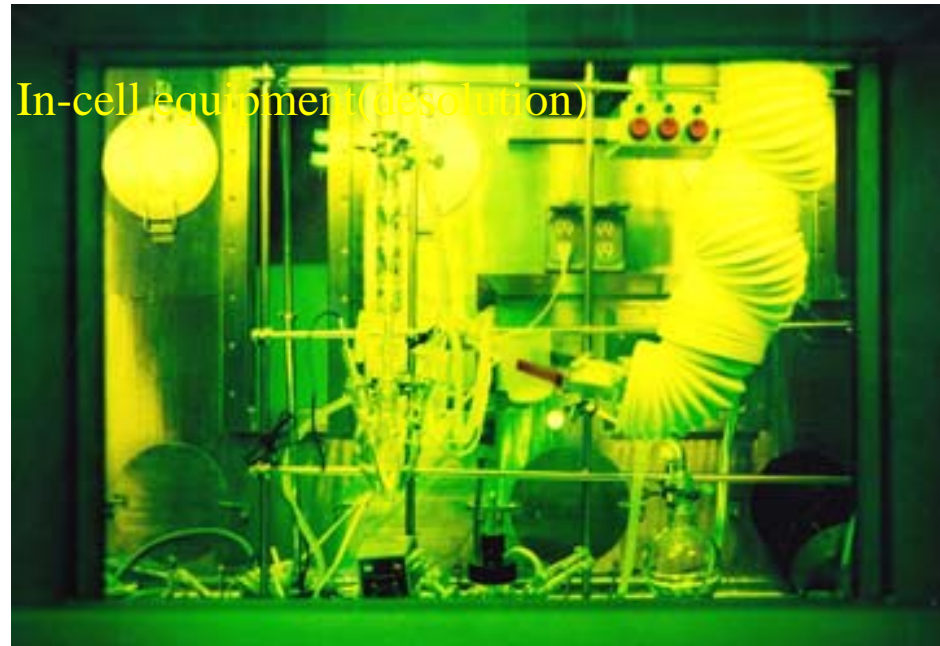
# Irradiation tests of magnetic probe for ITER under Japan/USA/EU collaboration (JAEA/EU/Tohoku Univ./USA)







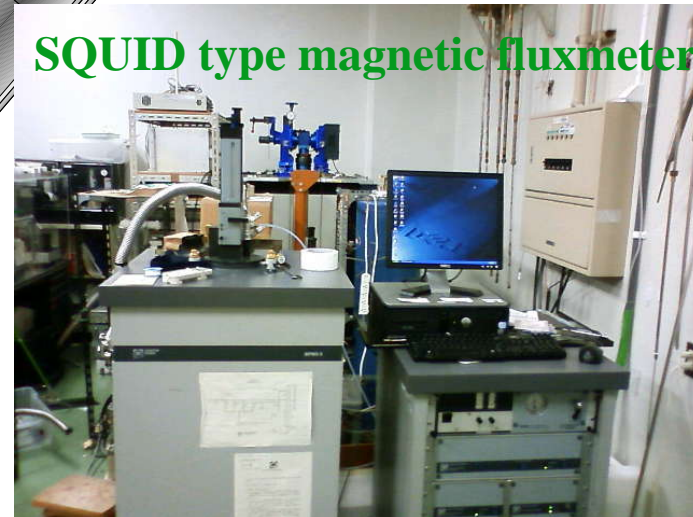
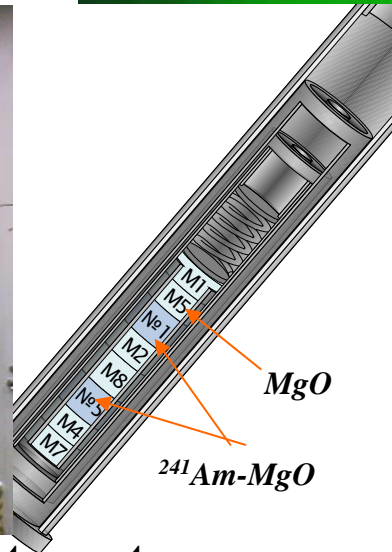
**Actinide research facility  
Oarai branch, Tohoku Uni.**



**In-cell equipment (dissolution)**



**Nuclear magnetic resonance spectrometer**

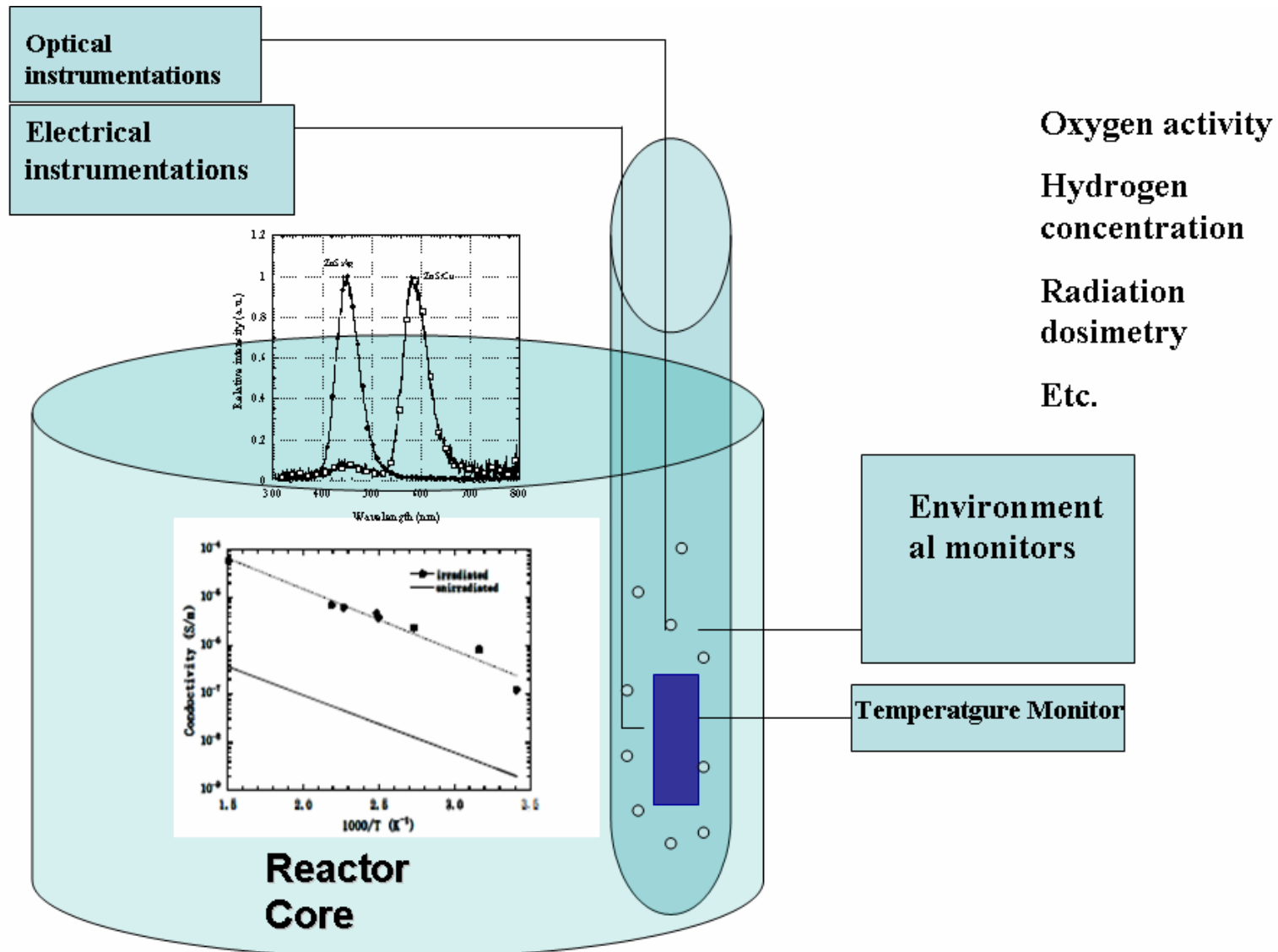


**SQUID type magnetic fluxmeter**

**Fundamental studies on fuels and TransUranium elements Close collaboration with Oarai branch, Tohoku University in the area of actinide related study )**



# Concept of shroud for controlled and monitored irradiation in refurbished JMTR for fundamental studies of universities



# Summing ups

- The Oarai Branch is planning to extend its activity of utilizing reactors around Oarai as well as overseas, under collaboration and cooperation with the JEAE.
  - **Refurbishing of JMTR**
  - **More cooperative utilization of JOYO**
  - **JRR-3 utilization on its easy access to its core region**
  - **International collaboration with BR-2 in SCK/CEN, HFIR and its international materials irradiation center of ORNL.**
- Its unique feature of advanced technology of microstructural analyses will be more emphasized to make a rigid basis for hot laboratory linkage around Oarai.
  - **Oarai COE for reactor irradiations**
- The international collaboration will be essential for the future activity of the Oarai Branch.
  - Effective utilization of limited sources
  - Improvement of reliability of studies with research reactors