

International Conference on Nuclear Knowledge Management and Human Resources Development: Challenges and Opportunities (July 1-5, 2024)



**THE EXPANDING ROLE OF THE KINDAI UNIVERSITY REACTOR  
AS A POWERFUL EDUCATIONAL TOOL  
FOR NUCLEAR HUMAN RESOURCE DEVELOPMENT**

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# Introduction



- A number of low-power research reactors were built to develop nuclear engineers during the early years of nuclear development in the 1950s and 1960s.
- The Kindai University Reactor (UTR-KINKI) is one such reactor with a rated thermal power of 1 W, and has been utilized for education and training in nuclear science and technology in Japan for more than 60 years since the first criticality in 1961.
- As the number of research reactors available for education and training decreased, the role of UTR-KINKI in Japan is expanding.
- Activities utilising UTR-KINKI as a valuable nuclear education resource are reported.

# KINDAI UNIVERSITY REACTOR UTR-KINKI



Mr 1 Watt

**UTR:** University Teaching and Research Reactor

- Designed and built for university education and training.
- Extremely safe reactor with a rated thermal power of **1 W**.
- Precious reactor that allows not only nuclear engineering students but also science teachers and the general public to experience experiments.
- First criticality: November 11, 1961. Japan's first private and university nuclear reactor.



- ◆ **Higher education:** experiments for graduate and undergraduate programs
- ◆ **Secondary education:** workshop for science teachers and high school students
- ◆ **Employee training:** employee training for nuclear industry
- ◆ **International cooperation:** engineer training for new comer countries (IAEA schools)
- ◆ **Research applications:** detector development, reactor physics studies, biological sample irradiations

UTR-KINKI (diameter: 4 m, height: 2 m)

# UNIVERSITY REACTORS IN JAPAN

Start	End	University	Reactor	Power	Place
1961		Kindai University	UTR-KINKI	1 W	Higashiosaka-shi
1961	2001	Rikkyo University	TRIGA-II	100 kW	Yokosuka-shi
1963	1989	Musashi Institute of Technology	TRIGA-II	100 kW	Kawasaki-shi
1964	2026	Kyoto University	KUR	5 MW	Kumatori-cho
1971	2011	University of Tokyo	Yayoi	2 kW	Tokai-mura
1974		Kyoto University	KUCA	100 W	Kuomatori-cho

- Only Kindai University and Kyoto University operate research reactors, currently .
- The Kyoto University Reactor (KUR) is scheduled to shut down in May 2026.



# HIGHER EDUCATION

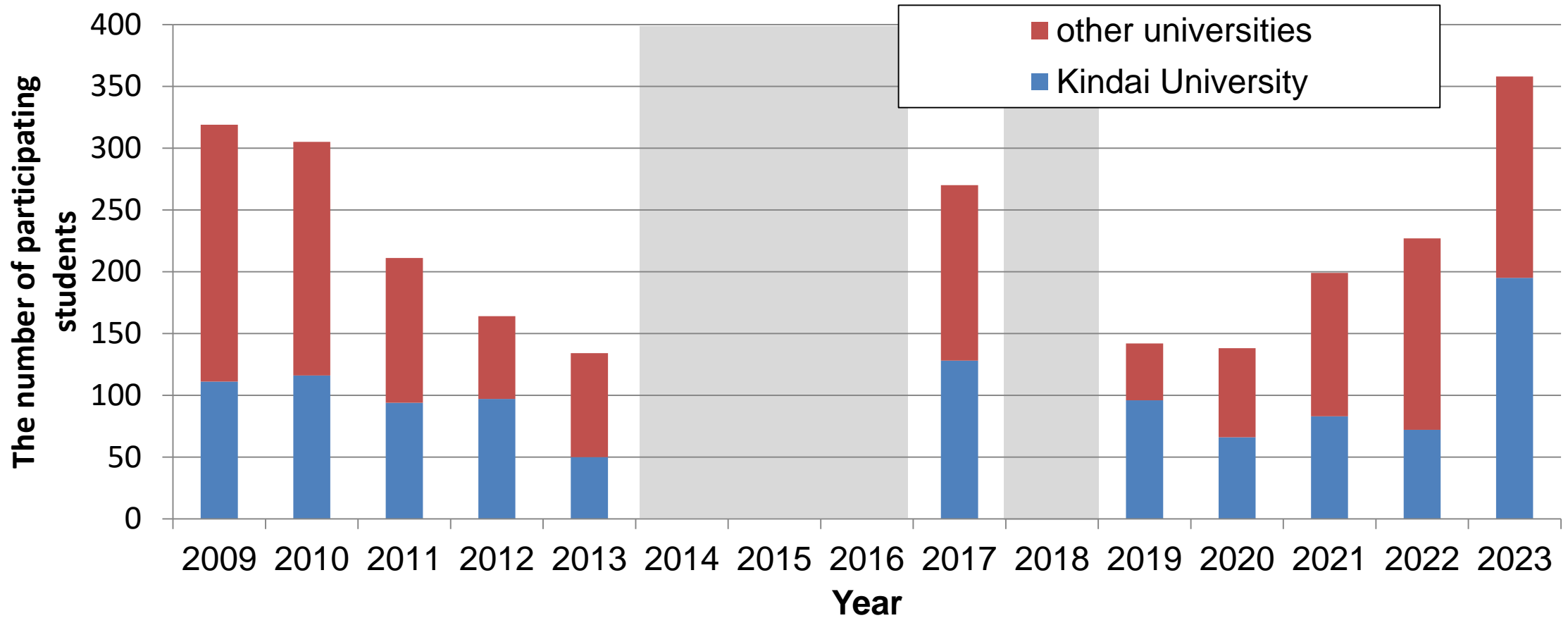
- Graduate and undergraduate students from 15 universities and technical colleges participate in reactor experiment programs (**approx. 250 students/year**).
- **Students operate the reactor themselves** and perform experiments on reactor physics, radiation control and applications.
- The range of participants has been broadened to include radiology students.

- ◆ Reactor tour
- ◆ Reactor operation
- ◆ Approach to criticality
- ◆ Rod worth measurement
- ◆ Activation and half-life measurement
- ◆ Neutron and gamma dose rate measurement
- ◆ Leakage gamma-ray spectrometry
- ◆ Neutron radiography
- ◆ Neutron flux mapping by foil activation
- ◆ Subcriticality measurement



- ◆ **Connect classroom knowledge with reality by putting them into practice in hands-on training.**
- ◆ **Understand overall system for operating a nuclear facility (nuclear safety, security, safeguards, radiation control).**

Textbook: *Introduction to Nuclear Reactor Experiments*, Springer, Singapore (2023).  
(Open Access)



- The number of students decreased after the Fukushima NPP accident in 2011 but is recovering to the level before the accident.
- 2014-2016: Shut down due to safety reviews for new regulatory standards.
- 2018: Suspended operation again due to malfunction of control rod drive mechanism.
- 2020-2021: Some training workshops were held online due to the COVID-19 pandemic.

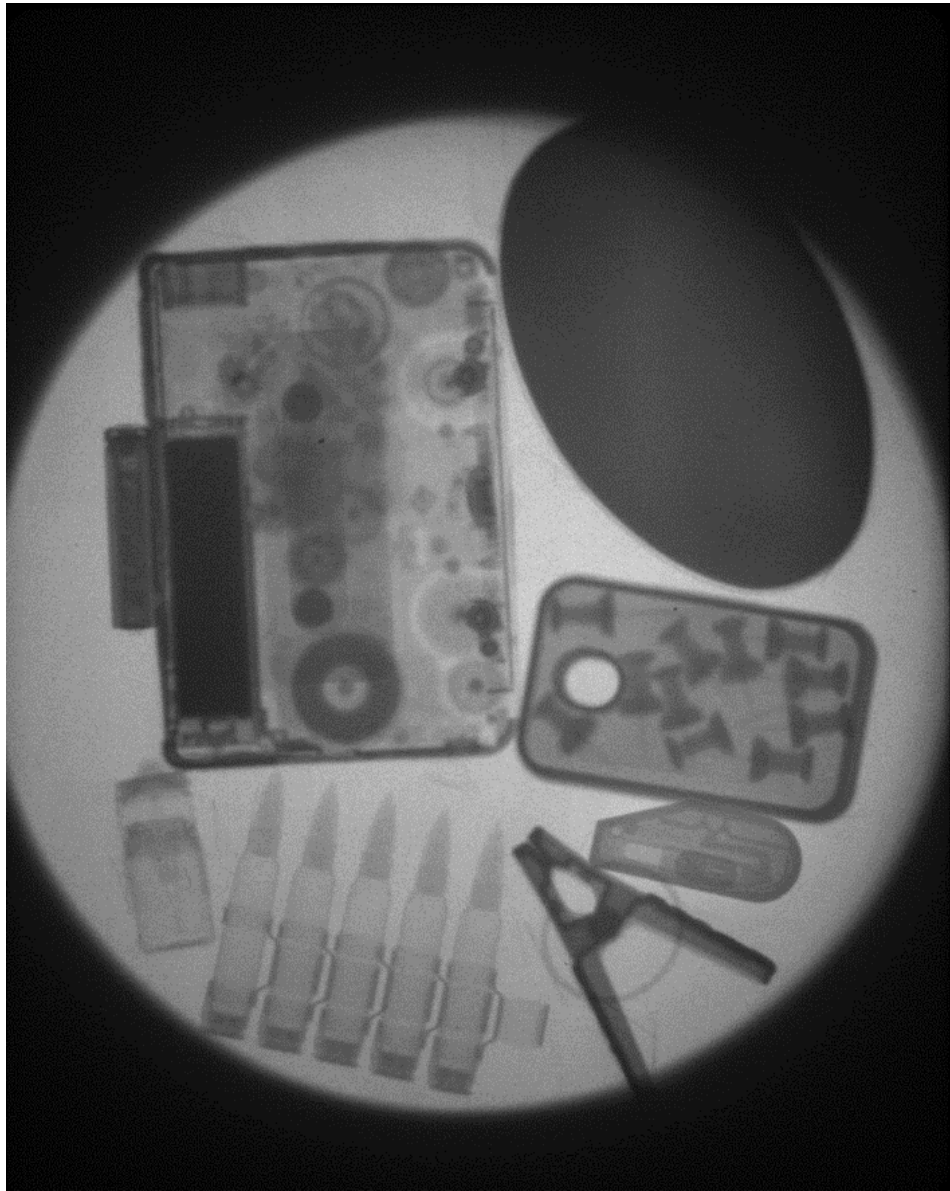
# OUTREACH TO SECONDARY EDUCATION (1)

## Reactor Workshop for Science Teachers (1987-)

- Aim to provide science teachers with scientific knowledge about nuclear science and technology (NST) through the experience of reactor operation and radiation measurement, and to use it in the classroom (approx. 60 teachers/year).
- In Japan, NST had not been included in the science curriculum of junior high school for 30 years. NST was included in the curriculum in 2012, but most science teachers have no experience in both teaching and learning NST. The workshop gives science teachers the confidence to teach NST.

<b>Lecture</b>	Safety instruction Radiation basics Nuclear reactor basics Health effect of radiation Application of radiation
<b>Experiment</b>	Reactor tour Reactor operation Neutron radiography Environmental radiation Radiation measurement Cloud chamber





Neutron radiography



X-ray radiographiy



# OUTREACH TO SECONDARY EDUCATION (2)

## Reactor Workshop for High School Students (2022-)

- High school students with an interest in NST participate from all over the country.
- One-day workshop to tour the reactor, experience reactor operation, neutron radiography.
- 5 workshops have been held so far, **with far more applications than the capacity** (max. 16 students), and parents and teachers have also participated. **Half of the participants were girls.**
- Since the Fukushima NPP accident, many people in Japan have believed that NST is not popular among young people. However, students with a strong interest in NST do exist, and it is important to show them a future vision for further education and work.



Reactor workshop for high school students is cohosted by KAC.

# OUTREACH TO SECONDARY EDUCATION (3)

## Nuclear Open Campus (2023-)

Held at Kindai University in 2023 for high school and technical college students who are interested in NST, with 30 participants.

- **Reactor experiment** (neutron radiography, activation of Al-foil and half-life measurement)
- **Introduction of universities and companies** (14 universities, JAEA and 6 nuclear companies set up booths and explained to participants).



# INTERNATIONAL COOPERATION

## IAEA Regional Research Reactor School

- Aims to provide young researchers and engineers with technical degrees in nuclear science and technology with knowledge and experience in the safe operation and use of research reactors.
- Jointly organised with Kyoto University and Wakasa Wan Energy Research Centre.
- The first school was held in 2019. The second school was planned in 2021, but was postponed to 2022 due to the COVID-19 pandemic. The next school is planned in 2025.



## JAEA Instructor Training Program

- Young researchers and engineers from Asian countries are trained in reactor operation workshop.
- 10 trainees / year

# SUMMARY

- UTR-KINKI is a research reactor designed and built for education and training at universities, and has been utilised for education and research in Japan since its first criticality in 1961.
- As the number of research reactors available for education and training decreased, the role of UTR-KINKI is expanding.
- UTR-KINKI provides various programs in NST to students from universities and technical colleges across the country. Participating students are not only nuclear engineering students, but also extend to radiology students.
- The extremely safe reactor can also be used for outreach activities to secondary education. UTR-KINKI has contributed to provide many science teachers with knowledge of NST and to encourage young generation to pursue their careers in NST.
- UTR-KINKI has the potential to make a significant contribution to international cooperation: several international programmes, including IAEA schools, have been conducted using UTR-KINKI.



We hope to continue the operation of the Kindai University Reactor, a **powerful educational tool**, for as long as possible and to develop the next generation of nuclear human resources.

**Your continued support and co-operation will be greatly appreciated!!**



**近畿大学**  
KINDAI UNIVERSITY