

## 報 告

## Educational Activities in the Academic Year 2020

Genichiro Wakabayashi

### 1. Introduction

The educational activities by the use of UTR-KINKI in the academic year 2020 (April 1, 2020 – March 31, 2021) was severely affected by the spread of the new coronavirus (COVID-19), which began at the end of the previous academic year. After the declaration of a state of emergency on April 7, most staff had to work from home and classes were held online. The first state of emergency was lifted on May 21, but remote working and online classes continued. Restrictions on travel also continued, so most educational activities planned for the summer were either carried out online or postponed until later in the autumn. From September, the infection situation temporarily calmed down and we were able to resume educational activities, but from the end of the year the infection spread again and the second state of emergency was declared from January 17 to February 28, 2021. In addition, due to the continued difficulties in travelling abroad, the program at the Kyung-Hee University Reactor Research and Education Centre in South Korea was cancelled, unfortunately. The international seminar, which was planned as part of Instructor Training Program of Nuclear Human Resource Development Center, Japan Atomic Energy Agency (JAEA), was also cancelled.

### 2. Higher Education

#### 2. 1 Kindai University

UTR-KINKI is used for one of the compulsory subjects, “Energy and Environment Experiment”, in the curriculum of Energy and Environment Course, Department of Electric and Electronic Engineering, Faculty of Science and Engineering. The subject includes a lecture on nuclear reactor basics, facility tour of UTR-KINKI, reactor operation and neutron radiography. 66 students took the subject which was offered in the second semester of the academic year 2020. In order to avoid the effects of the pandemic, the subject was carried out intensively between September and December. This meant that all practices in the subject could be carried out in person.

17 undergraduate fourth year students from Department of Electric and Electronic Engineering and Department of Life Science, Faculty of Science and Engineering and 3 graduate students from Graduate School of Science and Engineering Research conducted their researches using UTR-KINKI for these. These students were also encouraged to obtain a qualification of co-operator, with which one can operate the reactor under the supervision of a qualified reactor operator. In the academic year 2020, 11 students completed a prescribed training course to be qualified as a co-operator of UTR-KINKI.

## 2. 2 Training Workshop for Other Universities

Eight training workshops were held for graduate and undergraduate students in the academic year 2020, in which 72 students from eight universities participated. Part of the workshops were held under the International Nuclear Human Resource Development Initiative Program funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan. The contents of the workshop were selected from the following subjects based on the request of the participating university.

- A. safety instruction
- B. tour to UTR-KINKI
- C. reactor operation
- D. rod worth measurement
- E. neutron and  $\gamma$ -ray dose rate monitoring
- F. neutron flux measurement by activation
- G. leakage  $\gamma$ -ray spectrometry
- H. neutron flux mapping
- I. neutron radiography
- J. Aluminum foil activation and half-life measurement
- K. approach to criticality
- L. others

The training workshops held in the academic year 2020 are summarized in Table. 1.

Table 1. Training workshops held for graduate and undergraduate program.

No.	University	Date	Format	Students	Contents
1	Kyushu University*	August 27-28	Online	7	B I J K
2	Osaka University	August 31	In person	4	A B C D K
3	Tokyo City University*	September 15	Online	9	B K
4	Fukui University of Technology	September 16-17	In person	8	A B C
5	Tokyo Metropolitan University	September 29-30	In person	8	A B F L**
6	University of Fukui*	October 3-4	In person	16	A B C E H K
7	Nagoya University*	October 10-11	In person	3	A B C D E F G H I
8	Tokai University*	December 2-4	In person	17	A B C D E G H I J
<b>Total</b>				72	

\* MEXT International Nuclear Human Resource Development Initiative Program (Kindai University, AY2019-2021)

\*\* Neutron Measurement with a  $BF_3$  counter



Undergraduate and graduate students operated UTR-KINKI by themselves and conducted various experiments.



Part of the workshops were held online by using the Reactor Remote Experiment System developed in the previous year.

## 2. 3 MEXT International Nuclear Human Resource Development Initiative Program

The 2020 academic year was the second year of the three-year educational program "The enhancement of training system for the effective use of educational nuclear reactors" (2019-2021) under the MEXT International Nuclear Human Resource Development Program. The

participating universities in this program are: Kindai University, Kyoto University, Kyushu University, Nagoya University, University of Fukui, Tokai University, Tokyo City University, and Kyung Hee University (South Korea).

This program includes two kinds of workshop: Basic Reactor Experiment Workshop provided by Kindai University and International Reactor Experiment Workshop provided by Kyung Hee University in South Korea, but as mentioned above, the workshop in South Korea was cancelled due to the spread of COVID-19.

The program also includes the development of a remote reactor experiment system for UTR-KINKI. This was planned before the start of the COVID-19 outbreak, but coincidentally could be used to a large extent to hold reactor workshops online.

#### (1) Basic Reactor Experiment Workshop

The aim of the workshop is to arouse the interest of the participating students in nuclear science and technology and to encourage them to pursue their careers in the field. For this reason, the main program consisted of basic level experiments on reactor physics and radiation measurements using UTR-KINKI. Five workshops were organized in this program and 52 students from five universities participated as shown in Table 1 in the previous section. All lectures and experiments were provided in Japanese.

Two of the five workshops were held online using the remote reactor experiment system described in the next section.

#### (2) Remote Reactor Experiment System

In the Remote Reactor Experiment System,

signals of operation parameters, such as control rod positions and detector outputs of nuclear instrumentation, are extracted from the control console of the reactor and displayed on a virtual console (VC) constructed on a PC using LabVIEW. This screen is shared with a remote PC by using the screen sharing function of the video conference system. Fig. 1 shows the image of the VC.

The original plan was to show the VC screen to the students gathered in a remote classroom, and instructors would provide guidance from both the reactor and the remote classroom. However, due to the COVID-19 pandemic, the entire workshop had to be held online, with participants using their own PCs from home. Therefore, the workshop was directly conducted from the reactor control room, using not only the VC screen but also live images from several video cameras installed in various parts of the reactor room.

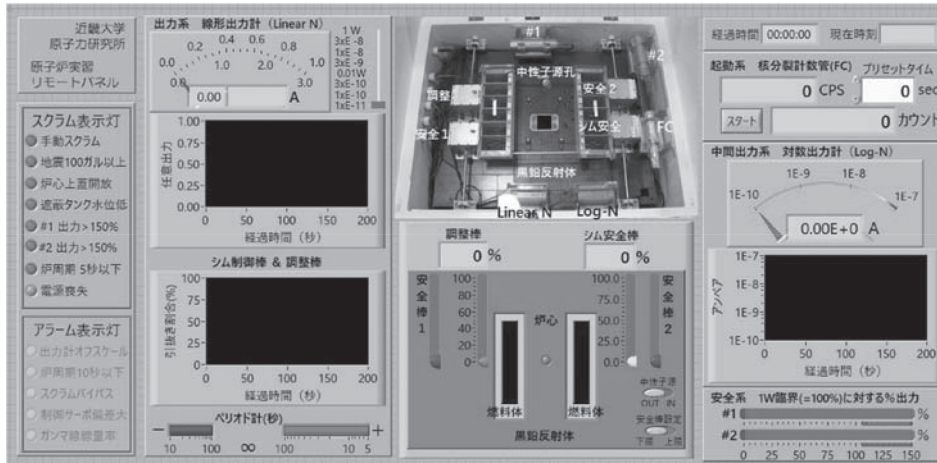


Fig. 1 The image of the Virtual Console of the Reactor Remote Experiment System.

### 3. Secondary Education

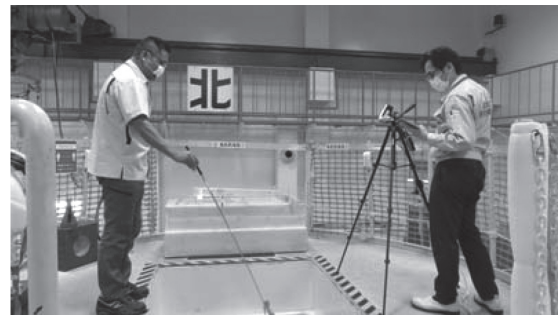
#### 3. 1 Training Workshop for Teachers

Training workshop for teachers began in 1987 and has been continued for more than thirty years. The aim of the workshop is to provide teachers with scientifically correct knowledge on nuclear science and technology through experiencing experiments on a real nuclear reactor and radiation measurements.

In the 2020 academic year, as in previous years, the training workshops were planned to be held in the summer in person. However, due to the COVID-19 pandemic, this was postponed and three online workshops were held in November and December. The summary of the workshops is shown in Table 2.

The workshop had been scheduled for two days, but when it was changed to online, it was decided to shorten it to one day. Instead, we made a video recording of the lecture part of the workshop, which was freely available for participants to watch in advance. On the day of the workshop, we utilized the Remote Reactor Experiment System to show and explain the reactor, control console and Virtual Console live from the reactor,

and we communicated with the participants in an interactive manner. The schedule of the workshop is shown in Table 3 and 4.



Training workshop for science teachers were held online by using the Reactor Remote Experiment System.

Table 2. Summary of training workshop for teachers held in the 2020 academic year.

No.	workshop	date	participants
1	Training workshop for science teachers (co-hosted by KAC)	November 8	5
2	Training workshop for science teachers (co-hosted by JAIF)	November 29	8
3	Training workshop for science teachers (co-hosted by KAC)	December 13	13
<b>total</b>			26

JAIF: Japan Atomic Industrial Forum

KAC: Kansai Atomic Conference

Table 3. The schedule of training workshop for science teachers (November 8).

time		contents
10:30	10:45	Opening Remarks
10:45	11:30	Tour to UTR-KINKI
11:30	12:00	Neutron Radiography (sample preparation)
12:00	13:00	Lunch Break
13:00	15:00	Reactor Operation and Approach to Criticality
15:00	15:10	Break
15:10	15:30	Power Change Operation
15:30	15:50	Gamma and Neutron Dose Rate Measurement
15:50	16:00	Reactor Shutdown
16:00	16:05	Neutron Radiography (result explanation)
16:05	16:30	Q&A session
16:30	16:45	Closing Remarks

Table 4. The schedule of training workshop for science teachers (November 29 and December 13).

time		contents
10:30	10:45	Opening Remarks
10:45	11:30	Tour to UTR-KINKI
11:30	12:00	Neutron Radiography (sample preparation)
12:00	13:00	Lunch Break
13:00	15:10	Reactor Operation
15:10	15:20	Break
15:20	15:40	Gamma and Neutron Dose Rate Measurement
15:40	15:50	Reactor Shutdown
15:50	15:55	Break
15:55	16:05	Neutron Radiography (result explanation)
16:05	16:30	Q&A session
16:30	16:45	Closing Remarks

### 3. 2 Workshop for High School Students

Two workshops were held for high school students to encourage young generation to pursue careers in nuclear science and technology. The both workshops included reactor operation where high school students operated the reactor by

themselves under the supervision of university staff. Fortunately, the situation of the COVID-19 infection had temporarily calmed down, so we were able to hold all these workshops in person. The summary of the workshop and contents is shown in Table 5.

Table 5. The summary of the workshops held for high school students.

No.	High School	Date	Students	Contents
1	Kainan Senior High School	October 27-28	19	Safety instruction Tour to UTR-KINKI Reactor operation Neutron radiography Aluminum foil activation and half-life measurement
2	Otemae Senior High School	December 9	20	Safety instruction Tour to UTR-KINKI Reactor operation Lecture "Future of nuclear energy"

### 4. Conclusion

Educational activities in the 2020 academic year were severely affected by the COVID-19 pandemic. However, by using the Remote Reactor Experiment System that had been developed in the previous year, we were able to continue our educational activities by substituting some of them with online workshops. Although online

training is not a complete substitute for in-person training, we found that it is an effective means of expanding the opportunities for participation by resolving issues such as restrictions on the number of participants and travel costs. Therefore, we would like to utilize the advantages of online training after the pandemic is over.