RADIATION RE-EDUCATION MATERIALS THE UNIV. OF TOKYO DOC No.36（2018）

1. Space Development and Radiation Environment

1. Space development in the 21st century

More than half a century passed since the Russian cosmonaut Yuri Gagarin succeeded in the world 's first manned space flight in 1961. Whereas, the National Aeronautics and Space Administration (NASA) realized the lunar landing with the Apollo plan, accomplished the long-term stay in the space station Skylab, established the Space Shuttle system and so on. Meanwhile, Russia pioneered development of the space station Salyut and accumulated the experience and research results using a variety of technologies for living in space through the long operation of Mir. Then, at the end of the 20th century, Russia, NASA, European Space Agency (ESA), Canadian Space Agency (CSA) and Japan Aerospace Exploration Agency (JAXA) jointly cooperated in construction of the International Space Station (ISS) based on the technologies developed for the Mir; the ISS has been operating for 20 years up to now.

In the 21st century, the movement of promoting industries and sightseeing using the space environment has been strengthened, while it has been leaving the development and operation of flight technologies in the low Earth orbit (LEO) like ISS to private sectors. Actually, it became possible to fly in the space using ISS and seven civilians already stayed at ISS for one to two weeks, starting with Dennis Tito (USA) in 2001. Several private companies are also offering services that provide short flights at an altitude of approximately 100 km with their own spacecrafts [1].

On the other hand, space agencies in each country / region are focusing on deep space missions to the moon, Mars, etc. NASA plans to achieve the first human mission to Mars in the 2030's; ESA is also working on elemental technologies to realize human explorations in the solar system in line with the auroral plan formulated in 2001. JAXA is considering carrying out human exploration onto the lunar surface under multilateral cooperation. While, in China, they have repeatedly carried out human space missions towards the construction of their own space station according to their own plan established in 1992. In any plans, it is a challenge to ensure a sufficient budget (funding).

2. Radiation environment in space

For staying in the space environment, various types of radiation which have hardly been experienced on the ground, in particular, protons, heavy ions, and secondary neutrons generated from them, so-called high-LET radiations of greater biological effectiveness. On the ground, radiation from the outerspace (cosmic radiation) is effectively blocked by the atmosphere (equivalent to 10 m in thickness of water) and the earth's magnetic field; and then the dose level of cosmic radiation is about 0.03 μSv / h, about 0.3 mSv per year. While, as the altitude increases, the exposure to cosmic radiation will significantly increase (Figure 1). For example, we receive several μSv / h in cruising of a commercial jet (10 to 12 km) and astronauts experience 20 μSv / h or more at ISS (altitude of about 400 km), i.e., 0.4 to 1 mSv per day; this level is several hundred times larger than that on the ground.

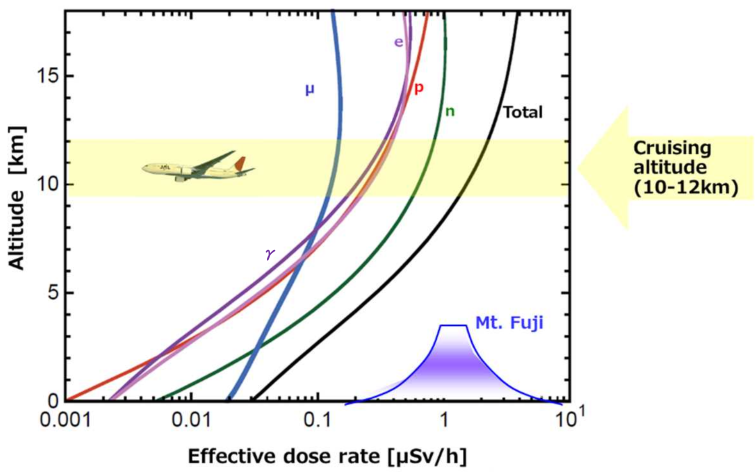

Figure 1. Altitude change of the effective dose rate of cosmic radiation components; the dose rate of the International Space Station altitude (about 400 km in altitude) exceeds 20 μSv/h.

Cosmic radiation is classified into three groups based on their origins: galactic cosmic rays, solar particles (protons ~ irons) and the particles of trapped radiation belt (Van Allen belt). The trapped radiation belt is a band-shaped region made of electrons and protons trapped by the earth's magnetic field; they are secondary charged particles generated by the interactions with the galactic cosmic rays or solar particles and the atmosphere. There is a region where the inner trapped radiation belt (inner band) hangs over Brazil (South Atlantic Anomaly: SAA) which is due to a deviation between the axis of the geomagnetism and the rotation axis; and then the dose rate increases remarkably when the ISS passes through the SAA region. At this timing, extravehicular activities are usually avoided.

Each space agency has set radiation regulations for astronauts to protect them from excessive radiation exposure in space. The core of the regulation is "operational limit" established by each agency for ensuring the radiological safety by comparing the actual (predicted or measured) doses with the operational limits and, if necessary, restrict their activities. As part of the operational limits, lifetime effective dose limits (Table 1) for the Japanese astronauts boarding ISS was set by JAXA to restrict the increase in their cancer mortality risk from radiation exposure within 3% [2].

Table 1. Lifetime effective dose limits set for the Japanese astronauts boarding the International Space Station (ISS)[2].

Age at the first space mission	Male [Sv]	Female [Sv]
27～30 y.o.	0.6	0.5
31～35 y.o.	0.7	0.6
36～40 y.o.	0.8	0.65
41～45 y.o.	0.95	0.75
46 y.o. and more	1.0	0.8

As a major concern on radiation exposure of astronauts, there could be a sharp dose increase associated with a large solar flare. It has been difficult to predict the effect of a solar flare in advance with a sufficient time for alerting astronauts and then allowing them to move to a thicker shielding place in a spacecraft, since it is hard to analyze data of solar monitoring for a reliable space weather forecast within the limited time before the energetic solar particles arrive. Thus, research and development are now carried out to establish an alert system having the functions of real-time, automatic predictions of the effects of any solar flares and then supporting them to take proper actions [3].

In deep space beyond the Earth's magnetosphere, radiation dose from high-energy particles, particularly heavy ions of galactic cosmic rays will inevitably increase. In a future mission to Mars, NASA predicted that the crew will receive more than 1 Sv of radiation exposure in the period of about two and half years, which includes a round-trip flight from the Earth to Mars (180 days x 2 times) and the stay for exploration on the Mars surface (about 500 days). The cancer risk attributing to this dose level is significant. In addition, some diseases other than cancer (e.g., cardiovascular disease, cataracts, etc.) should be concerned. For realization of the dreaming human space exploration, further progress of research and development to overcome these problems is awaited.

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Re-education Theme: Topics

2. Amendment Philosophy and Changes of the Act on the Regulations of Radioisotopes, etc. (Former Act on Prevention of Radiation Hazards due to Radioisotopes, etc.)

1. Background of amendment of the act

The Japanese Government have been reviewed IRRS (Integrated Regulatory Review Service) conducted by the International Atomic Energy Agency (IAEA) on 11-22 January 2016. The IAEA have pointed out, "*IRRS team recommended the NRA (Nuclear Regulation Authority, Japan) to give greater priority to radiation protection matters*", "*There are very limited requirements for EPR (Emergency Preparedness and Response) in relation to sources of ionizing radiation regulated under the Radiation Hazards Prevention Act.*", "*IRRS team observed the corresponding implementation activities about improvement of the safety and security interface are actually at a very early stage*" in the report of IRRS. Therefore, Japanese Government decided to amend the Act on Prevention of Radiation Hazards due to Radioisotopes, etc., and rebuild regulations on radiation, including the enhancement and strengthening of measures at the time of high-risk radiation sources and the addition of security measures. The amendment of the Act was carried out with the amendment of the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors, they were promulgated on April 14 2017. Concerning changes about NRA Ordinance have been discussed by the project team for regulation of radioisotope usage facilities established under the control NRA since June 2016. After public comments, the amended NRA Ordinance was promulgated on January 5, 2018. The amendment has in two phases. The first phase will put in force from April 1, 2018, except for some items. It is announced that the second phase will put in force around September 2019. Major changes are explained in the following sections. For further details, please refer to reference 1 (in Japanese).

2. Major Changes (First Phase)

<u>Strengthening reporting obligations [For all authorization users]</u>

An accident report to the NRA, which had been prescribed in the NRA Ordinance, regulated on Act as the obligation of the users. Specific amendment points are as follows.

- In order to clarify the responsibilities of authorization users, reporting obligations of persons entrusted with transportation are excluded
- Exemption rules are added when the radioisotope leaks in the controlled area "in case of function of the exhaust is properly maintained" and "in case of leak less than the surface density limit"

For the purpose, interpretation and notes on each obligation are described in "Interpretation concerning accident report to the NRA". Please refer to reference 2 for details. The old notifications will be phased out.

<u>Strengthening emergency measures [For all authorization users]</u>

In emergency, provision of information at the time is stipulated for the purpose of active explanation of information disclosure to the neighborhood or media, and safety and security explanations can be properly implemented. The main items and contents that have become required to Radiation Hazards Prevention Program are as follows.

- Organization and responsible person for providing information
- How to provide information to the outside and respond to inquiries from the outside (application of web site, setting up inquiries etc.)
- Contents of information to be provided to the outside (occurrence date and time, place, presence or absence of influence to the outside, cause, recurrence prevention measure, etc.)

<u>Education and Training [For Permission or Notification user and Permission waste management operator]</u>

The hours of education and training for new radiation workers have been defined uniformly. The minimum hours for each subject are shortened; Authorization users who use only one radioisotope equipment or whose purpose and method of usage are limited. However, it is not permitted being shortened simply. Authorization users are required to determine the appropriate hours according to the actual situation of radioisotopes usage. In addition, the subjects of "Laws and regulations concerning the prevention of radiation hazards" and "Radiation Hazards Prevention Program" which stipulated based on the laws and ordinances were merged because of providing education and training to correlating laws and regulations. The subjects and hours are as follows.

- Effects of radiation on human body (over 30 minutes)
- Safe handling of radioisotopes, etc. or radiation generating apparatuses (over 1 hour)
- Laws and regulations concerning the prevention of radiation hazards and Radiation Hazards Prevention Program (over 30 minutes)

And the interval of re-education and training have been defined within one year, it was changed to once every fiscal year.

3. Changes in Radiation Hazards Prevention Program associated with the amendment of the First Phase

Transitional measures are applied associated with the amendment of Act and regulations. All authorization users must notify the change of Radiation Hazards Prevention Program before August 30, 2019. Please refer to references 2 for details. Furthermore, the NRA expects not only adds articles to be defined but also aggressively reviews to takes necessary measures systematically concerning the description matter and preventing radiation hazard.

4. Major Changes (Second Phase)

Enhancement of security measures [For Permission or Notification user of specified radioisotopes and Permission waste management operator]

The Act will require regulation regarding security measures for specified radioisotopes. The NRA individually held the briefing sessions concerning the specific contents to the place of business. Therefore, it is omitted in this article.

Change of name, reinforcement and additional purposes of the Act

The current Act requires regulation from the viewpoint of "prevention of radiation hazards". In future (about September, 2019), "to secure specified radioisotopes" will be added to the purpose of the Act. At that time, the name of the act will be changed to "Act on the Regulations of Radioisotopes, etc.".

5. Conclusion

The new Radiation Hazards Prevention Program of all authorization users will be changed before the end of this fiscal year or the beginning of the next fiscal year. A major change for users is education and training. However, you will pay attention to changes of the Radiation Hazards Prevention Program because each authorization users might review the contents according to the actual situation.

◆References

[1] Nuclear Regulation Authority, Japan, Web site (in Japanese).
https://www.nsr.go.jp/activity/ri_kisei/kiseihou/setsumeikai.html

[2] Nuclear Regulation Authority, Japan, Web site (in Japanese).
http://www.nsr.go.jp/disclosure/committee/kettei/01/01_06.html

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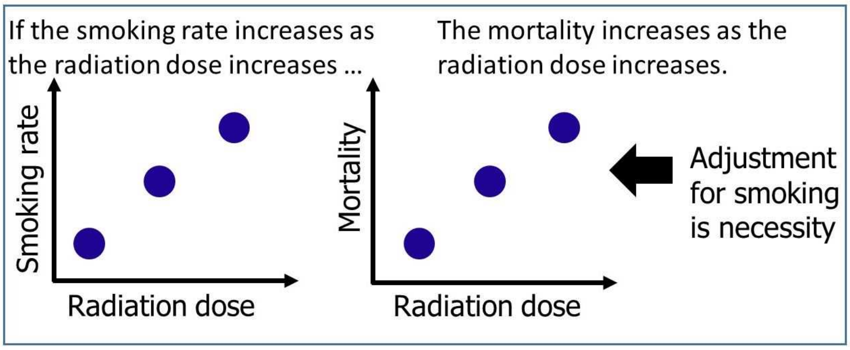
Assistant Professor, Shogo Higaki
Re-education Theme: Laws and Management

3. The Importance of Adjustment for Confounding Factor When Discussing Radiation Risk.
-Latest Information Based on Radiation Epidemiological Study Among Nuclear Workers in Japan-

Current radiation protection standards are based upon the recommendations of the International Commission on Radiological Protection (ICRP)[1]. The dose limits of the ICRP are mainly based on the results of the studies of atomic bomb survivors who were acutely exposed to high-dose rate radiation. However, the causal relationship between low-dose rate radiation and health effects remains unclear despite a number of epidemiological studies[2] undertaken to obtain scientific evidence on the health effects of low-dose and low-dose rate of radiation exposure. One reason is that the adjustment for confounding factors which bias or distort radiation risk is not sufficient.

A confounding factor is the factor that distorts the relationship between interesting factor and results. For example, it is well known that smoking rate affects mortality[3]. When we discuss radiation risk, if the smoking rate increases as the radiation dose increases, you will see a superficial trend that mortality increases as the radiation dose increases, despite radiation effects are very few. Excluding smoking effects are necessity to discuss radiation risk and it is called “adjustment for smoking”.



The Institute of Radiation Epidemiology (IRE) of the Radiation Effects Association (REA) initiated an epidemiological study of Japanese nuclear workers in 1990 entrusted by Japanese government. The follow-up population consists of nuclear workers of Japanese nationality who were engaged in radiation work as of the end of March 1999. A lifestyle questionnaire survey was completed by a part of the follow-up population. The results showed a trend that smoking rate increases as the radiation dose increases[4]. The trend may reflect the tendency that blue collar worker tends to smoke than white collar worker[5].

In radiation epidemiological study, radiation risk is often expressed as mortality increase proportion per one Sv (Excess Relative Risk, hereafter ERR/Sv) which compares radiation risk (mortality) to the workers who have no radiation exposure (background mortality). For example, if ERR/Sv is one, it means the mortality is added one fold when exposed one Sv (namely the mortality doubled). When we compared ERR/Sv with and without adjustment for smoking, almost of all causes of death showed ERR/Sv decreasing after adjustment for smoking, in other words superficial risk decreased[6,7]. The confounding factor is not only lifestyle factor such as smoking, but also socio economic status is a potential confounding factor. In addition to smoking, when years of education is added to adjustment, the ERRs were estimated almost zero in some causes of death[6,8]. Here you see the results.

Table. The ERRs/Sv and 90% confidence interval with and without adjustment for smoking and years of education (extraction from REA report[6])

Adjustment	All causes	All cancers excluding leukemia	Non-cancer diseases
Basic※	0.50 (-0.34, 1.35)	0.78 (-0.65, 2.20)	0.75 (-0.67, 2.17)
Basic + Smoking	0.08 (-0.71, 0.86)	0.31 (-1.03, 1.65)	0.26 (-1.06, 1.59)
Basic + Smoking, Years of education	-0.17 (-0.93, 0.58)	0.08 (-1.22, 1.39)	-0.06 (-1.33, 1.21)

※Basic: adjustment for age, geographical region

Some countries have examined collaborated studies that combined different countries to obtain larger statistical power[9,10]. Their studies have not adjusted for smoking that affects large effect to mortality, and have used indirect method which compare ERR/Sv before and after excluding lung cancer from all cancers. Cardis et al. denoted ERR/Sv was 0.97 (0.27, 1.80) for all cancers, and it decreased to 0.59 (-0.16, 1.51) when lung cancer was excluded. This result implies that higher dose group has higher smoking rate, namely confounding from smoking exists, and ERR/Sv will decreased if adjustment for smoking could be examined.

Adjustment for confounding factors other than radiation is important when discussing radiation risk, and Japanese data demonstrate the importance.

◆References

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[2] Effects of Ionizing Radiation volume 1. 2006, United Nations Scientific Committee on the Effects of Atomic Radiation, http://www.unscear.org/docs/publications/2006/UNSCEAR_2006_Annex-A-CORR.pdf, Accessed Feb 13 2018

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[7] Kudo S, Ishida J, Yoshimoto K, Mizuno S, Ohshima S, Furuta H and Kasagi F. 2018 Direct adjustment for confounding by smoking reduces radiation-related cancer risk estimates of mortality among male nuclear workers in Japan, 1999-2010 J Radiol Prot, 38 357-71

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[9] Cardis E et al. 2007, The 15-country collaborative study of cancer risk among radiation workers in the nuclear industry: estimates of radiation-related cancer risks Radiat. Res. 167 396-416

[10] Richardson D et al. 2015 Risk of cancer from occupational exposure to ionizing radiation: retrospective cohort study of workers in France, the United Kingdom, and the United States (INWORKS) BMJ. 351 h5359

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Re-education Theme: Human Body Effects

4. Characteristics of High-intensity Light Source Facilities and Key Points for Safe Usage.

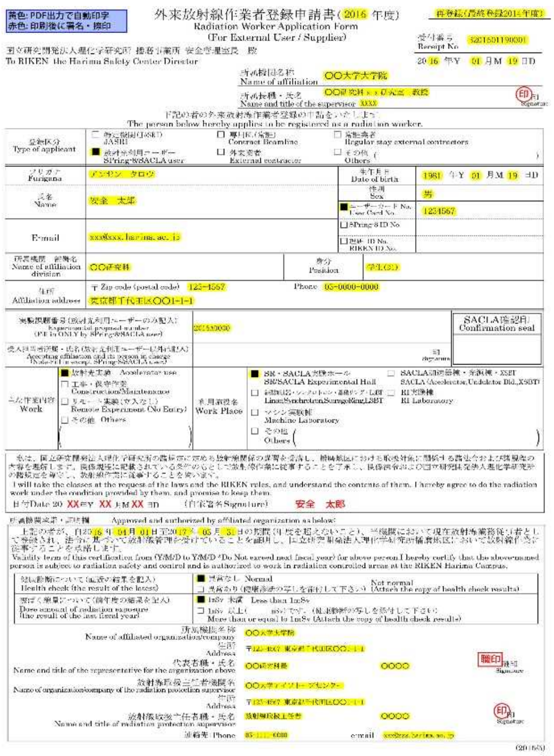
Recently, the number of people experimenting with high-intensity light source facilities, such as SPring-8, are increasing. Electromagnetic waves used in high-intensity light source facilities are called synchrotron radiation. When traveling direction of charged particle such as electrons accelerated to near light speed by high energy accelerator is bent by magnetic field, electromagnetic radiations are generated in the tangential direction. It is called Synchrotron radiation.

Synchrotron radiation is a white light with high intensity and high directivity and has a wide energy range from the infrared to X-ray regions. Splitting synchrotron radiation produces a tunable, high-intensity monochromatic light which is used as a source for various experiments in high-intensity light source facilities.

Currently, the number of research that uses electromagnetic waves with energy in the X-ray region at high-intensity light source facilities is increasing. Generally, laws such as the Industry Safety and Health Act and the Prevention of Ionizing Radiation Hazards rules apply to those who use X-rays. Therefore, it is necessary to take a course on X-rays before users are able to use X-rays at the University of Tokyo. However, as the high-intensity light source equipment is a radiation generating device, experimental apparatus and related machines are located in the radiation control area. Therefore, the use of electromagnetic waves that have energy level in the X-ray region is also subject to the Act on Prevention of Radiation Hazards due to Radioisotopes, etc. and related laws in the same way as the use of other sources of radiation. For this reason, those who conduct experiments and researches at high-intensity light source facilities will need to be qualified as those who work with radiation (radiation worker) by taking the current RI-X course lecture at the University of Tokyo.

For example, when using SPring-8, a high-intensity light source facility, user registration, which can be done online through the website is required. Users are required to select necessary tasks that meet their needs from a list and submit their application. Once the application has been accepted, all other necessary documents are to be submitted.

When an assignment is accepted by SPring-8, it is necessary to register as a "SPring-8/SACLA user", in effect register as a radiation worker of RIKEN/JASRI (hereinafter "RIKEN Harima"). If you are a radiation worker at the University of Tokyo, you must submit a Radiation Worker Application Form (Figure 1) to RIKEN Harima at least 10 days in advance of the first visit each year. This form is to be submitted to the radiation control office of the graduate school/institute once the signature (or stamp) of head of the laboratory. The form is then checked and stamped by the radiation control supervisor as well as the head of the affiliated organization (dean or director, etc.), once it is confirmed by the radiation control office that the applicant is registered as a radiation worker and that they have undergone the necessary controls for radiation based on the laws and regulations (special health check, special training etc.). As it is possible that the radiation control supervisor may be absent on a business trip etc., please make sure to apply with sufficient margin in the schedule. Also, if you bring samples etc. to RIKEN Harima, please make sure to submit the necessary applications for each sample etc. Although there are things that can be done online, please be aware that there are some procedures where paper-based documentations are necessary.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外来放射線作業者登録申請書(2016 年度)
Radiation Worker Application Form
(For External User / Supplier)
To RIKEN the Harima Safety Center Director
20 16 年Y 01 月M 19 日D
Name of affiliation ○○大学大学院
Name and title of the supervisor
The person below hereby applies to be registered as a radiation worker.
Type of applicant
Furigana
Date of birth 1981 年Y 01 月M 19 日D
Name 安全 太郎
Sex 男
User Card No. 1234567
E-mail

Figure 1. Sample of Radiation Worker Application Form[1]

After arriving at RIKEN Harima, you will need register in and also take the radiation safety training program (education on the Radiation Hazards Prevention Regulations). Please make sure that you bring your personal dosimeter provided by your institution. After confirming that you have your own dosimeter with you, you will be provided with a SPring-8/SACLA dosimeter and allowed to enter the controlled area. If you forget your personal dosimeter, you will not be allowed to enter the controlled area and you will not be able to participate in or carry out experiments etc., so please be careful.

Similar management procedures are taken at other high-intensity light source facilities, so please take care regarding schedules when applying.

In principle, a strong fail-safe mechanism is in operation in the controlled areas of high-intensity light source facilities, and the possibility of radiation accidents are low. However, as there is still a danger of radiation accident due to wrong use of equipment, etc., please take care when performing your experiments. In addition to the key points regarding radiation safety, as there are a large number of people using the facility from all over the country please make sure to keep everything orderly and clean (*seiri*, *seiton*). Furthermore, as the space within the facilities is limited, piping and wiring etc. may straddle the experimental equipment. Please be careful of electric shocks, bruises and so on.

◆References

[1] Sample of Radiation Worker Application Form (Spring-8/SACLA user)
https://harimariken01.spring8.or.jp/info/pdf/RW_sample_e.pdf

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Re-education Theme: X-rays

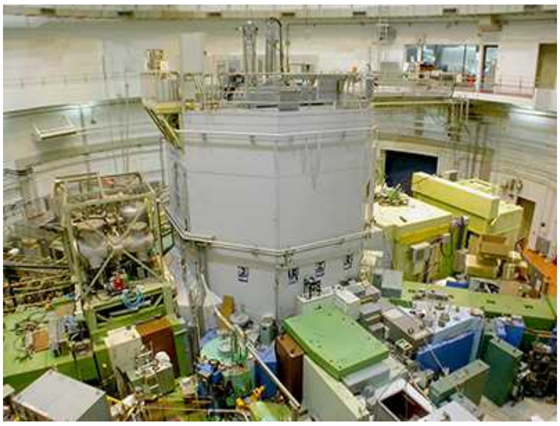
5. Characteristics of Nuclear Research Reactors and Safety Points for Usage

In this document, we introduce two Nuclear Research Reactors and one Critical Assembly operated by two universities in Japan. These are officially open to use for purposes of education, training and research. Please understand each feature and use them, conveniently and safely.

1. **Kyoto University Research Reactor Institute, Kyoto University Research Reactor (KUR) and Kyoto University Critical Assembly (KUCA)** (Citation or Reference: http://www.rri.kyoto-u.ac.jp/)

In 1963, the Institute was established at Kyoto University as a joint research center for collaborative research on nuclear energy research and education. This institute operates KUR, KUCA, etc. and has opened facilities.

KUR is the medium-sized thermal neutron research reactor, installed in the university in Japan. It is one of the world's largest research reactors owned by a single university. KUR has played a foundation role in academic and education so far. It is a nuclear reactor of the swimming pool tank type. The core consists of plate fuel elements and graphite reflector elements of around 20% enriched uranium. It uses light water as a moderator and coolant. Its thermal output is 5,000 kW, and the average thermal neutron flux is about 3×10^{13} n/cm^{2}s. Experimental equipment attached to the equipment includes four experimental holes, four irradiation holes, thermal neutron facilities (heavy water, graphite), three compressed air transport pipes, hydraulic transport pipes, inclined irradiation holes. In the through hole and the core are precision control irradiation tubes that can control the sample temperature during irradiation and long term irradiation equipment where irradiation is performed on a weekly basis.



Reactor room of KUR

Heavy water neutron irradiation field

KUCA is a multi-gantry type device which is rare in the world. It consists of A frame, B frame, and C frame (A and B are solid moderator frames, C is light water moderator frame) and one attached accelerator. The thermal power of KUCA is almost zero. KUCA has a major feature of being able to conduct research and education on the core of the nuclear reactor itself. You can build your own fuel core arrangement by yourself, and you can operate the nuclear reactor by yourself. The facility that can conduct such training and training is extremely rare and are also a place for cultivating precious nuclear human resources.

B frames: solid moderator frame

C frame: light water moderator frame

Submission for usage: http://www.rri.kyoto-u.ac.jp/visitor/researcher

2. Kindai University Atomic Energy Research Institute and Nuclear Research Reactor (UTR-KINKI)

(Citation or Reference: http://www.kindai.ac.jp/rd/research-center/aeri/)

Kinki University Atomic Energy Research Institute was established as a joint research laboratory in the whole university for research and education on nuclear energy in 1960. UTR-KINKI reached the criticality in 1965. Its thermal power was 0.1W at that time. UTR-KINKI began operation as the first private university reactor in Japan. In 1974, they increased the thermal power to 1 W. In 1985, irradiation equipment for small animals, equipment for neutron radiography and expanded vertical irradiation equipment were additionally installed. Since the nuclear reactor core is surrounded by sufficient shielding tank, it is possible to enter the reactor room even during the operation. The control room in contact with the reactor room has a console for operation and control of the reactor. It was designed to be suitable for the driving training of students, therefore it is easy to operate it such as start-up, shut-down, power adjustment and so on. It has been used greatly in student nuclear reactor training and education, nuclear research in a wide range of fields, various reactor workshops, and has shown great results.

Overview of UTR-KINKI

Operation control room

Submission for usage: http://www.kindai.ac.jp/rd/research-center/aeri/guide/outside.html

3. Safety Points for Usage of Nuclear Research Reactors

In the case of nuclear facilities as described above, which are under the application of the Reactor Regulation Law, radiation workers are obliged to take safety education based on the safety preservation regulations. For example, in the case of KUR, advance training items are set together with education based on the Radiation Hazard Prevention Law, as follows. "Effects of Radiation on Human Body" "Law Concerning Prevention of Radiation Hazard by Radioactive Materials and Radiation generators" "Safe Handling of Radioactive Materials and Radiation Generators (radiation facilities)" "Radiation Safety Management" "Implementation of Nuclear Regulations" "Laws and Safety Regulations Concerning Nuclear Reactor Regulation Law" "Measures to be Taken in Emergency" "Structure, Performance and Operation of Reactor Facilities" "Structure, Performance and Operation of Reactor Facilities (laboratory facilities)" " Safe Handling of Nuclear Fuel Materials (Including Nuclear Physical Protection)" "Safe handling of Materials Contaminated with Radioactive Waste and Nuclear Fuel Materials, etc." "Safe handling of Radioactive Materials and Radiation Generators" "Facility Tour (Nuclear reactor building, Hot laboratory building, Tracer building, Radioactive waste disposal building"

Nuclear facilities that are subject to the Nuclear Reactor Regulation Law have been required to deal with extremely severe security. Meanwhile, in the revised Radiation Hazard Prevention Law, applied to so-called radiation facilities, some facilities have just been obligated to deal with security. There is a strict confirmation of the status and belongings of entrance/exit persons, restrictions on taking pictures in the facility, compliance with the obligation of confidentiality based on the signature, etc. Understanding exactly the instructions and prohibitions of the facility manager is strongly required to begin using facilities.

In response to compliance with the new regulation standards for nuclear reactors in Japan, operation of research nuclear reactors in the universities has been restarted since FY2007. I hope to expand the use of them for various purposes such as education, training, research and development while keeping the safety at a high level by taking advantage of the features of these facilities.

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Re-education Theme: Nuclear Fuel Materials and Nuclear Research Reactors