

Safety training for radiation workers at ICRR

2025/05/27
Atsushi Takeda

- This lecture on the radiation safety is **ONLY** for those who treat LINAC/DT or small sources in Kamioka.
- If you use none of them, you do not need to attend.

Outline

- **Law, Rules at ICRR**
 - **Radiation management at ICRR**
 - **Rules at ICRR**
- **Safety handling**
 - **Important notices on radiation work**
 - **Radiation effect on human body**
 - **Emergency**
- **Radiation work at Kamioka Observatory**
- **(Regulation on X-ray devices)**

Law, Rules at ICRR

(IPMU members also follow ICRR
law and rules.)

User categories

- Three user categories, **ICRR (and IPMU)**, **Other institute** and **DT/LINAC users**.
- All users need to follow “ICRR rules”.
- DT/LINAC users also need to follow “Kamioka rules”.

• ICRR and IPMU
researchers, students

• Researchers, students,
etc. in other institute

Users of DT/LINAC
and who enters the management area

Kamioka special rule (Japanese law)

Rules of ICRR

Rules related to radiation

ICRR General Rules

(Rules of Prevention from Radiation Hazards at ICRR, Univ. to Tokyo)

ICRR internal rule

All the people in ICRR, IPMU (staff, students, cooperative researchers, etc.), who are using small weak sealed radiation sources and X-ray device.

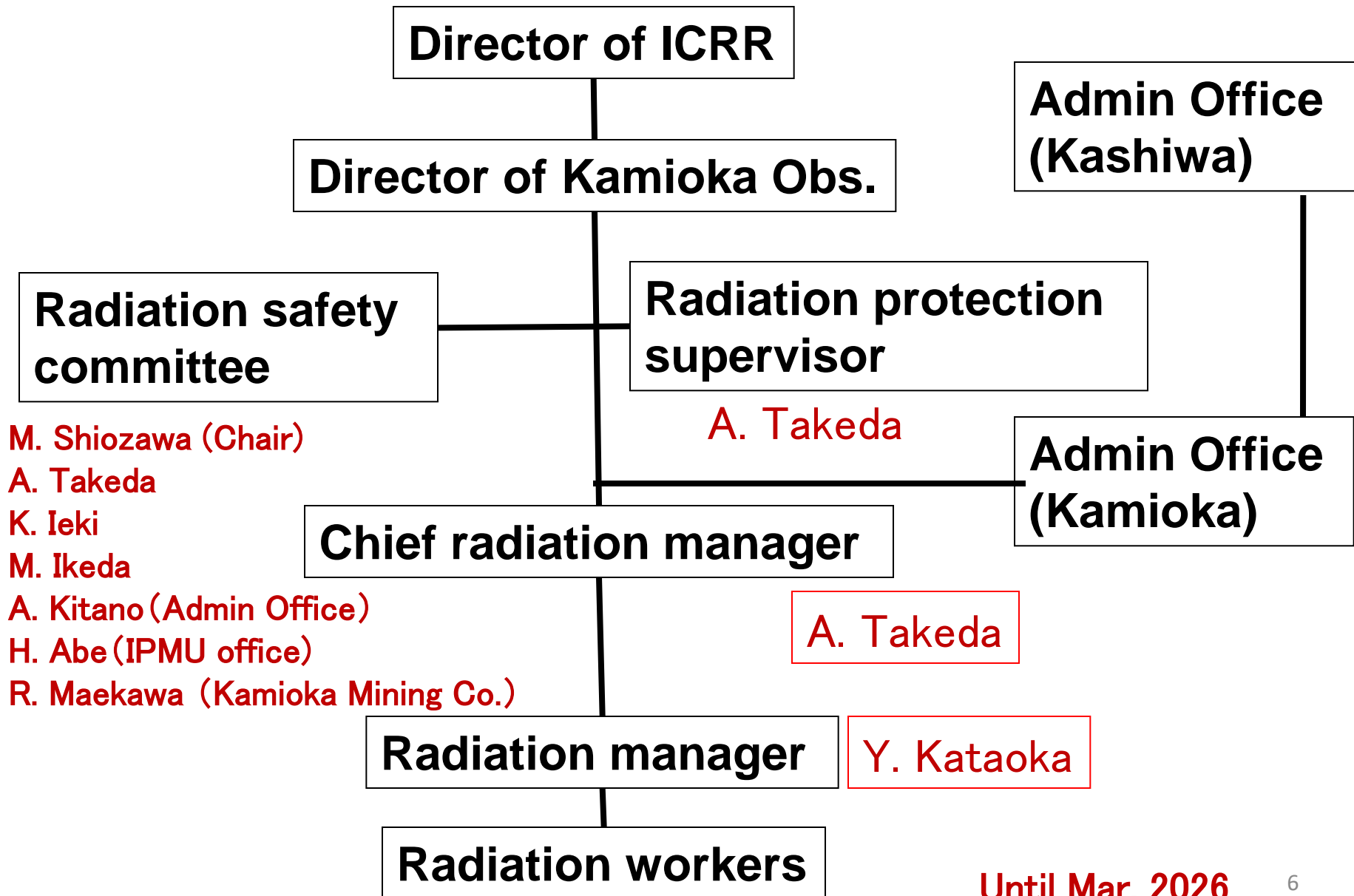
Kamioka Special Rules

(Rules of Prevention from Radiation Hazards at LINAC and DT of Kamioka Observatory, ICRR, Univ. to Tokyo)

Approved by Nuclear Regulatory Commission.

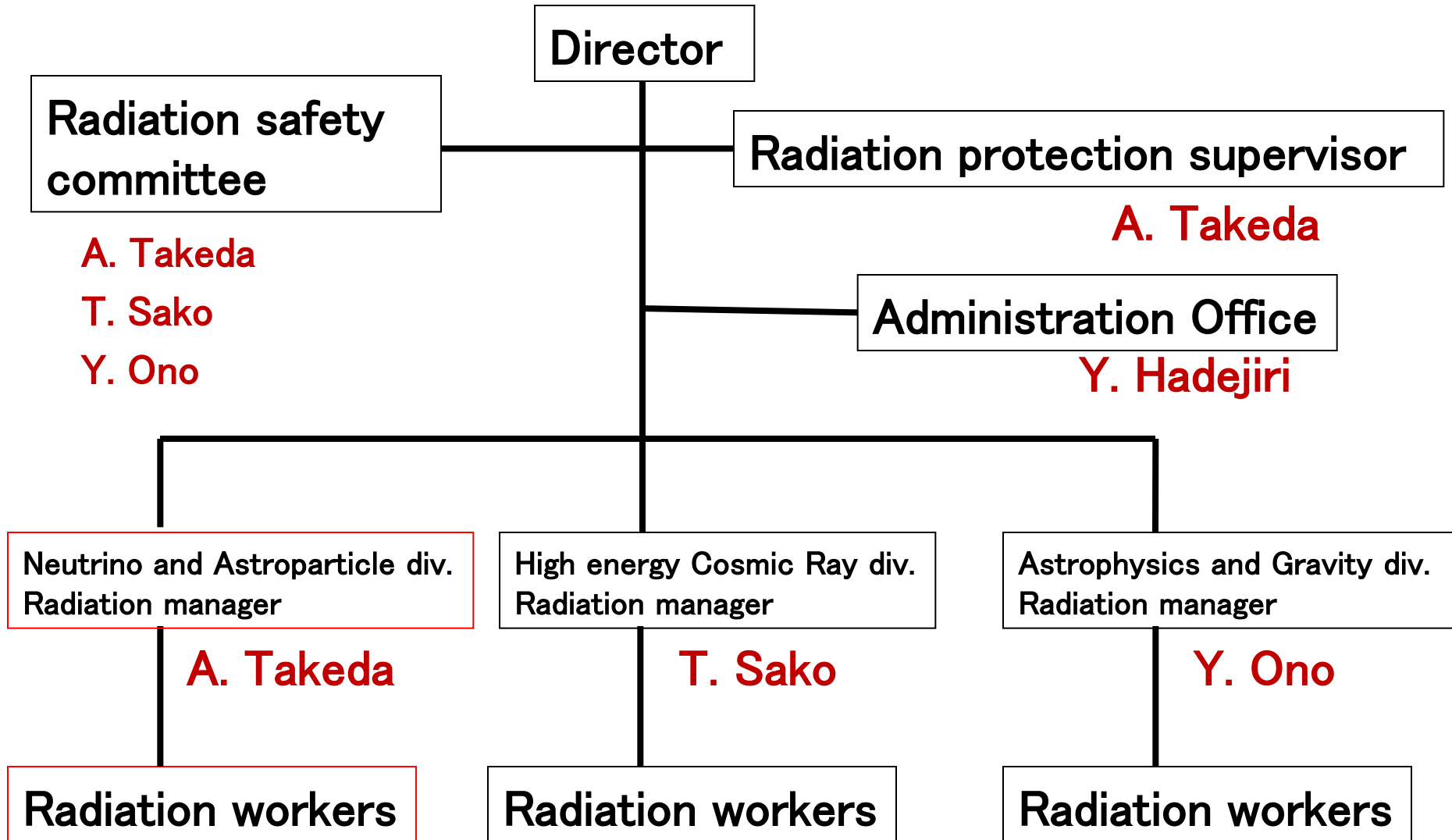
Users of LINAC / DT generator, people entering the radiation management area in Kamioka Obs.

Radiation management in Kamioka



Until Mar. 2026

Radiation management in ICRR



Radioactive source at ICRR

In Kashiwa

- Weak sealed radiation sources.

In Kamioka

- Weak sealed radiation sources
- LINAC, DT generator (approved by Nuclear Regulatory Commission)
- X-ray devices at IPMU

Weak sealed radiation source:

- The sealed source whose radioactivity is below the lower limit of the radioactive materials defined in law.
- There is no lower limit of the radiation activity in the present rules.
- For the time being, regard the radiation sources obtained from the Japan Radioisotope Association as the “sealed radiation source”.

Lower limit of the radioactive materials

Law

- The lower limit of the radioactive materials defined in ISHA. (One has to obey the Law to handle those materials)
- For us, only the sources below these limit are available

Examples:

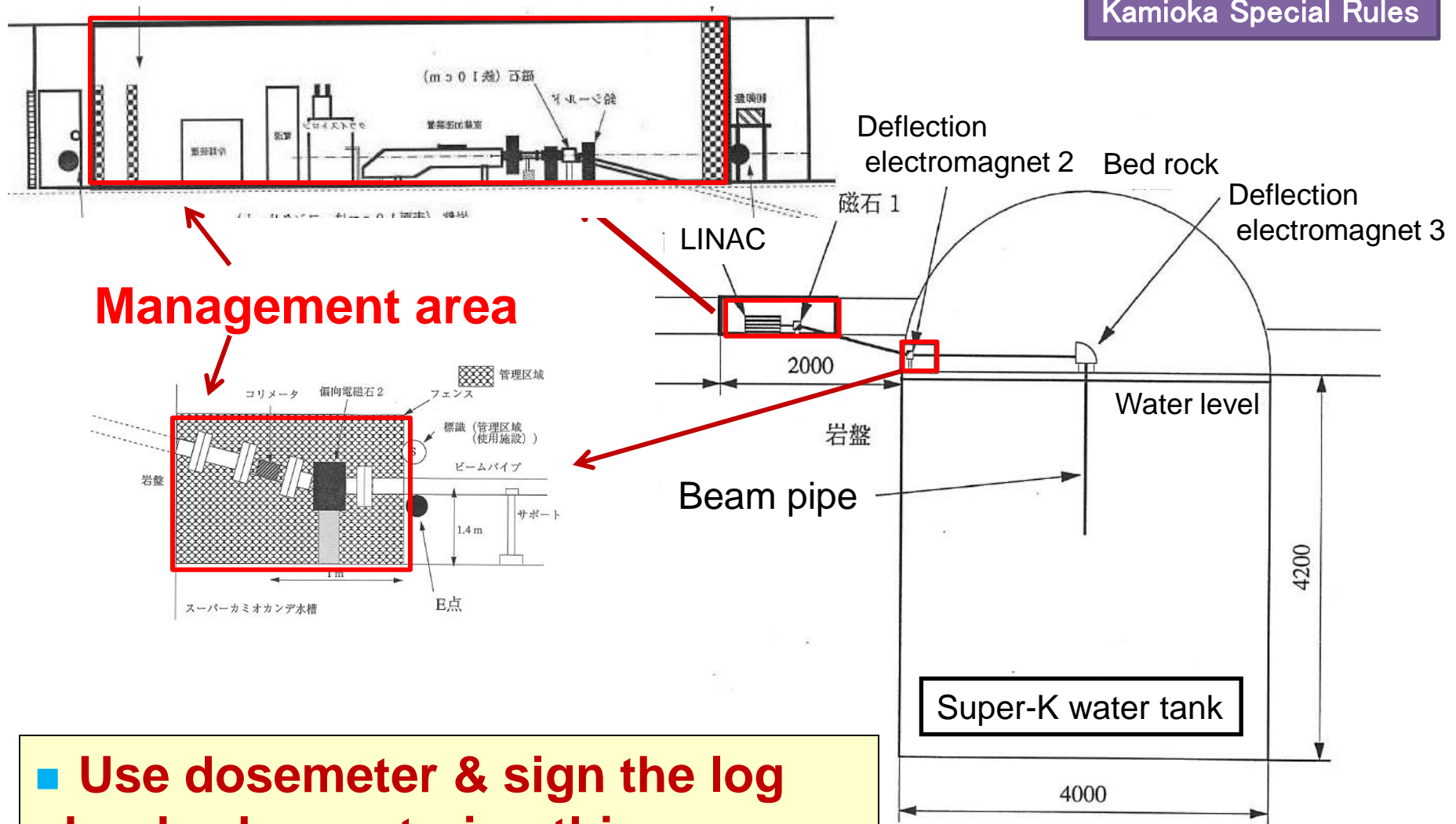
Isotope	(MBq)	(Bq/g)
60Co	0.10	10
57Co	1	100
45Ca	10	10000
51Cr	10	1000
90Sr	0.01	100
137Cs	0.01	10
241Am	0.01	1
226Ra	0.01	10

Full list (in Japanese):

<http://law.e-gov.go.jp/htmldata/S47/S47F04101000041.html>

Radiation management area in Kamioka

Kamioka Special Rules



- Use dosimeter & sign the log book when entering this area
- Safety training is needed

Registration of the radiation workers

For ICRR
members

- Required for
 - All users of well sealed radiation sources.
 - All users of LINAC/DT generator in Kamioka.
 - Staff to use radioactive materials in other institutions.
 - Staff, student who needs the Certificate of Radiation Work at ICRR.
- Registration procedure: obtain **approval from Radioisotope Center, Univ. of Tokyo**, as radiation worker at Univ. of Tokyo.
 - Safety training & health check are needed. Exemption is possible (<http://cosmo.ric.u-tokyo.ac.jp/gyomu/>)
- **Health check (every half year)** and **safety education at ICRR (once per year)** are needed.

Radiation work in other institutions

For ICRR
members

- ICRR has to manage all the exposed dose of the ICRR staff by ISHA.
 - Treat ICRR students in the same way
- **Please report your exposed dose from the radiation work in other institutions.**
- Any dosimeter could be used.
 - Use the glass dosimeter provided from ICRR, if possible.
 - TLD, electric dosimeter, and so on are also OK.
 - Use neutron dosimeter for the neutron sources.
 - **Please report your exposed dose every month when the glass dosimeter provided from ICRR is not used.**
 - Research group → Radiation manager → Radiation protection supervisor
 - Ask Radiation protection supervisor, for details.

Cooperative researchers

For Non-ICRR
members

- Take radiation safety training (once per year).
- LINAC & DT generator users should be registered as radiation workers at Univ. of Tokyo.
- The sealed radiation source users should submit the Certificate of Radiation Works from their institutions.
- Ask radiation protection supervisor if you bring a weak sealed radiation sources into mine.
 - The radioactive materials in ISHA cannot be brought.
- Radiation protection supervisor: A. Takeda

Safety handling of radiation

Important notices on radiation work

- Minimize your exposed dose
- Use personal dosimeter to enter management area, doing radiation work
 - Glass dosimeter
 - Electric dosimeter
 - Thermo luminescence dosimeter (TLD)
- Sign the log notes to use LINAC / DT generator, weak sealed radiation sources.
- Sign the log note to enter the management area.

Glass dosimeter from ICRR

- The glass dosimeter from ICRR can be start / stop using with one month unit.
- Ask administration office to start / stop using the glass dosimeter by 15th in the preceding month.
 - In Kashiwa : ICRR Administration office
 - Kamioka: Nishikawa-san

Dose Limit of radiation workers

ISHA

Updated from Apr. 1st 2021. (until then, only 150 mSv/year)

	Effective dose limit	Equivalent dose limit	
Male	100 mSv/5 years 50 mSv/year	Eye	100 mSv/5 years 50 mSv/year
		Skin	500 mSv/year
Female (other than the following)	5 mSv/3 months	(same as male)	
In pregnancy (from the person's offer to childbirth)	1 mSv/till childbirth	Abdominal surface(till childbirth) 2 mSv	
Those who have offered to have no intention of becoming pregnant	100 mSv/5 years 50 mSv/year (same as male)	(same as male)	
Those who have been diagnosed as infertile			

Effective dose (Sv): consider effect on human body

Do not exceed even one.

Effect on human body

- Natural radiation = 1.5mSv/year (average in Japan)
- Medical radiation = 2.3mSv/year (average in Japan)
- Dose limit for general people = 1mSv/yr (except for natural, medical)
- Effect of large acute dose
 - <200mSv (body): no clinical sign
 - 3000~5000mSv (body): 50% death
 - 7000~10000mSv (body): 100% death
- 1m from 1MBq β source: about 30 μ Sv/h (skin)
- 1m from 1MBq γ source: about 0.3 μ Sv/h (body)
 - Co-60: 0.3 μ Sv/h, Cs-137: 0.1 μ Sv/h
- Narita-NY round flight: 0.2mSv

Usage of the sealed radiation sources

ICRR general Rules

- (1) Confirm if the seal is not broken.
- (2) Do proper shields
- (3) Reduce exposure time as much as possible
- (4) When one steps away from the working place during the radiation work, one must put sign, barrier, etc. to prevent possible accident.

Keeping of the sealed radiation sources

ICRR general Rules

- (1) Keep the radiation sources in predefined storage box, then the manager manages them.
- (2) When radiation worker takes the sources out from the box, obtain the permission(*) from the manager or protection supervisor.
- (3) After the radiation work, return the sources into the box, then report(*) to the manager or protection supervisor.

(*): Usually, the writings of the log book (take out & bring back) are regarded as the permission & report. If there is improper treatment of the radiation sources, the worker would be asked to obtain permission individually.

Log book of usage of the sources

密封小線源使用記録 (Lognote of small source usage)

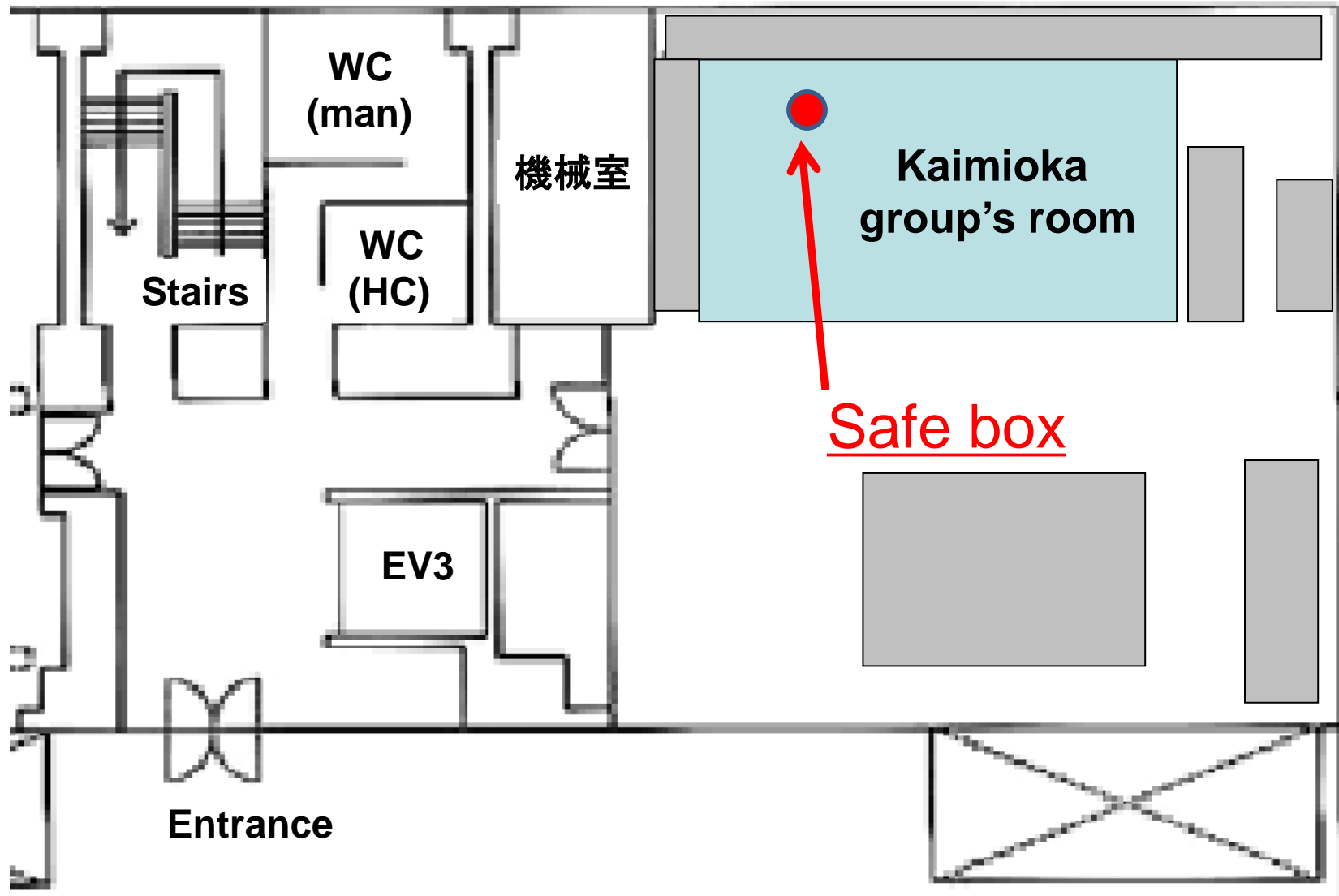
登録番号 : (ID) 神岡-56 核種名(RI) : ^{55}Fe 数量(Quantity) : $8.93\text{E}+05 \text{ Bq}$

保管場所(Storage location) : 地下坑内・第2純水室 保管責任者(Storage officer) : 竹田 敦
(研究棟から坑内へ、(あるいは坑内から研究棟へ) 線源を移動した場合には、その旨も記録すること。)

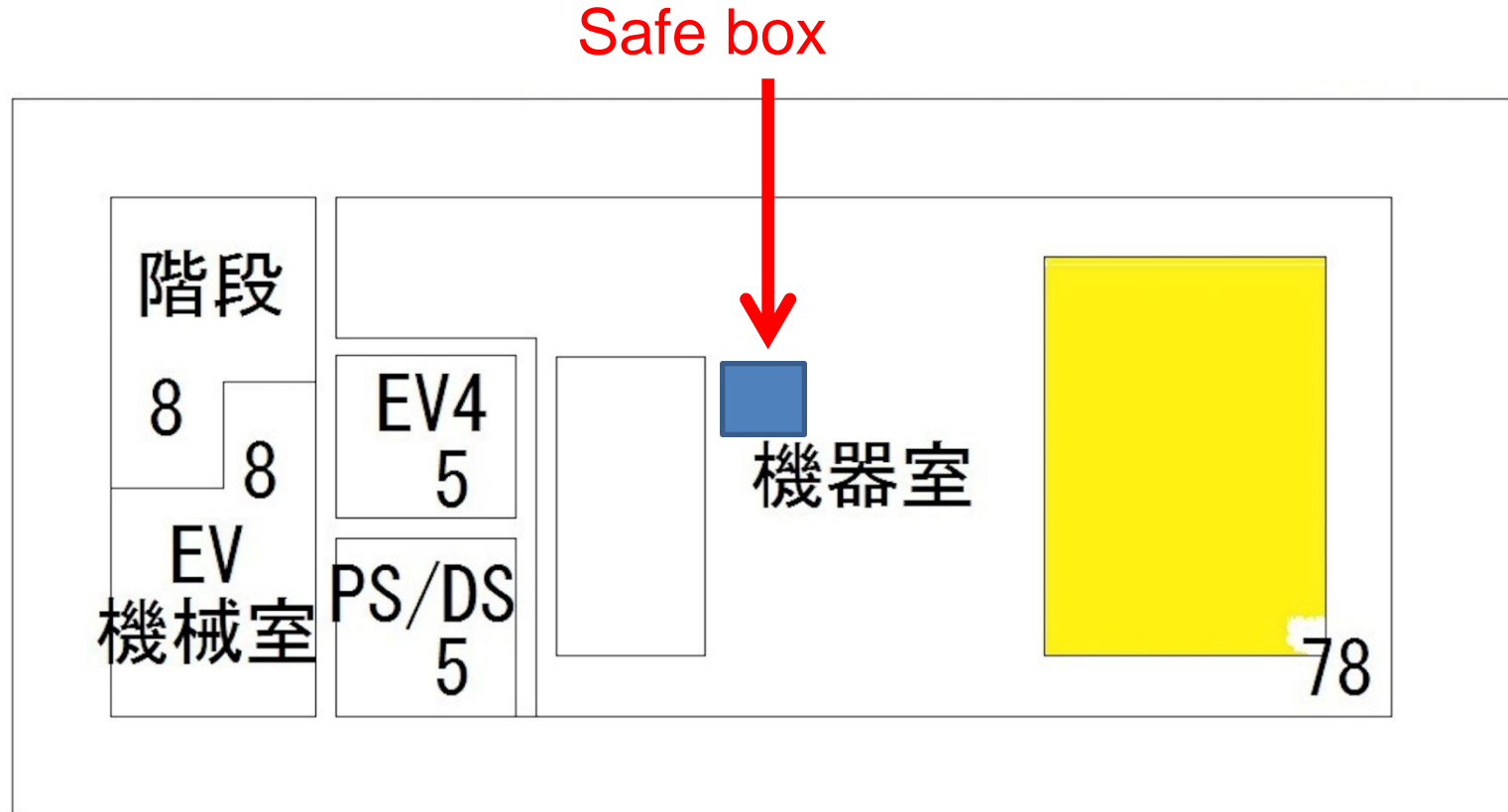
使用者名 (Your name)	使 用 場 所 (Place to use)	使用 年月日 (Take out date)	返却 年月日 (Return date)

Write down when taking out & returning

The predefined storage (Kashiwa 1F)



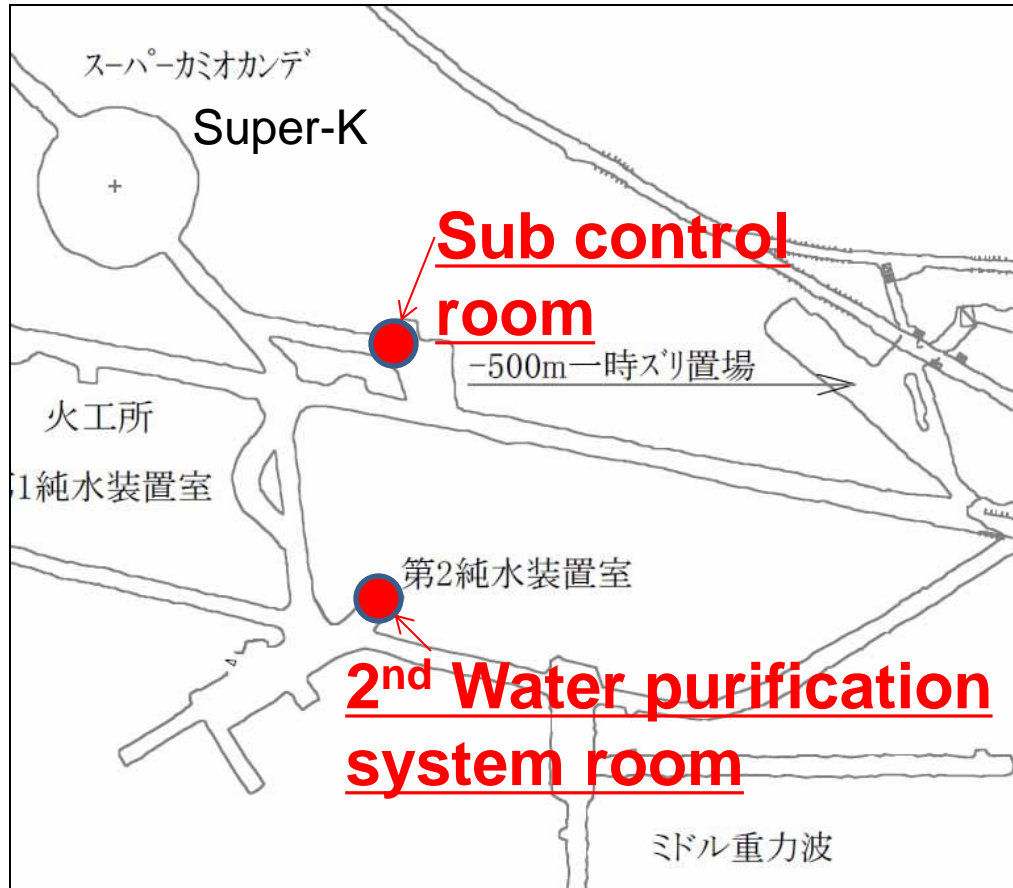
The predefined storage (Kashiwa B2F)



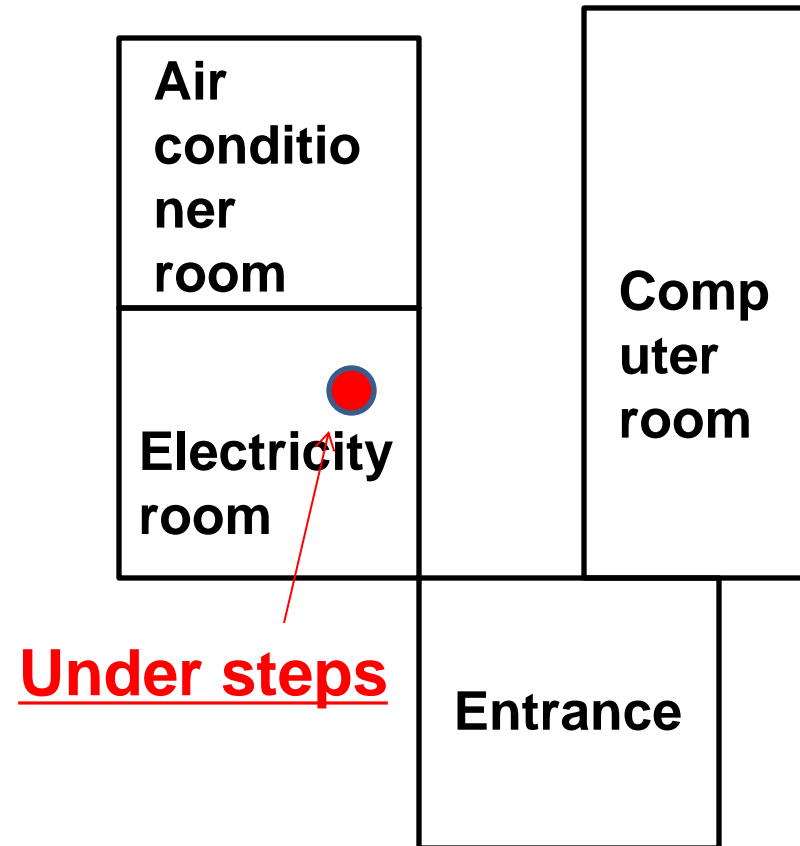
Kashiwa B2F low background laboratory

The predefined storage (Kamioka)

In the mine



In computer building



There are safe boxes in each place

Note of radiation source usage

- If one uses the sources under high / low pressure, low temperature, etc., confirm the specification of the source.
- If there is possibility of contamination, one must make contact with the radiation manager, chief radiation manager, & protection supervisor.
- Mark the possible contamination place to prevent other people from entering.

Measures in an emergency (1)

- Make phone call following the ICRR **Safety & Health emergency phone list**.

■ Radiation: A. Takeda (0578-85-9610)
E-mail: takeda@km.icrr.u-tokyo.ac.jp

- Incident related to radiation

- **Try to prevent the expanding of the accident**

- Damages from fire/earthquake, **loss of the source**, leak of contaminations, (possible) abnormal exposures, (possible) radiation damages, other unexpected contingencies.

- Make contact with the **radiation manager, chief radiation manager, & protection supervisor**

- Supervisor → Director → Univ. of Tokyo, MEXT

Measures in an emergency (2)

- **Do the health examination as soon as possible in the following cases:**
 - **Swallowing / uptake of the sealed sources or contaminations.**
 - **There is a (possible) exposure of more than 5mSv of effective dose or equivalent dose limit.**
- **Disasters, like Earthquake, Fire (Kamioka)**
 - **Make phone call following the Kamioka Observatory Emergency phone list.**
 - **Do inspection of observatory/equipments, if needed.**

Radiation work at Kamioka Observatory

Those who use DT and LINAC in Kamioka

Radioactive materials in Kamioka

Approved by Nuclear Regulatory Commission

- **d-T neutron generator (DT generator)**
 - Sealed tritium source 171GBq
 - LINAC 100keV deuterium, 60 micro A
- **LINAC**
 - 15MeV electron, 200 nano A
- These two can be used only when the supervisor is around nearby region.
 - The supervisor can nominate a proxy if he is abesent.
 - Please tell the schedule of usage **beforehand**.

Usage of radioactive sources

Kamioka Prevention Rules

- Accelerating particles, energies, fluxes should be within the permitted limits.
- One has to understand and obey the rules before using the devices
- Sign the log notes to use the device (**Name, Time, Contents of the work**)
- DT generator must be used **under water in the SK tank**.
- The maximum number of generated pulses by DT generator is **100,000 pulses per week**. (From June 2011)

Keeping, disposing, moving

ICRR general Rules

- DT generator must be kept **in the LINAC room or horizontal magnet No.2 area**. The doors should be locked.
- DT generator will not be disposed.
- When DT generator will be moved outside Kamioka Observatory, it is packed as a radioactive package, then obey the rules of transport.

LINAC usage log note

Managed
under Law

LOG OF LINAC

超微弱電子発生装置使用記録

operating time

Date and Time	Purpose	Operation mode	User	Operating time
Date and Time	Purpose	Operation Mode	User 使用者	time 使用時間
2017.7.5 16:00 19:00	7-1 取得	8MeV mode	Ikeda Kai	2h

DT generator usage log note

Managed
under Law

LOG OF DT GENERATOR USAGE

中性子発生装置（含むトリチウム密封線源）使用記録

放射線発生装置の種類： 中性子発生装置

放射性同位元素の種類及び数量： トリチウム、7-4ギガベクレル

DATE PURPOSE Place to use # of pulses Operation time user

Date	Purpose	Place to use	# of pulse	Operation time (*)	User
例 M/D/Y 1999.4.5	例: Data taking データ取得	例 In SK tank タンク水中で取得	例: 100	例: 400秒	例: 中畑 雅行
2-26-19	X+12, Y+12 DT CALIB	X+12, Y-12 IN TANK	4000	16000	Jeff + DT crew
2-27-19	DT CALIB	Y+12	3200	12800	Jeff + DT crew
2-28-19	DT CALIB	X-12	2000	8000	Jeff + DT crew

(*) パルス数×4秒にて計算

(*) Operation time = # of pulse × 4sec

Operating time
= # of pulse X 4sec

DT generator keeping log note

Managed
under Law

LOG OF H3 CUSTODY

トリチウム密封線源（中性子発生装置装備）保管記録

放射性同位元素の種類及び数量： トリチウム、¹⁷¹74ギガベクレル

保管に従事する者の氏名： 岸本 康宏

返却年月日 時刻 Return Time	返却者 Return person	保管方法 How	保管場所 Place	持ち出し年月日 時刻 Take out time	持ち出した者 Take out person
例(eg) : 1999.4.5 13:20	例(eg) : 中畑 雅行 (B.Svoboda)	例(eg) : LINAC 室内に置き施錠 (Put in LINAC room and lock)	例(eg) LINAC 室 (LINAC room)	例(eg) : 1999.5.6 9:00	例(eg) : 中畑 雅行 (B.Svoboda)
2-28-19 12:00AM	Jeff + KAI	LINAC CAGE Locked	LINAC CAGE	2-25-19 9:00AM	Jeff + KAI + Team

M/D/Y

返却した時はここまで記録する。

Write down <--
at returning DT

持ち出す時はここ以降を記録。

Write down -->
at taking out

Entrance log of Management area (1)

Managed
under Law

超微細電子発生装置 管理区域出入記録

Date

Workers

8月 19日
6 8 12 18

8月 20日
6 12 18

8月 21日
6 12 18

Time

Takenchi
Miyabe

Ikeda Nakajima
Koshio, Xu, Fukuda
Nakabata

Takenchi
Pierce

Ikeda
Moriyama
Xu, Fukuda

Sekiya
Mori
Pierce

KAI, IKEDA,
NAKANO

Entrance log of Management area (2)

Managed
under Law

神岡宇宙素粒子研究施設 超微弱強度電子線発生装置

H29

管理区域立ち入り記録 (一時立ち入り者) For Visitor

日付、時刻	氏名	所属 (会社等)	作業内容
Date & Time	Name	Affiliation	Purpose
5			立ち入り
6	東 哲工	ICRR	点検
H29.8.3	長谷川 誠	神戸大	LINAC
"	中島 康博	ICRR	LINAC
H29.10.24	大澤 (KEK)	KEK	見学