

# Safety training for radiation workers at ICRR

2023/05/31  
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.**

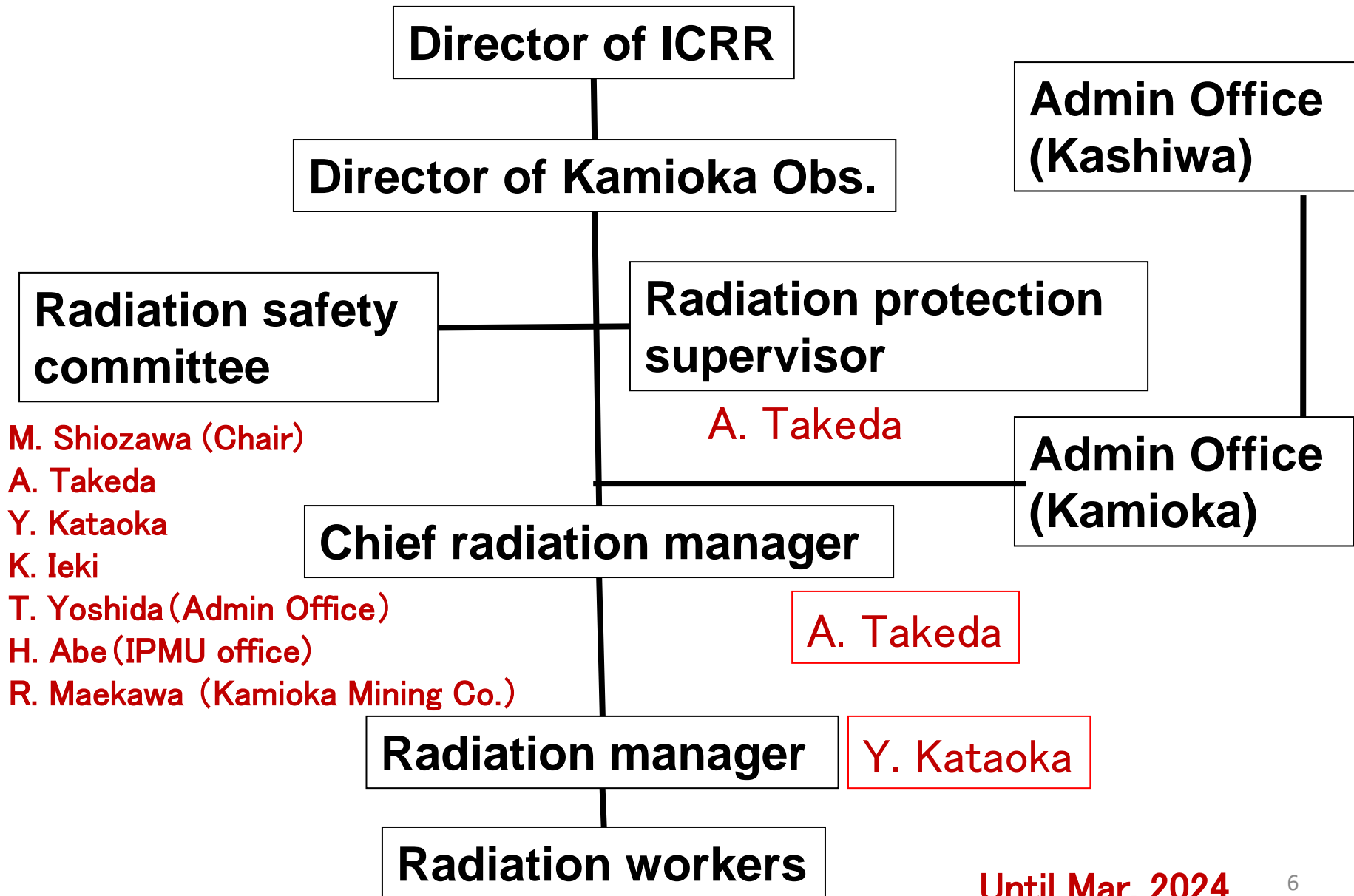
## **Kamioka Special Rules**

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

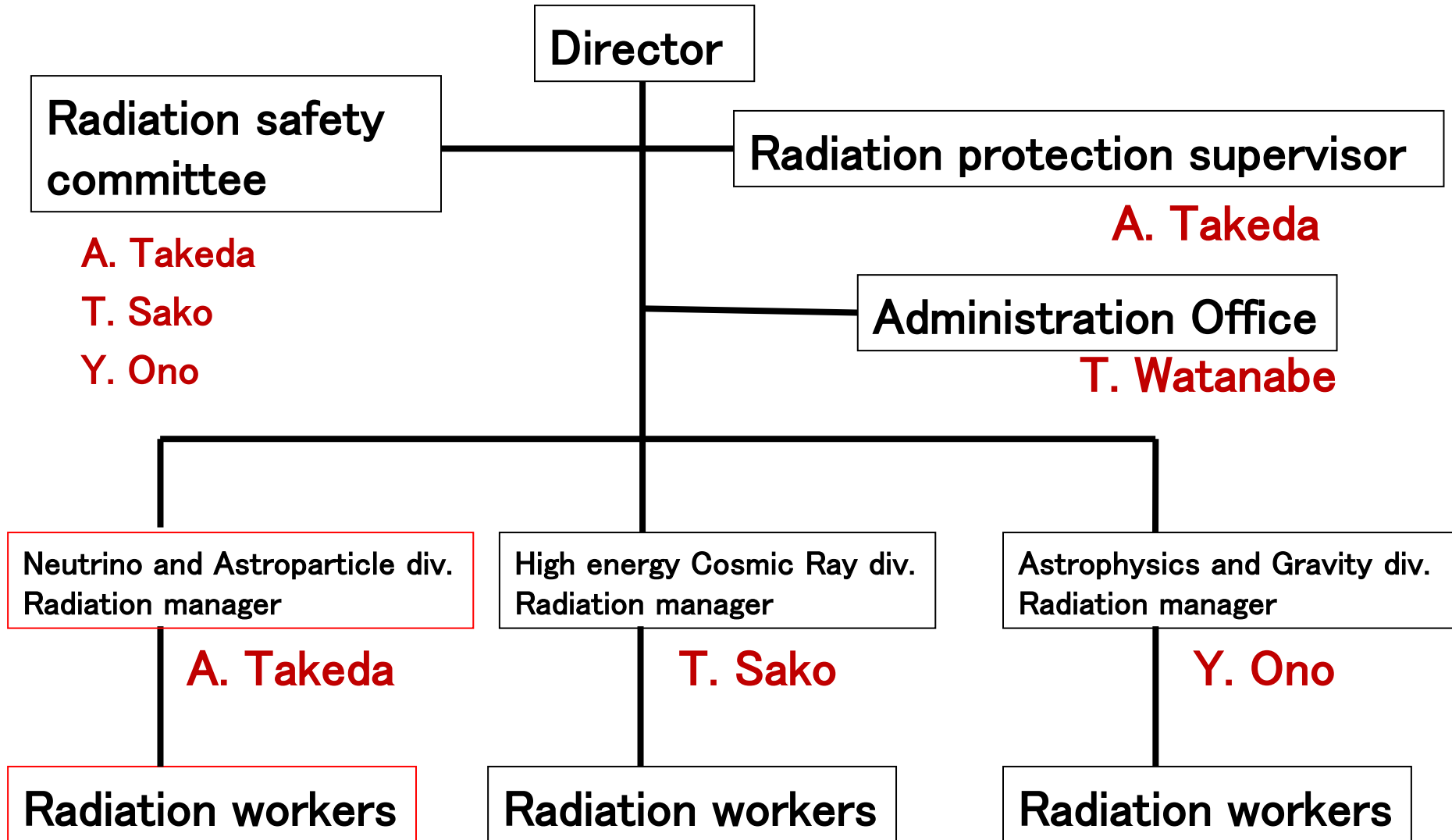
Approved by Nuclear Regulatory Commission.

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

# Radiation management in Kamioka



# 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:

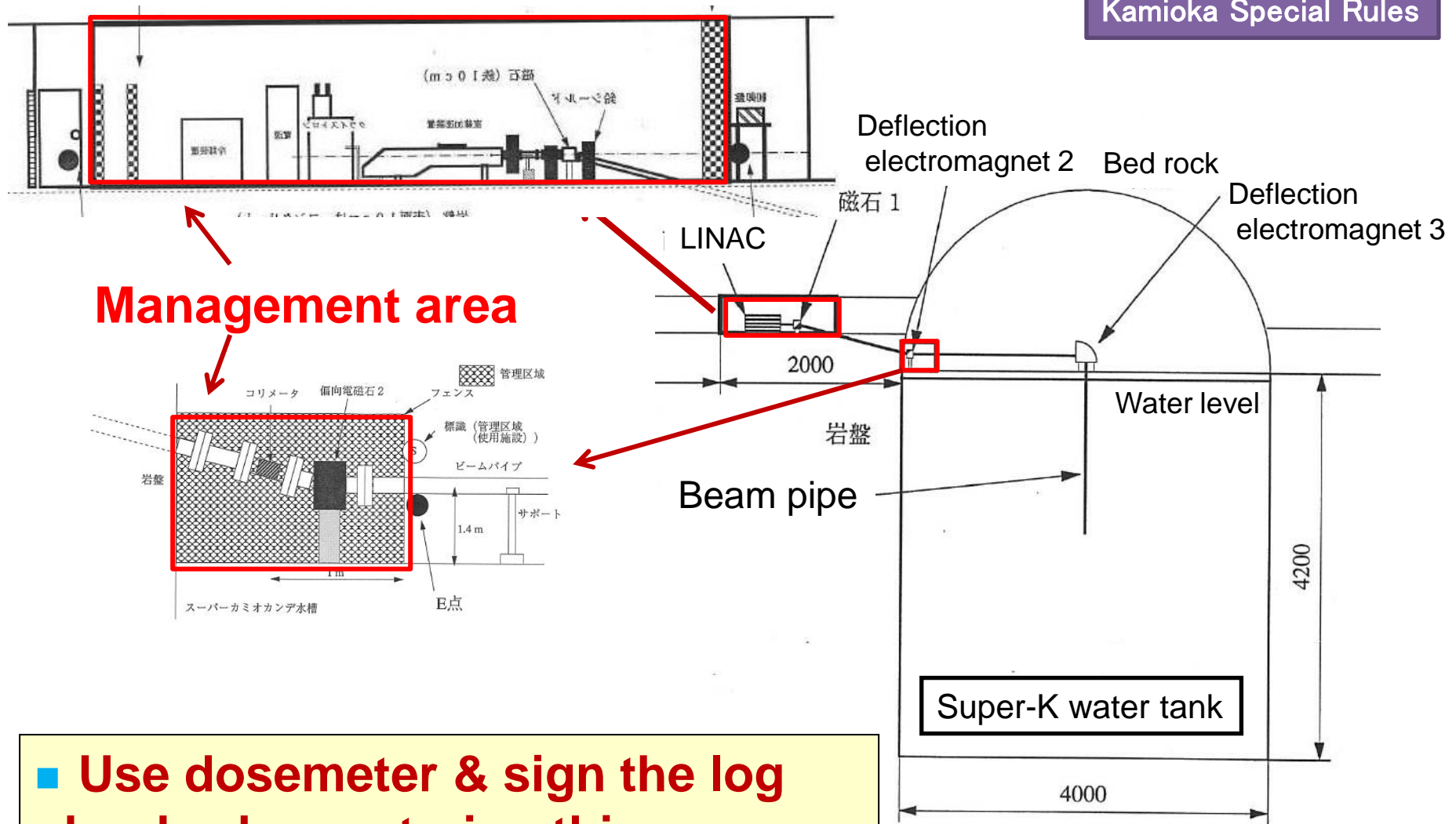
Isotope	(MBq)	(Bq/g)
60Co	0.10	10
57Co	1	100
45Ca	10	10000
51Cr	10	1000
90Sr	0.01	100
137Cs	0.01	10
241Am	0.01	1
226Ra	0.01	10

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 15<sup>th</sup> in the preceding month.
  - In Kashiwa : ICRR Administration office
  - Kamioka: Nishikawa-san



# Dose Limit of radiation workers

ISHA

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

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

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  $\beta$  source: about 30 $\mu$ Sv/h (skin)
- 1m from 1MBq  $\gamma$  source: about 0.3 $\mu$ Sv/h (body)
  - Co-60: 0.3 $\mu$ Sv/h, Cs-137: 0.1 $\mu$ 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

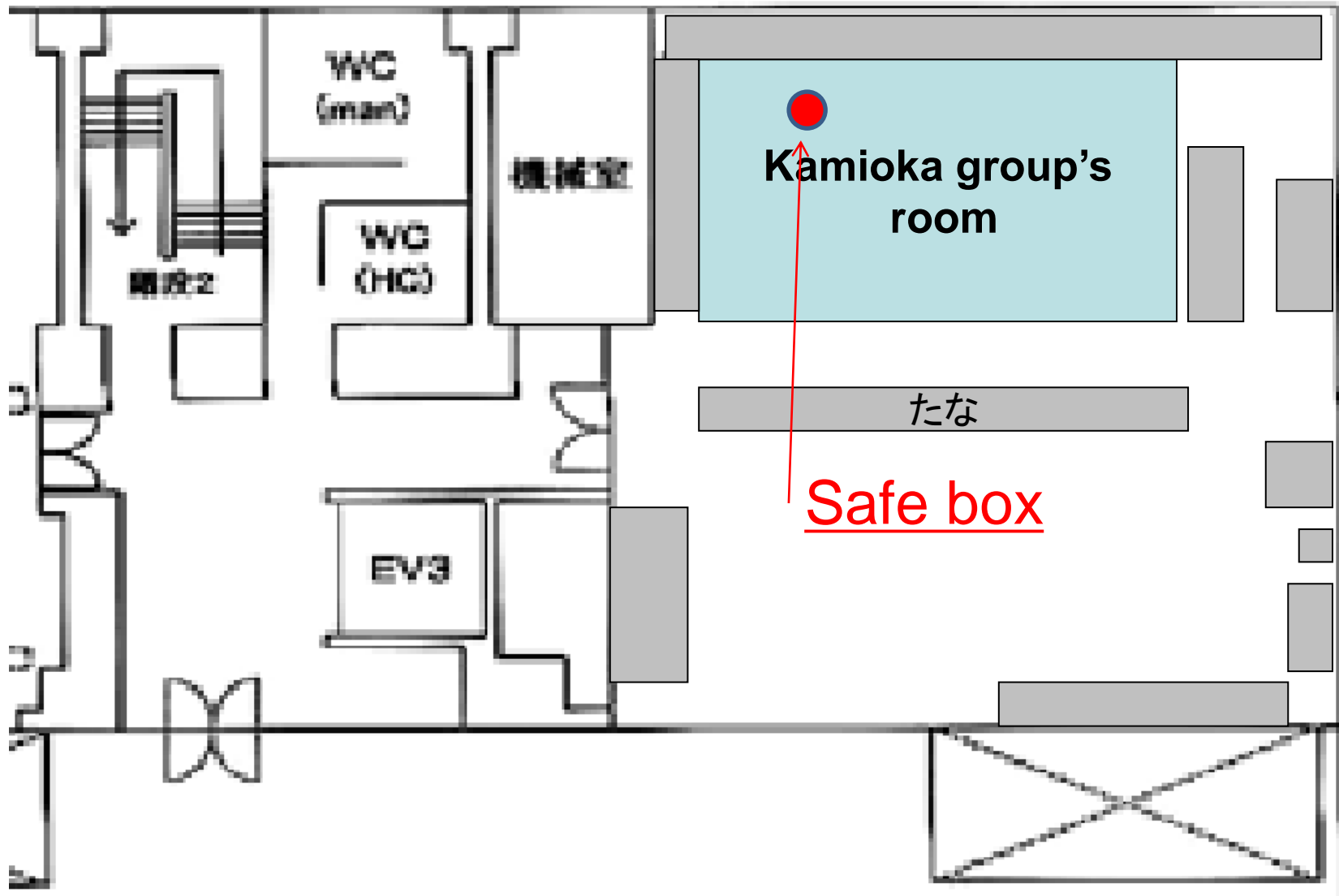
## 密封小線源使用記録 (Lognote of small source usage)

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

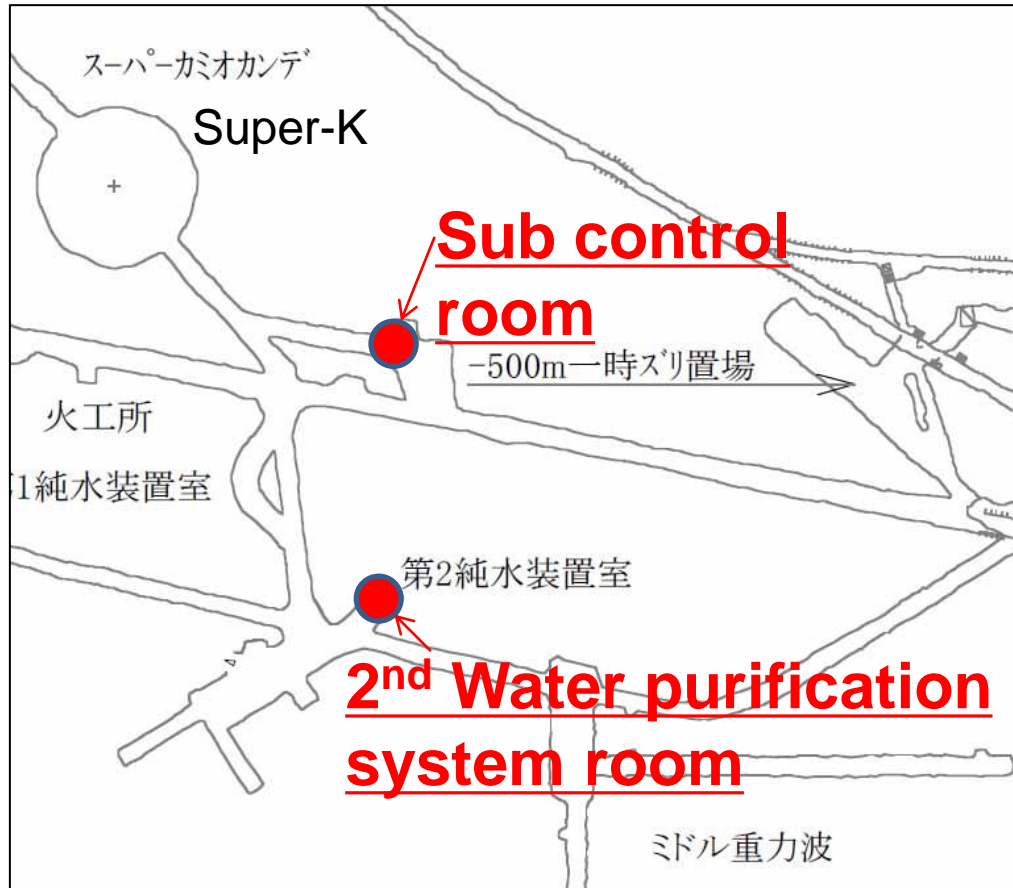
**Write down when taking out & returning**

# The predefined storage (Kashiwa 1F)

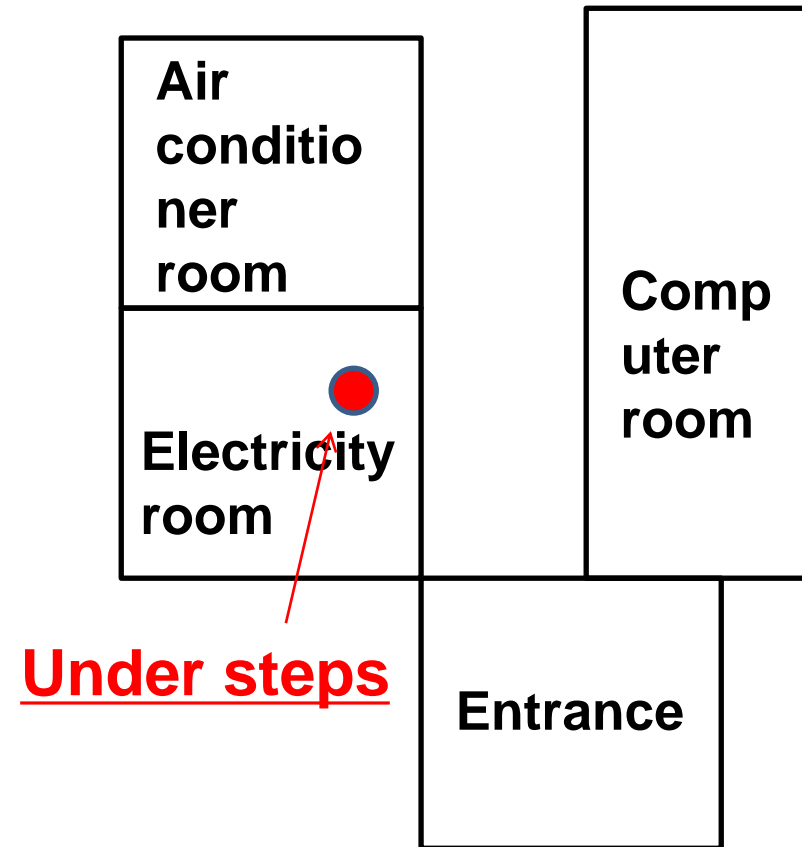


# The predefined storage (Kamioka)

## 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](mailto: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	8 MeV 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	<del>X+12, Y+12</del> 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、<sup>171</sup>74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 管理区域立ち入り記録

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