

- **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.**

# **Safety Training for Radiation Workers at ICRR, Univ. of Tokyo**

**May, 2019**

# Outline

- **What is new in this year**
- **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)**

## What new in this year

- **Amendment of the law related to radiation safety in 2018 April.**
- **Point of the amendment:**
  - **Information disclosure at emergency cases**
  - **Strengthen leadership and management to prevent radiation hazards**
- **Radiation safety regulation rule was revised following the amendment.**

# Law, Rules at ICRR

(IPMU members also follow ICRR  
law and rules.)

# Users

- ICRR staff

- Researchers, students, etc. in other institute

**Users of DT/LINAC  
and who enters the management area**

Japanese low

Rules of ICRR

# Rules related to radiation

## **Rules of Prevention from Radiation Hazards at ICRR, Univ. to Tokyo**

ICRR internal rule, called as “ICRR General Rules”

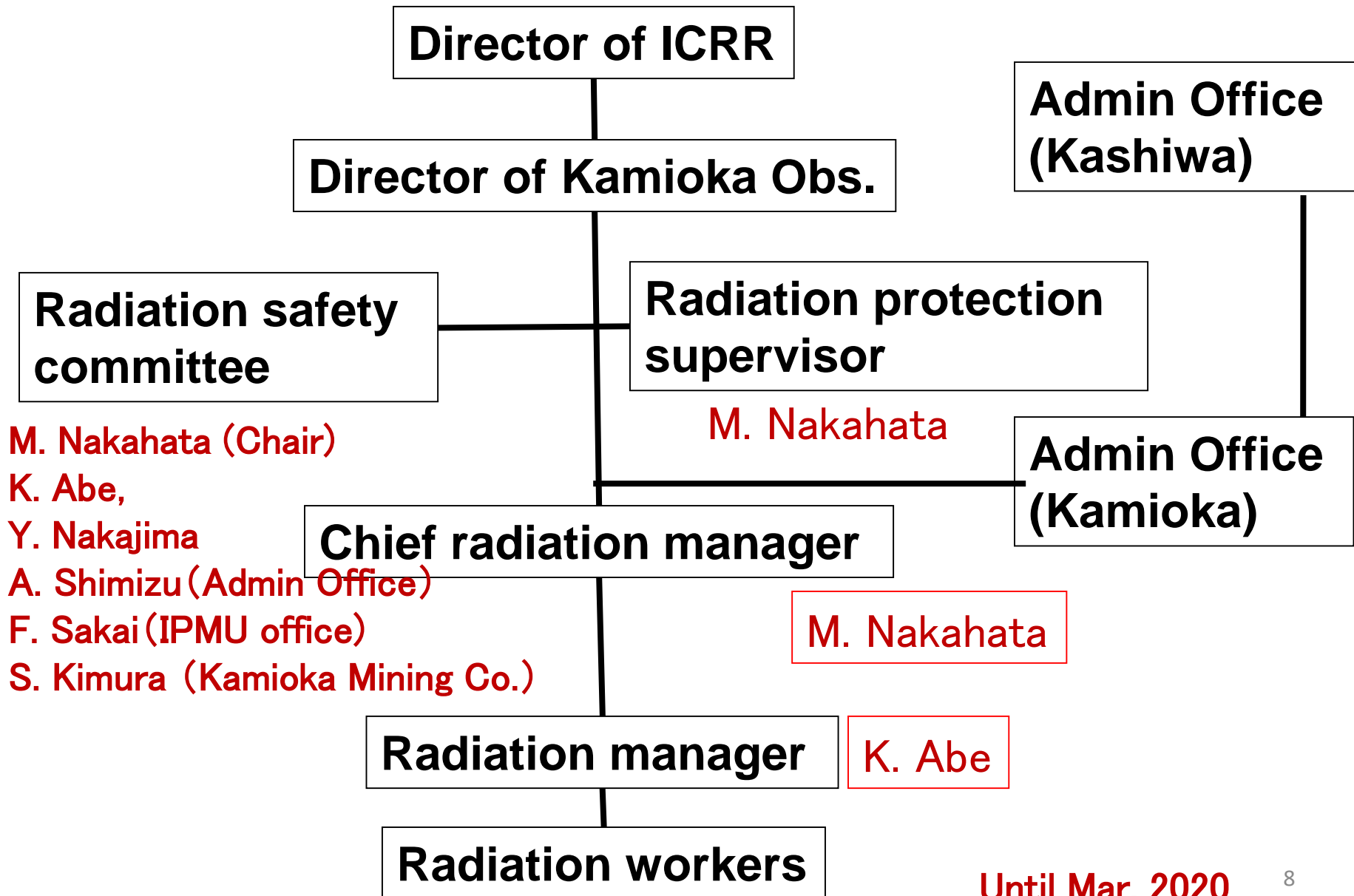
**All the people in ICRR, IPMU (staff, students, cooperative researchers, etc.), who are using small weak sealed radiation sources and X-ray device.**

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

Approved by MEXT, called as “Kamioka Special Rules”

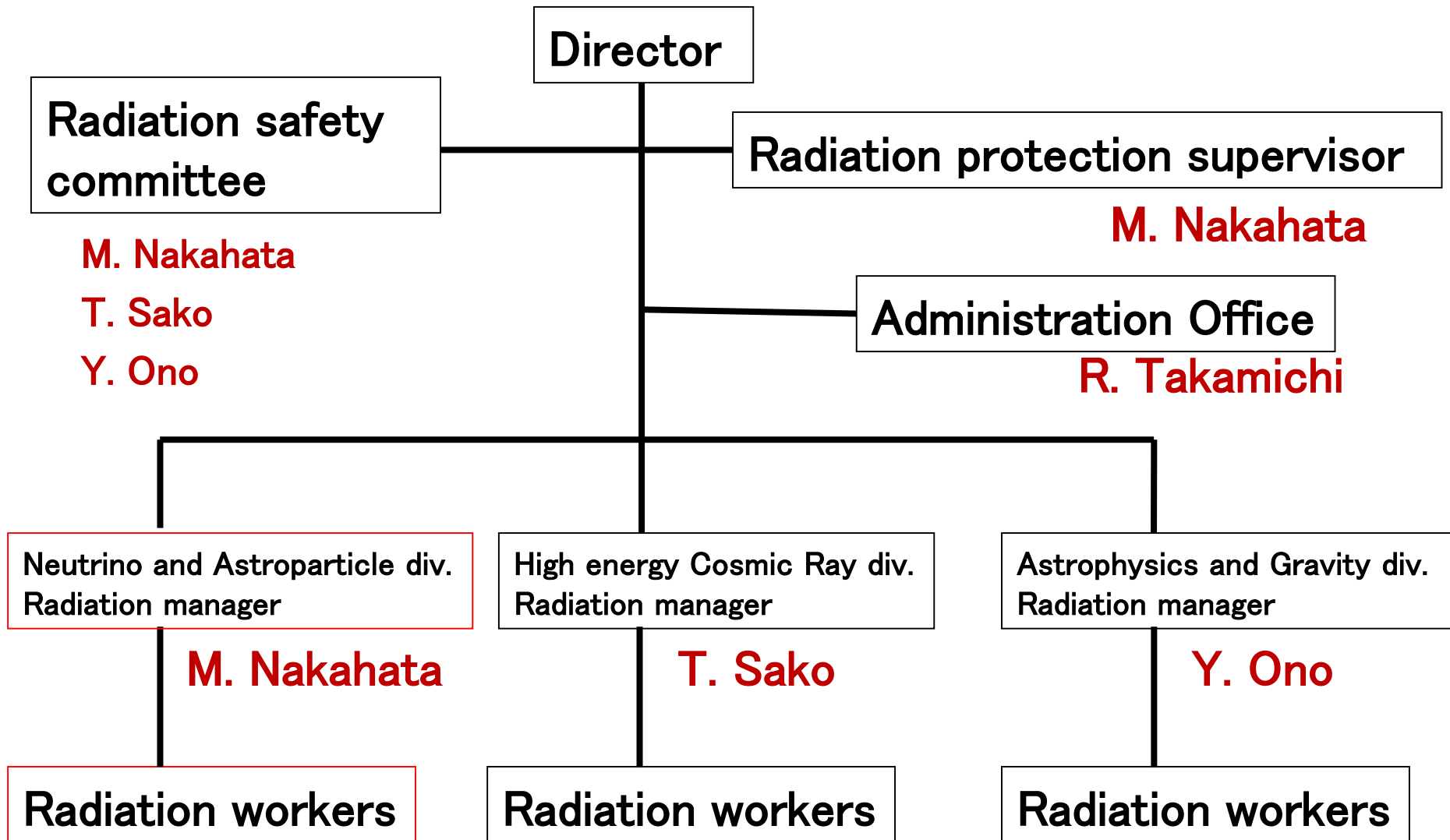
**Users of LINAC / DT generator, people entering the radiation management area in Kamioka Obs.**

# Radiation management in Kamioka





# Radiation management in ICRR



# Radioactive source at ICRR

ICRR general Rules

## In Kashiwa

- Weak sealed radiation sources.

## In Kamioka

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

**There is no lower limit of the radiation activity in the present rules.**

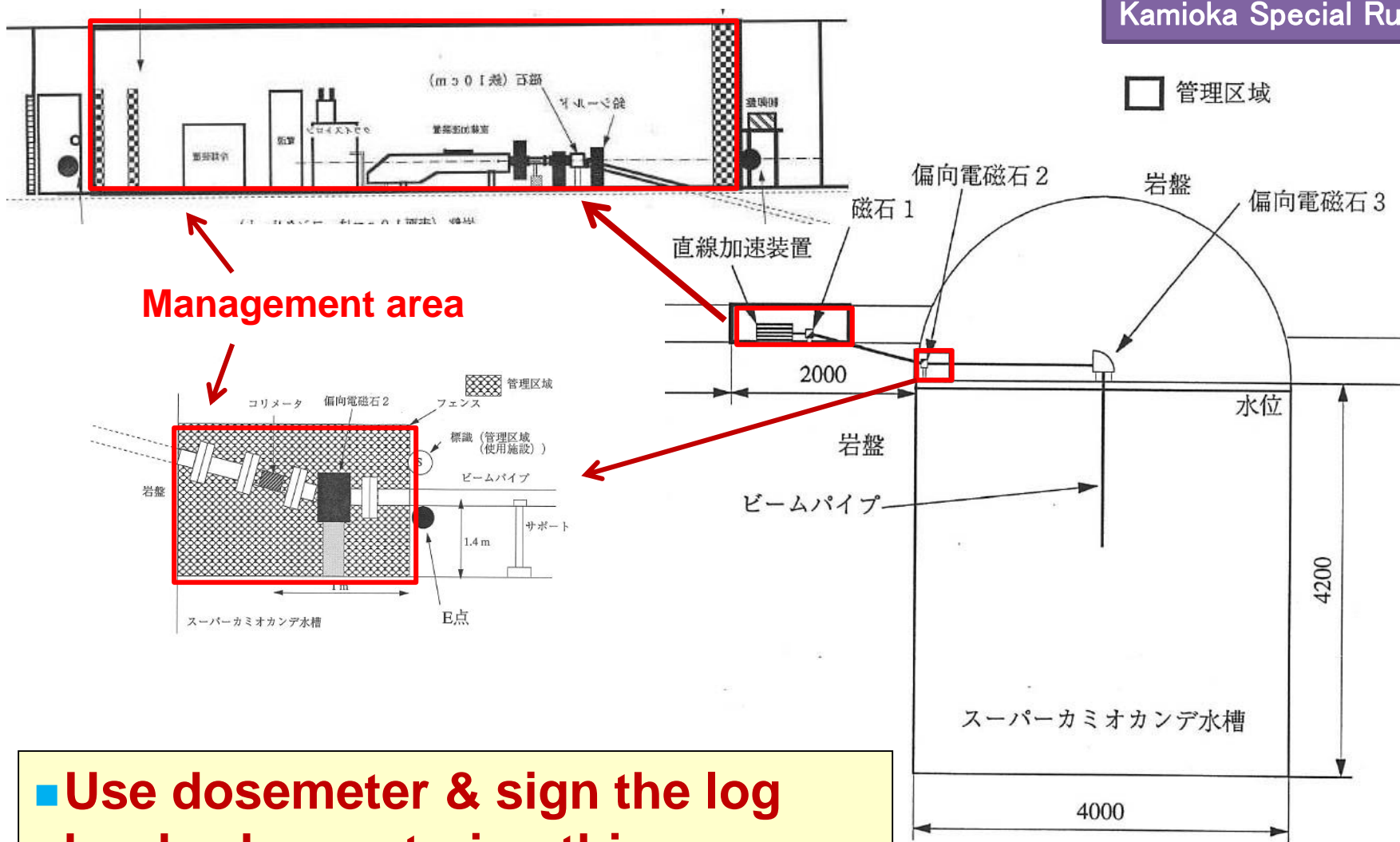
**For the time being, regard the radiation sources obtained from the Japan Radioisotope Association as the “sealed radiation source”.**

## ■ One note:

- There sometimes are questions about development and usage of small and very weak neutron generator, such as “neutrostar”.
- According to the safety management office in the Univ. of Tokyo, it should be treated as “*an accelerator*”, like our LINAC.
- This means that it is not easy to handle because the regulation on the neutron device is not a piece of cake.

# Radiation management area in Kamioka

## Kamioka Special Rules



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

# Lower limit of the radioactive materials

ISHA

The lower limit of the radioactive materials defined in ISHA.  
(One has to obey the Law to handle those materials)

## Examples:

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

Full list (in Japanese):

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

# Registration of the radiation workers

For ICRR  
members

- **Required from the Law, Univ. of Tokyo**
  - All the users of LINAC/DT generator in Kamioka.  
(staffs, students, **cooperative researchers**)
  - Staff to use radioactive materials in other institutions.
  - ICRR staff, students who needs the Certificate of the Radiation Work at ICRR.
- **Required from ICRR general Rules**
  - Staff & students to use the weak X-ray device
  - Staff & students to use the weak sealed radiation sources
  - The cooperative researchers are requested to submit the Certificate of Radiation Works from their institutions.<sup>14</sup>

# Registration of the radiation workers

For ICRR  
members

- **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.**

# Cooperative researchers

- 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: Y. Kishimoto



# Radiation work in other institutions

- 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.

# 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

	Effective Dose Limit	Equivalent Dose Limit	
男子 Male	100mSv / 5 year 50mSv / year	Eye	150mSv / yr
		Skin	500mSv / yr
下記以外 Female	5mSv / 3 month	(same as male)	
妊娠中 In pregnancy (本人の申し出から 出産まで)	1mSv / till childbirth	腹部の表面(～出産まで) 2mSv	
妊娠の意思のない旨 を申しでた者	100mSv / 5年 50mSv / 年	(男子と同じ)	
妊娠不能と 診断された者	(男子と同じ)		

# Effect on human body

- Effective dose (Sv): consider effect on human body
- Natural radiation = 1.5mSv/year (average in Japan)
- Medical radiation = 2.3mSv/year (average in Japan)
- DL 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

使用記録

**Source No.**

**Nuclide name**

**Intensity**

登録番号： 神岡—1

核種名： Am/Be

数量： 9.7  $\mu$ Ci

保管場所： 神岡研究棟

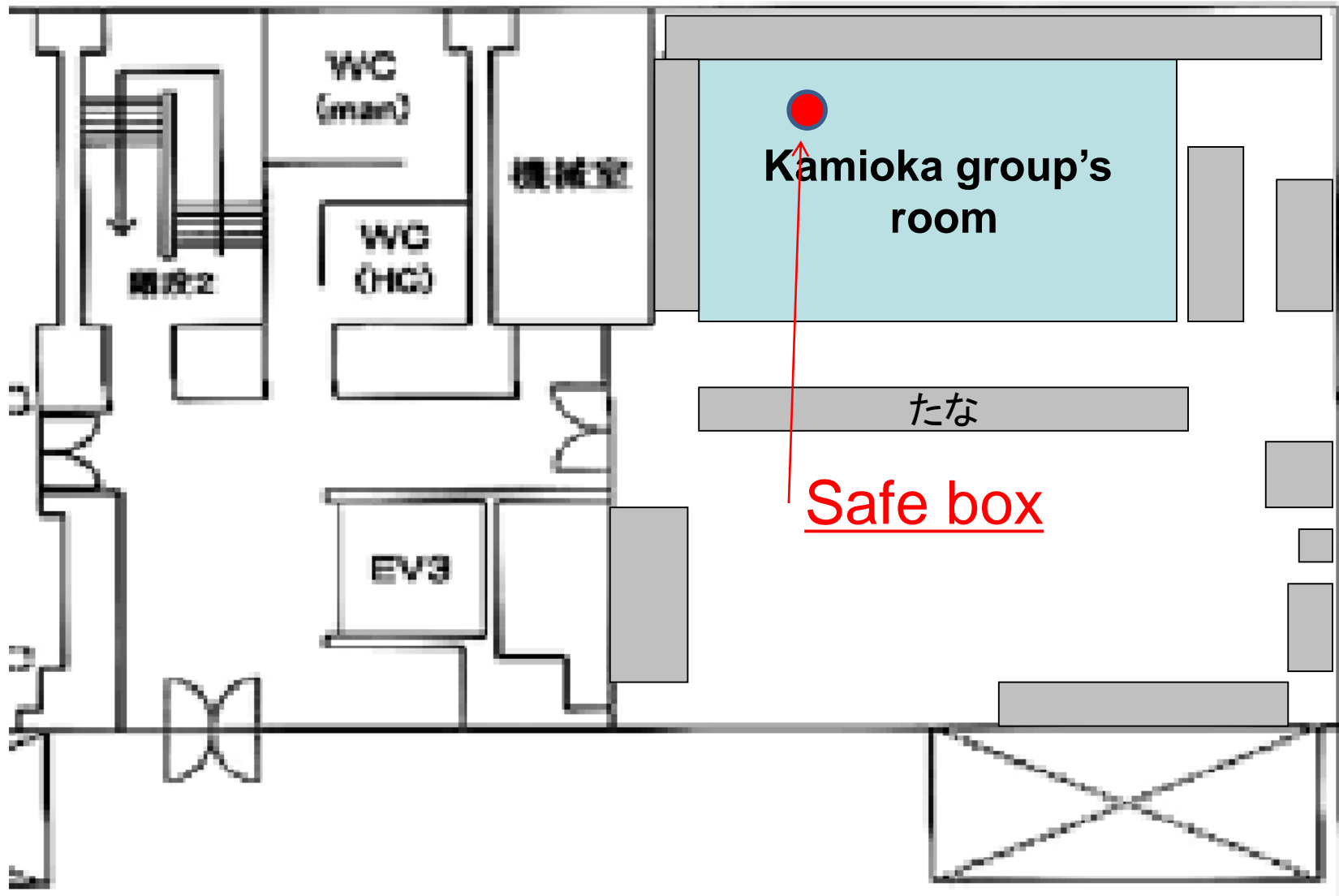
保管責任者： 中畑 雅行

(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は、その旨も記録すること。)

使用者名	使用場所	使用年月日	返却年月日
—	2005年6月29日現在 研究棟	—	—
Name	Place to use	Take out date	Return date

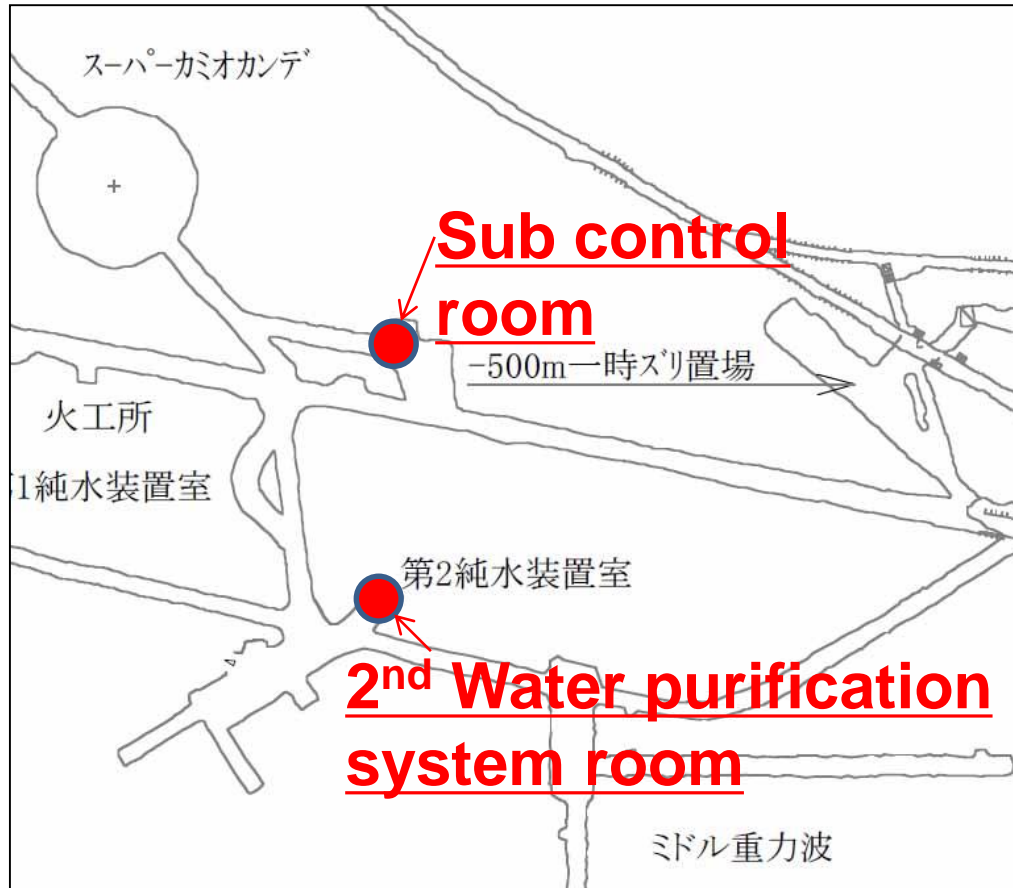
**Write down when taking out & returning**

# The predefined storage (Kashiwa 1F)

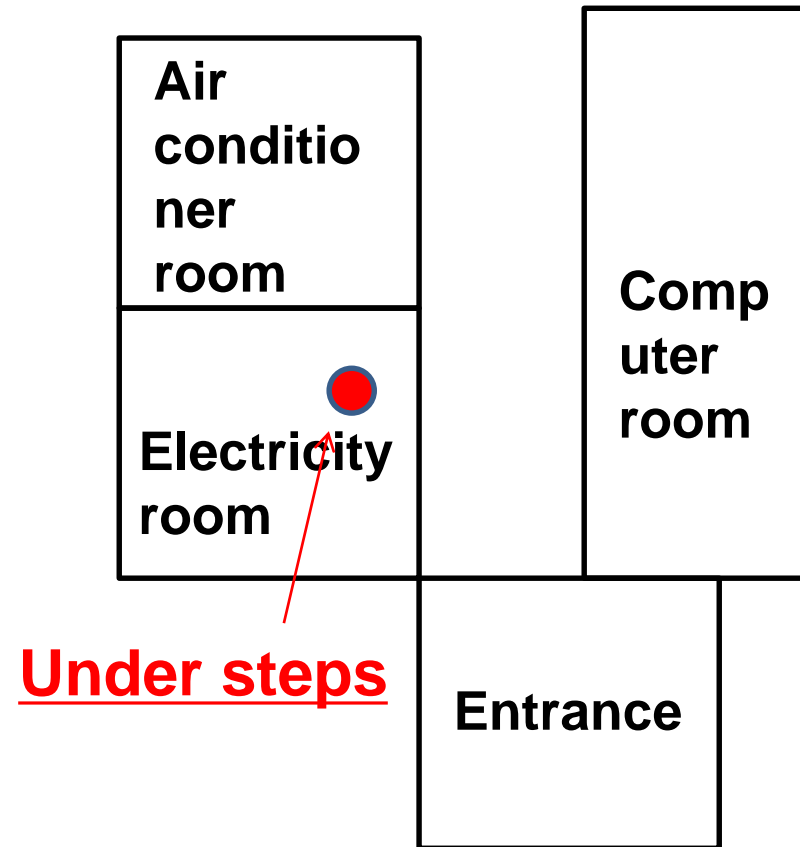


# The predefined storage (Kamioka)

## 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** (April 1, 2019).

■ Radiation: M. Nakahata(0578-85-9603)  
E-mail: nakahata@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 MEXT

- **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

- 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 last June)

# 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	
時間	目的	方法	使用者	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
年月日	目的	方法・場所	パルス数	使用時間（＊）	使用者
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

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 管理区域出入記録

Date													
Workers	8月 19日				8月 20日				8月 21日				
	6	8	12	18	6	12	18		6	12	18		
Takenchi Miyabe													
Ikeda Nakajima Koshio, Xu, Fukuda Nakabata													
Takenchi Pierce													
Ikeda Moriyama Xu, Fukuda													
Sekizawa 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
<b>Date &amp; Time</b>	<b>Name</b>	<b>Affiliation</b>	<b>Purpose</b>
5			立ち入り
6	栗田工	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