June 19, 2017

To Nuclear Regulation Authority

Toshio Kodama
President
Japan Atomic Energy Agency

Report on the contamination at Plutonium Fuel Research Facility

I will report on the radioactive contamination at Plutonium Fuel Research Facility as described in the Attached sheets based on the Article 62–3 of Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors.

The causes and measures to be taken will be subsequently reported based on the investigation that will be made.

Attached sheets: Report on failure, etc. of a nuclear facility

Attached sheets

Report on failure, etc. of a nuclear facility

June 19, 2017

Japan Atomic Energy Agency

Title	Contamination at Plutonium Fuel Research Facility (PFRF)
Date and time of the occurrence of the event	Date and time: Tuesday, June 6, 2017; around 11:15 Date and time of decision: Wednesday, June 7, 2017; 13:00
Place of the occurrence of the event	Analyzing room of PFRF (in a controlled area)
Name of the nuclear facility where the event occurred	Plutonium Fuel Research Facility Oarai Research and Development Center (north zone) Japan Atomic Energy Agency
Situation of the event	Around 11:15, June 6, 2017, in the hood (H-1) of the analyzing room of PFRF (hereinafter "Room No. 108"), during the inspection work of a storage container of plutonium and enriched uranium that contains nuclear fuel materials (hereinafter "storage container"), vinyl bags in the storage container encapsulating a container of nuclear fuel materials (hereinafter "resin bags") burst. As a result of a contamination check conducted in the Room No. 108 using surface contamination test meter of α-ray, all the five workers were confirmed to be contaminated. To prevent expansion of the contamination, a greenhouse was set at the entrance of the Room No. 108 to the side of the corridor, and the workers' exit from the room started at 14:30. By the body contamination test conducted in the greenhouse when they left the room, contamination was confirmed in the special work clothes, etc. of the five workers (more than 322 Bq/cm^2 (α-ray) at a maximum), and skin contamination and nasal cavity contamination were confirmed respectively among four and three of the workers. Before the workers with skin contamination left the controlled area, they were decontaminated in the shower room installed inside the controlled area and underwent inspection to confirm the dose level was

	lowered below the detection limit. Due to these results of body contamination, the Room No. 108 was designated as restriction area at 16:27. Through measurement of the five workers using lung monitor at Nuclear Fuel Cycle Engineering Laboratories, 2.2×10 Bq^{4} and 2.2×10 Bq^{2} were confirmed, respectively, with regard to Pu-239 and Am-241 at a maximum. Therefore, with cooperation of the National Institute of Radiological Science (hereinafter "NIRS"), injection of chelating agent was carried out aiming to prompt egestion of ingested Pu etc. As based on the fact that 2.2×10 Bq^{4} and 2.2×10 Bq^{2} were confirmed, respectively, with regard to Pu-239 and Am-241 at a maximum through the measurement of the five workers using lung monitor, their levels of exposure exceeded or might exceed 5 mSv, the level at which report is required in the event of unplanned exposure of radiation workers entering a controlled area, and also there was a possibility that the surface density of the floor etc. of the Room No. 108 exceeded the level of the restriction area designated in the operational safety program (alpha nuclide: 4 Bq/cm^{2}), it was judged at 13:27, June 7, 2017 that this accident is an event of which report is required by laws and regulations based on the provision of the Article 62 – 3 of the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors. The report on the above was made to the Nuclear Regulation Authority at 13:27. The surface density of the Room No. 108 was confirmed to be 55 Bq/cm^{2} (α-ray) and 3.1 Bq/cm^{2} (β-ray (γ-ray)) at a maximum by the measurement of the floor carried out on June 7. 2017. Also particles assumed to have scattered from the storage container were confirmed in front of the hood (H-1). On June 7, 2017, the five workers were transferred to NIRS and underwent treatment including decontamination of the body surface and measurement using lung monitor. JAEA received a report from NIRS on June 12, 2017 to the effect that as a result of the measurement using lung monitor, no obvious energy peak was confirmed with regard to plutonium and that there were people

	with whom energy peak was confirmed with regard to americium based on the measurement data, but the level was declining. On June 13, 2017, the five workers were discharged from NIRS. Their state of health is normal and they are under treatment following the instruction of the doctors. Now the storage container is covered with lid and placed in the hood (H-1) which is shut with sliding glass doors. The storage container is monitored with TV camera through the glass doors of the hood (H-1). The ventilation system of PFRF keeps operation to maintain the normal negative pressure in the controlled area. The values indicated by the monitoring posts, the ventilation dust monitor of PFRF and the Pu dust monitor No.2 (inside Room No. 108) are within the normal fluctuation range. For the restoration of the Room No. 108, which is the site of the accident, transfer of the storage container and the inside nuclear fuel materials, recovery of the scattered particles etc., detailed inspection on the state of contamination of the hood (H-1) and inside of the Room No. 108, and gradual decontamination are planned to be conducted, as well as the investigation into the causes of this accident. The dose evaluation of the five workers by bioassay etc. concerning internal exposure is being conducted at NIRS, and JAEA will cooperate in the dose evaluation. Also, JAEA will provide care to the exposed workers in cooperation with NIRS. (Refer to the attached file)
Cause of the accident	Under investigation.
Kind of safety devices and the state of their operation	No device.
Impact of radiation	The values indicated by the ventilation duct monitor of PFRF keep stable, and no impact on the environment has been confirmed so far. The situation will be continuously monitored.
Victim	The exposure dose of the five workers are under evaluation.

Other damage	No.
Date and time of recovery	Not yet determined.
Measures to prevent similar accidents	Based on the result of the investigation into the causes, prevention of similar accidents, dissemination and sharing of the information throughout JAEA, and other necessary measures will be taken.

Attachment

Report on

Contamination at Plutonium Fuel Research Facility

June 2017

Japan Atomic Energy Agency

1. Title: Contamination at Plutonium Fuel Research Facility (PFRF)

2. Date and time of the occurrence of the event:

Date and time: Tuesday, June 6, 2017; around 11:15

Date and time of decision: Wednesday, June 7, 2017; 13:00

- Judgement that the workers' exposure levels exceed or may exceed the 5 mSv, the level at which report is required
- Possibility of the surface density of the floor, etc. of the analyzing room of PFRF (mentioned below) exceeding the level of the restriction area designated in the operational safety program (alpha nuclide: 4 Bq/cm^2)

3. Place of the occurrence of the event:

Plutonium Fuel Research Facility

Oarai Research and Development Center (north zone)

Japan Atomic Energy Agency

4. Situation

4.1 Background to the occurrence of the event

At PFRF (Attachment 1 and Fig.1), in response to the improvement request in the direction from the Nuclear Regulation Authority (NRA) issued in February 2017 ("Points confirmed in the safety inspection concerning long-term storage using glove box, etc. of nuclear fuel materials in use facilities" dated January 15, 2017), work concerning the improvement of inappropriate management of nuclear fuel materials (work for storing in the storage facility the nuclear fuel materials temporarily stored in glove boxes etc. supposing they were being used, and dispose of them in the disposal facility) (hereinafter "improvement work") were being carried out. As part of this improvement work, based on the application for licensing use and change of nuclear fuel materials, inspection work of plutonium/enriched uranium storage container (hereinafter "storage container" (Fig. 2) was being conducted with a hood (H-1). In the storage container, a container encapsulated in vinyl bags (hereinafter "resin bags") were stored (The resin bags were supposed to keep closed). The position of the inspection work with the hood is shown in the Attachment 2. During the work, the workers wore necessary protections (special working clothes, special work cap, cotton gloves, double rubber gloves, half-faced mask, shoe covers, IR work shoes, arm covers required for workers engaged in work with a hood: Fig.3) following the radiation work slip etc. which examines safety measures etc.

The situation of the inspection work of the storage container is shown in the Attachment 3.

4.2 Situation at the time of the occurrence of the event

(1) The event

Around 11:15, June 6, 2017, in the hood (H-1) (Fig. 5) of an analyzing room in PFRF (in a controlled area) (hereinafter "Room No. 108" Fig. 4), resin bags encapsulating a container of nuclear fuel materials that the storage container contained burst during the inspection work of the storage container. As a result of a contamination check conducted in the Room No. 108 using surface contamination test meter of α-ray, all the five workers were confirmed to be contaminated. The location of the five workers (Worker A～E) when the event occurred is indicated in Fig. 6.

Below is the situation at the time of the occurrence of the event.

When the Worker E slowly removed the four of the six bolts fastening the container diagonally and then loosened the other two, he heard hiss like the one made when gas comes out. He collected the smear from the lid and all the circumferences of the gaps and confirmed that there was no contamination. Because in the past air came out in the situation where the room temperature was high, and no smear contamination was confirmed, the Worker E decided to continue work. When the Worker E removed the remaining two bolts holding the lid with one hand, the resin bags burst. Then he put the lid in the hood. At the time of the burst, the Worker E sensed wind pressure in the stomach, and all the other workers heard the sound of burst. Mist-like leakage was observed coming from the burst container. Though wearing a mask, the Worker E confirmed no abnormal odor. Though wearing rubber gloves, he touched the metal container and confirmed no rise of temperature.

Among 80 storage containers, the inspection work had been completed with 30 by the time the event occurred (The inspection work of 28 storage containers was conducted by the previous day. On June 6, 2017, inspection work was carried out for four storage containers including two for which inspection work had once been conducted and second inspection was conducted on that day). The event occurred during the inspection work of the thirty-first storage container.

In the interview, it was confirmed that the workers took photos before and after the occurrence of the event of the storage container in the hood, and therefore on June 14, 2017, the recording media (SD card) inside the digital camera was taken from the

controlled area, and images were confirmed (Attachment 5).

(2) Situation of radiation and contamination at the site of the event

After the occurrence of the event, in order to prevent the expansion of the contamination, a greenhouse[1] (Fig. 7) was set at the entrance of the Room No. 108 to the side of the corridor and the gaps at the emergency exit of the Room No. 108 to outside of the building were sealed up from outside. The sealed place is shown in Fig. 8.

The values indicated by the monitoring posts and the ventilation dust monitor of PFRF stayed unchanged before and after the occurrence of the event. The trend of the values indicated by the monitoring post nearest to PFRF (P-2) and the ventilation dust monitor of PFRF is shown in Fig. 9 and 10. With regard to the concentration of radioactive materials in the air of the site of occurrence, the value indicated by the dust monitor No.2 (inside the Room No. 108) (hereinafter "Pu dust monitor") at the time of the occurrence of the event was within the normal fluctuation range. At 13:55, June 6, 2017, the value indicated by the monitor rose to 5×10^{-8} Bq/cm^3 (average concentration of one week)[2], but there was no rise in the value subsequently. This value is lower by one digit than the air concentration limit of Pu-239 designated by the law (7×10^{-7} Bq/cm^3). As a result of replacement of the dust filter of the Pu duct monitor, decline of the value to within the normal fluctuation range was confirmed. Since then the value has been within the normal fluctuation range. the trend of the values indicated by the Pu dust monitor is shown in Fig. 11.

Based on the result of the body contamination test conducted when the workers moved from the Room No. 108 to the greenhouse, the Room No. 108 was designated as a restriction area at 16:27, June 16, 2027.

With regard to the surface concentration of the Room No. 108, levels of contamination of 55 Bq/cm^2 (α ray) and 3.1 Bq/cm^2 (β (γ) ray) at a maximum were confirmed at 18:55 by the measurement of the floor conducted June 7, 2017. It was confirmed that there is no contamination in the corridor in front of the Room No. 108, which is in a controlled area, and the outside of the emergency exit of the Room No. 108, which is exterior of the building.

The placement of radiation control monitors at PFRF, the system diagram of ventilation duct monitor and room Pu dust monitor, and the ventilation system at PFRF

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[1] The greenhouse is a structure built at the work area in association with decontamination work for the purpose of preventing expansion of contamination. The frame of pipes are covered with plastic sheets or, as necessary, flame resistant sheets.

[2] Concentration limit in the air designated by laws and regulations (Pu-239): 7×10^{-7} Bq/cm^3

are shown, respectively, in Fig. 13, 14 and 15.

Photos of the hood (H-1) after the occurrence of the event (taken on June 7, 2017) are shown in Fig. 16. Particles assumed to have scattered from the storage container were confirmed on the floor in front of the hood (H-1). Currently, the storage container is covered with a lid and placed in the hood (H-1) shut with sliding glass doors. The storage container is monitored with TV camera through the glass doors of the hood (H-1). (Fig. 17)

(3) Situation of the workers' contamination and exposure

At 14:30, June 6, 2017, the workers started to exit the Room No. 108 to the greenhouse. By the body contamination test conducted in the greenhouse when they left the room, contamination was confirmed in the special work clothes, etc. of the five workers (more than 322 Bq/cm^2 (α-ray) at a maximum; Table 1 and Attachment 6), and skin contamination and nasal cavity contamination were confirmed respectively among four and three of the workers. Before the workers with skin contamination left the controlled area, they were decontaminated in the shower room installed inside the controlled area and underwent inspection to confirm the dose level was lowered below the detection limit. Three of the five workers wore pocket dosimeters, which are auxiliary dosimeters, and the values indicated by them were 2 μ Sv (Worker B), 3 μ Sv (Worker D) and 60 μ Sv (Worker E). The five workers were transferred to Nuclear Fuel Cycle Engineering Laboratories, and as a result of the measurement conducted there using lung monitor, 2.2×10 Bq[4] and 2.2×10 Bq[2] were confirmed, respectively, with regard to Pu-239 and Am-241 at a maximum (Table 2 and Attachment 7). Therefore, with cooperation of the National Institute of Radiological Science (hereinafter "NIRS"), injection of chelating agent (Ca-DTPA)[3] was carried out aiming to prompt egestion of ingested Pu etc. On June 7, 2017, the five workers were transferred to NIRS and underwent treatment including decontamination of the body surface and measurement using lung monitor. JAEA received a report from NIRS on June 12, 2017 to the effect that as a result of the measurement using lung monitor, no obvious energy peak was confirmed with regard to plutonium and that there were people with whom energy peak was confirmed with regard to americium based on the measurement data, but the level was declining. On June 13, 2017, the five workers were discharged from NIRS. Their state of health is normal and they are under treatment following the instruction of the

[3] Chelating agent is a compound that can make coordinate bond holding a metal ion in the center. Pentetic acid calcium trisodium (Ca-DTPA) works to reduce body contamination by transuranic elements (Pu, Am, etc.).

doctors. The dose evaluation of the five workers by bioassay etc. concerning internal exposure is being conducted at NIRS, and the Japan Atomic Energy Agency (hereinafter "JAEA") will cooperate in the dose evaluation.

Occurrence of the event in chronological order is shown in the Table 3.

4.3 Situation concerning report required by laws and regulations

As based on the fact that 2.2×10 Bq[4] and 2.2×10 Bq[2] were confirmed, respectively, with regard to Pu-239 and Am-241 at a maximum through the measurement of the five workers using lung monitor, their levels of exposure exceeded or might exceed 5 mSv, the level at which report is required in the event of unplanned exposure of radiation workers entering a controlled area, and also there was a possibility that the surface density of the floor etc. of the Room No. 108 exceeded the level of the restriction area designated in the operational safety program (alpha nuclide: 4 Bq/cm^2), it was judged at 13:27, June 7, 2017 that this accident is an event of which report is required by laws and regulations based on the provision of the Article 62 – 3 of the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors. The report on the above was made to the Nuclear Regulation Authority at 13:27.

5. Environmental impact

At the time of the occurrence of the event, the ventilation system of PFRF continued operation to maintain the normal negative pressure in the controlled area, and values indicated by the monitoring posts and the ventilation dust monitor of PFRF were within the normal fluctuation range. Therefore, there is no impact on the environment caused by this event. (Fig.11 and 12)

6. Situation of the investigation into causes

In tandem with the investigation of the past records on the situation of the nuclear fuel materials (kind, chemical form, use history, etc.) stored in the storage container, listing phenomena that can cause burst of resin bags and preliminary examinations of their impact have been started, and plans for the investigation into causes are being mapped out.

With regard to the causes of the internal exposure and the impact, necessary investigation and confirmation items such as detailed contamination situation of the room, nuclide and chemical form of the scattered nuclear fuel materials etc., residual contamination of the half-faced masks the workers wore are being listed.

Elements in work management (work procedures, facilities, equipment, etc.) that

led to the occurrence of this event will be analyzed.

7. Measures (planned actions)

As mentioned in 4.2 (2), the storage container is now covered with lid and placed in the hood (H-1) shut with sliding glass doors. The storage container is being monitored though the glass doors of the hood (H-1) by TV camera. Entry to the Room No. 108 is continuously restricted, a greenhouse was set at the entrance of the room to the side of the corridor, and the gaps at the emergency exit from the room to the outside of the building were sealed up. Thus measures have been taken to prevent the expansion of contamination. The ventilation system of PFRF continuously operates as ever after the occurrence of the event to keep the normal negative pressure in the controlled area. The fluctuation of the values indicated by the ventilation dust monitor of PFRF and Pu dust monitor are within the normal range (Fir. 11, 12 and 13). Accordingly, no impact to the outside of the facility has been confirmed so far.

In response to the occurrence of this event, while the principle of putting safety first is being ensured all over JAEA, the similar work using nuclear fuel materials is suspended (Attachment 8).

For the restoration of the Room No. 108, which is the site of the accident, transfer of the storage container and the inside nuclear fuel materials, recovery of the scattered particles etc., detailed inspection on the state of contamination of the hood (H-1) and inside of the Room No. 108, and gradual decontamination are planned to be conducted. All the work concerning the restoration of the Room No. 108 will be carried out paying sufficient attention to safety and recording the situation of contamination etc.

With regard to the storage containers of which inspection work has not yet been conducted, measures will be taken to ensure safe storage method.

Response required by safeguard in association with the occurrence of the event will be considered and appropriate measures will be taken in consultation among organizations concerned.

Verification of manuals and procedures concerning the inspection work conducted during the occurrence of the event and chronological analysis and vilification of process up to the exit of the workers from the controlled area and response after the occurrence of the event including dissemination to the outside of information will be implemented.

Not only Oarai Research and Development Center, the site of the event, the entire JAEA will launch full-scale effort to move forward with the above mentioned actions.

The dose evaluation of the five workers by bioassay etc. concerning internal

exposure is being conducted at NIRS, and JAEA will cooperate in the dose evaluation. Also, JAEA will provide care to the exposed workers in cooperation with NIRS.

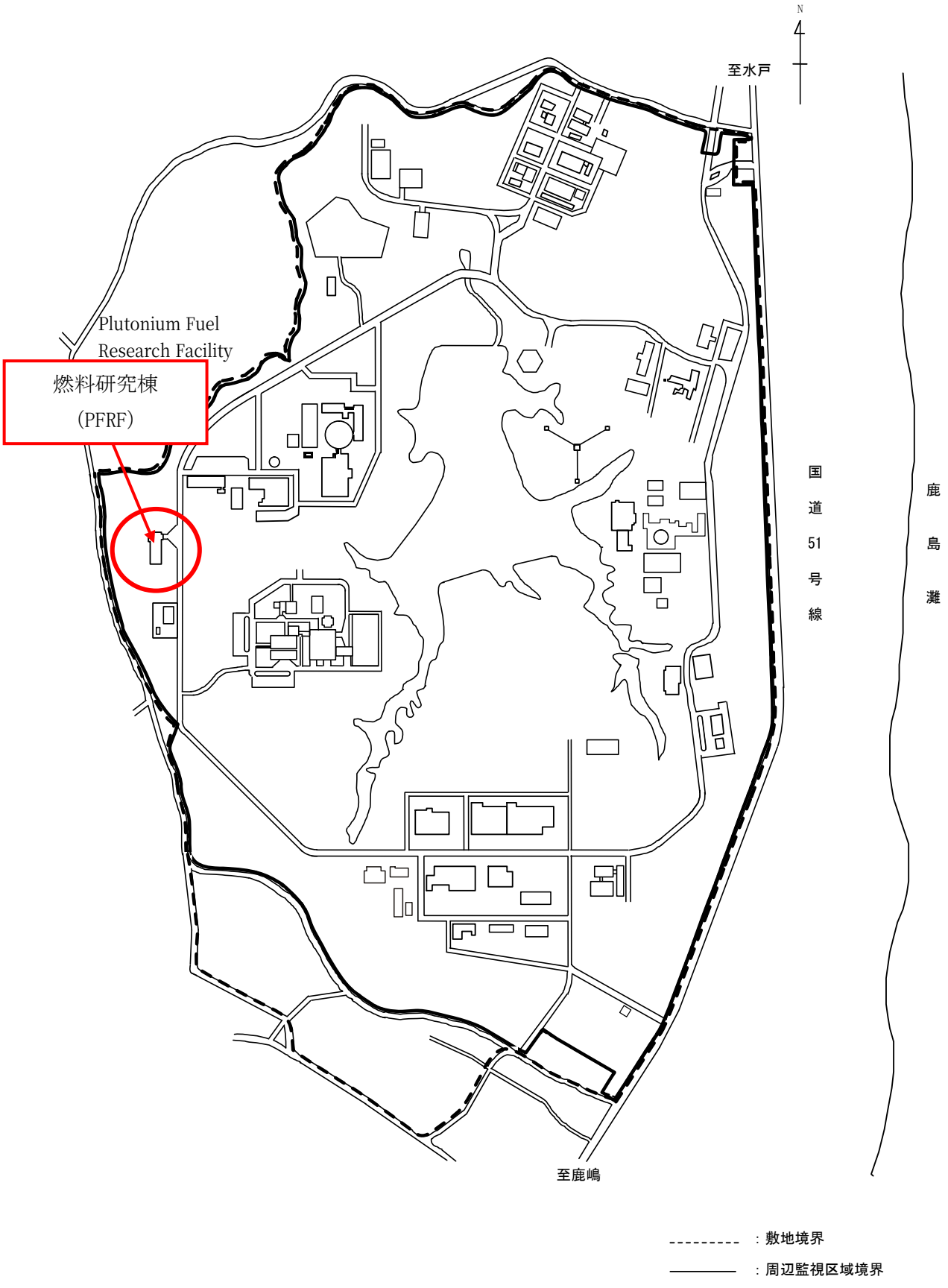


図１　大洗研究開発センター施設配置図

Fig.1　Facility layout of Oarai Research and Development Center

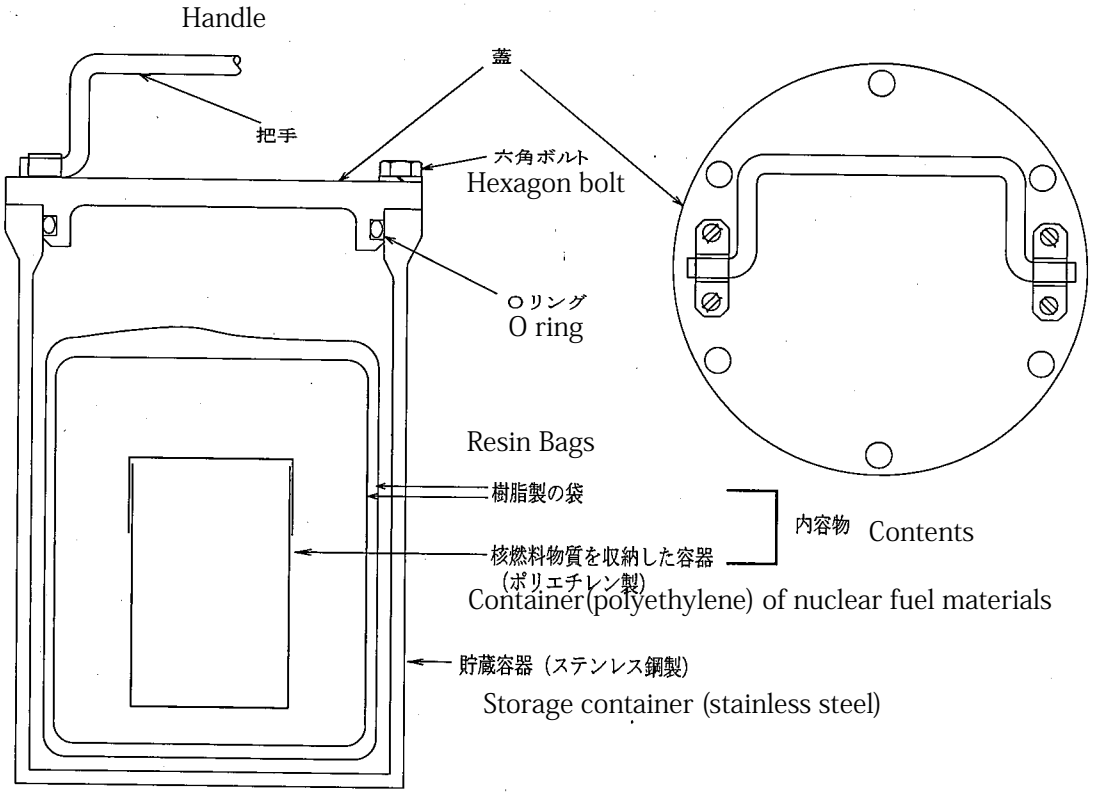


図2　プルトニウム・濃縮ウラン貯蔵容器の構造と内容物

Fig.2 Structure and contents of Plutonium and enriched Uranium storage container

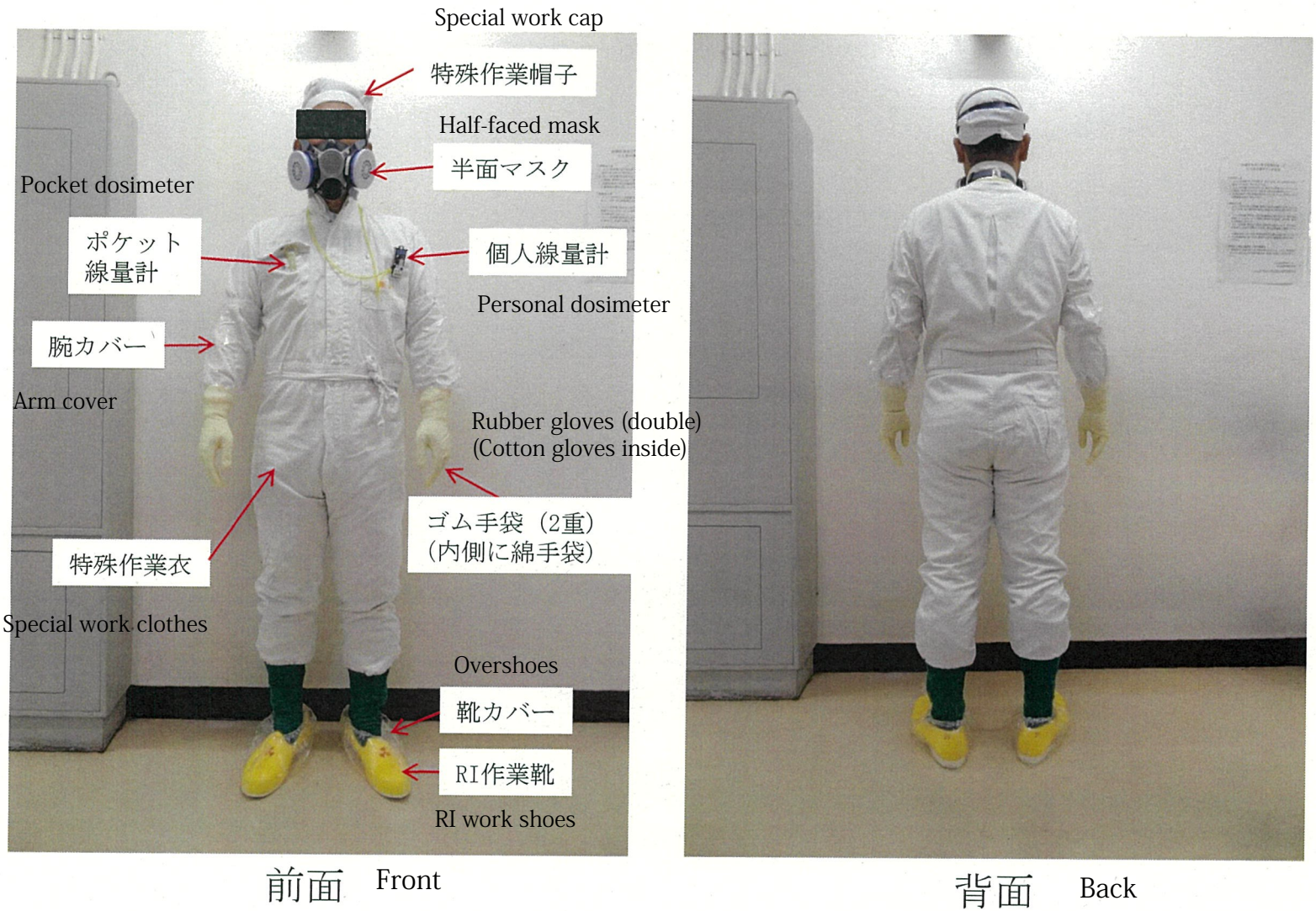
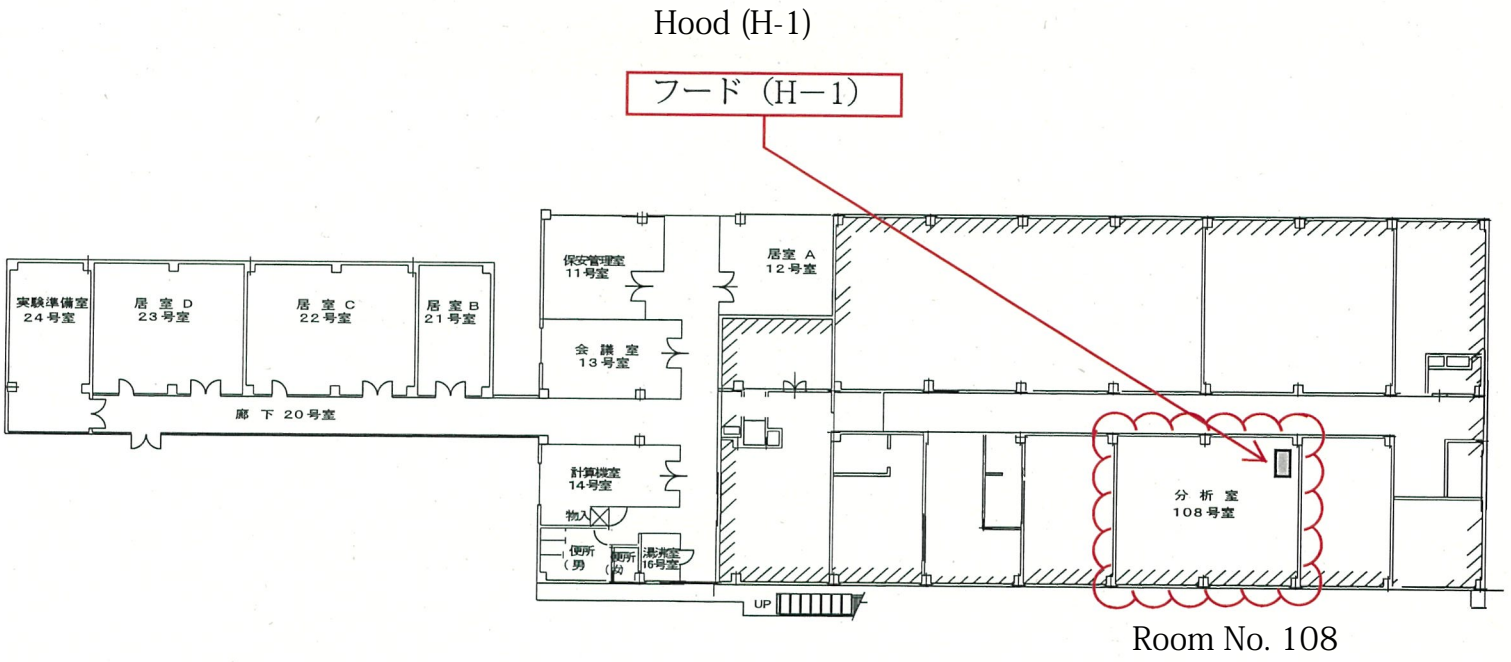


図3　事象発生時の作業員と同等の防護具を装着した状態

Fig. 3 The same protective gear which the workers put at the time of the incident occurrence

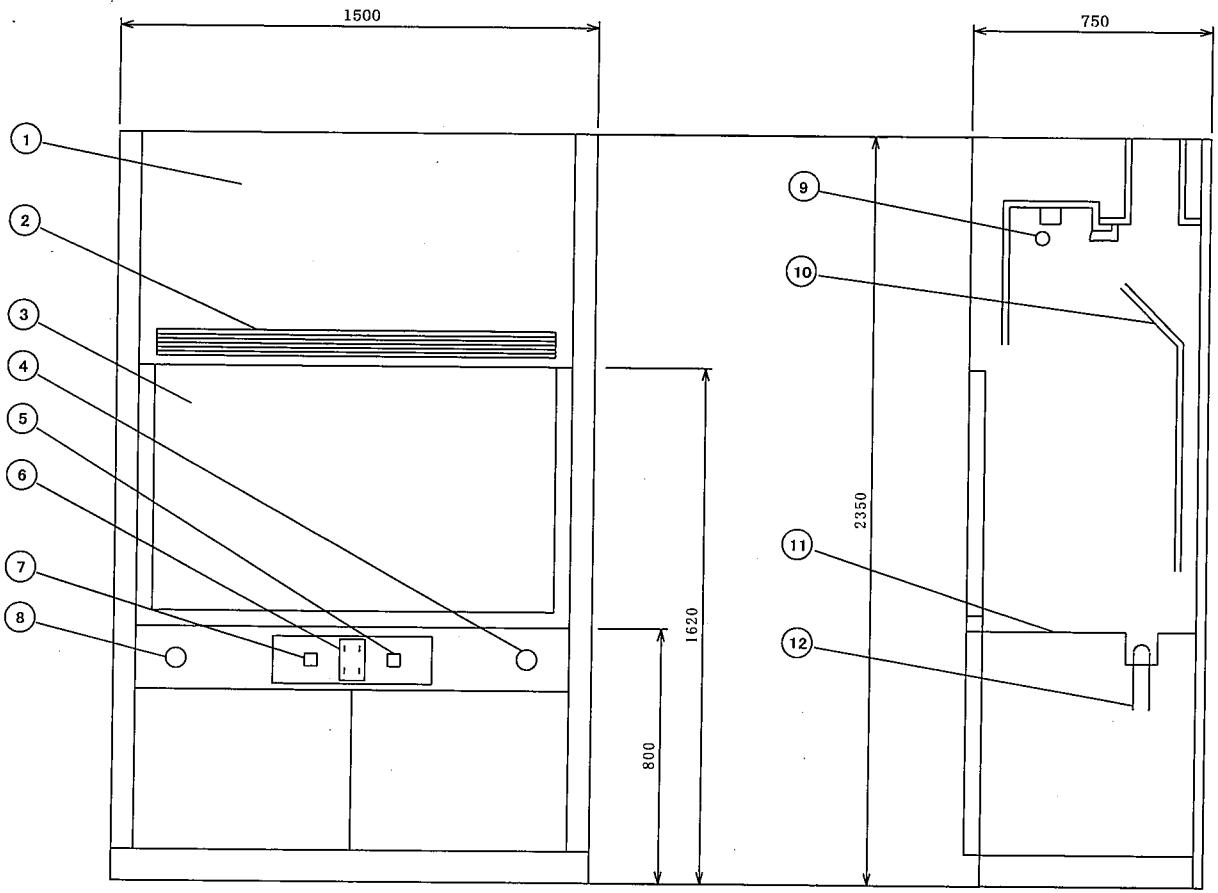


1 階 平 面 図
1F Plane view

斜線部は管理区域境界を示す。
Shaded line shows the boundary of controlled area.

図4　燃料研究棟平面図

Fig.4 Plane view of PFRF



番号	部 品 名 称
①	本 体
②	給気ギャラリ
③	スライド式ガラス窓
④	ガスハンドル
⑤	蛍光灯用スイッチ
⑥	電源コンセント
⑦	電源用表示ランプ
⑧	給水ハンドル
⑨	蛍 光 灯
⑩	バッフルプレート
⑪	鉛張り流し
⑫	排 水 管

（単位; mm）

1 Body
2 Air supply gallery
3 Sliding glass window
4 Gas handle
5 Fluorescent lamp switch
6 Power outlet
7 Power indicator lamp
8 Water supply handle
9 Fluorescent lamp
10 Baffle plate
11 Sink covered with lead
12 Drain pipe

図5　フード（H−1）概略図

Fig.5 Outline of hood (H-1)

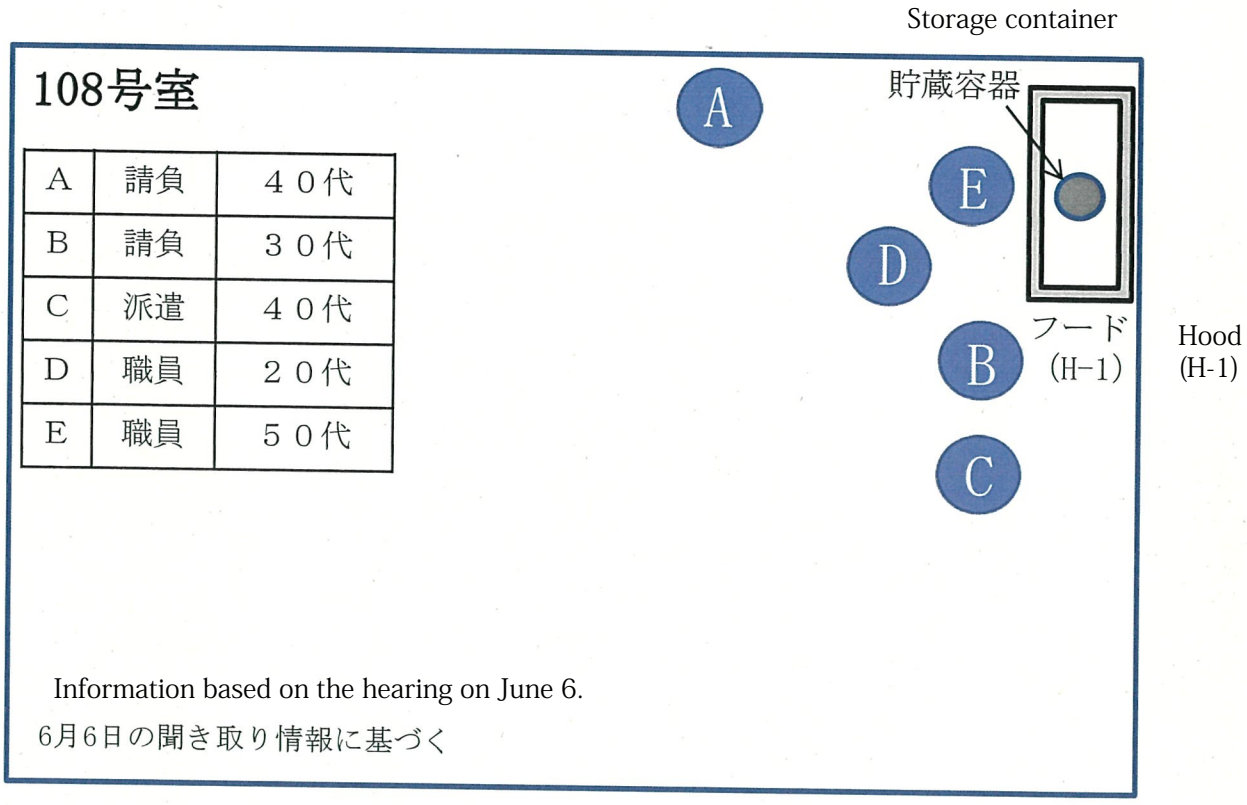


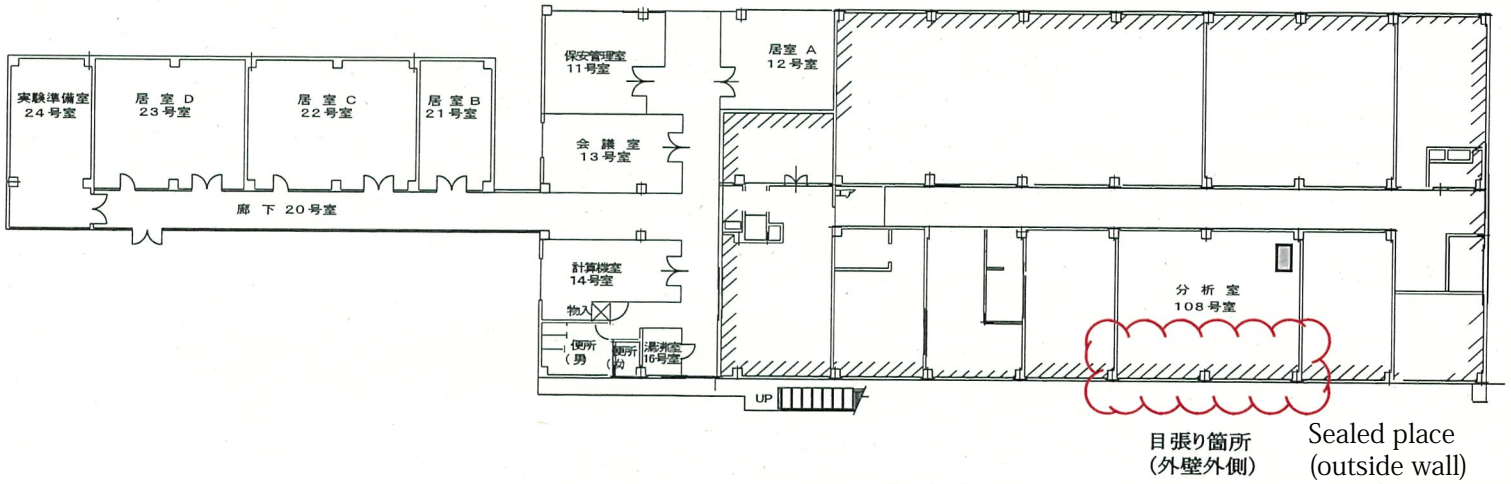
図6　108号室における事象発生時の作業員5名の位置関係

Fig.6 Location of the five workers in Room No. 108 at the incident occurrence

A	Contract-based worker	40's
B	Contract-based worker	30's
C	Temporary-worker	40's
D	JAEA staff member	20's
E	JAEA staff member	50's

図７　グリーンハウス

Fig.7 Greenhouse



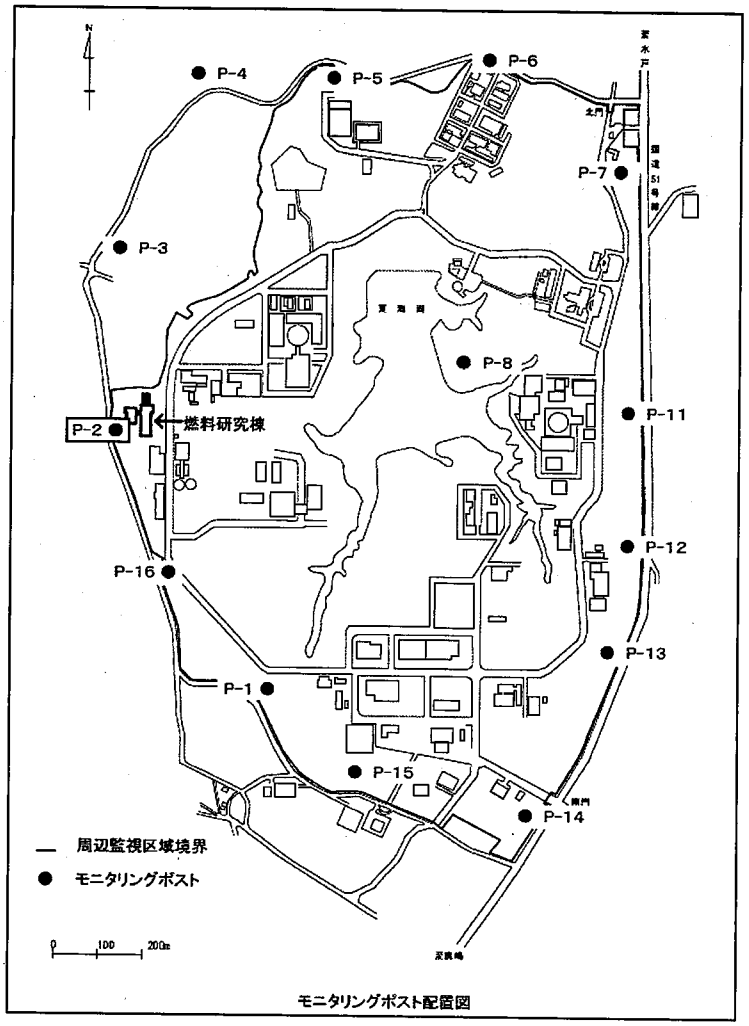
1階平面図
1F Plane view

斜線部は管理区域境界を示す。

Shaded line shows the boundary of controlled area.

図8　目張り箇所

Fig.8 Sealed place



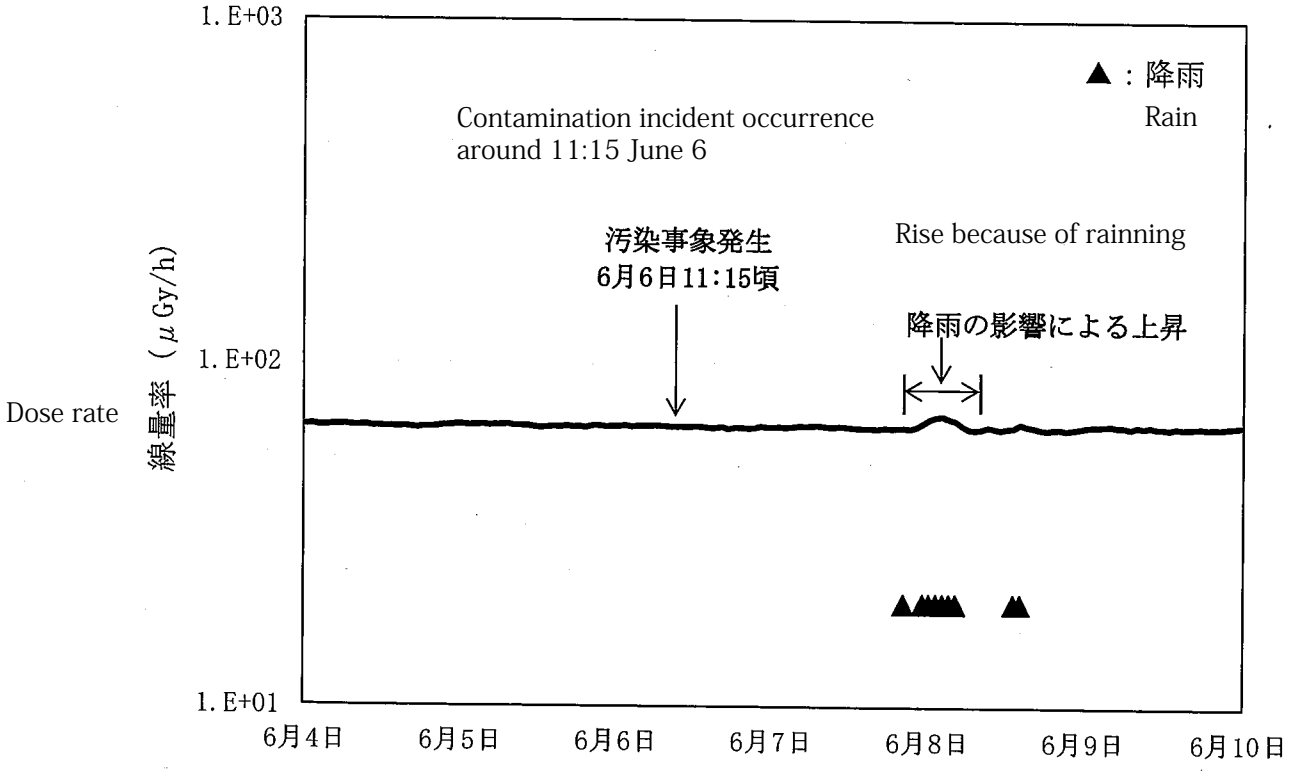


図9　モニタリングポスト（P-2）指示値のトレンド

Fig.9 Indicated value trend of monitering post (P-2)

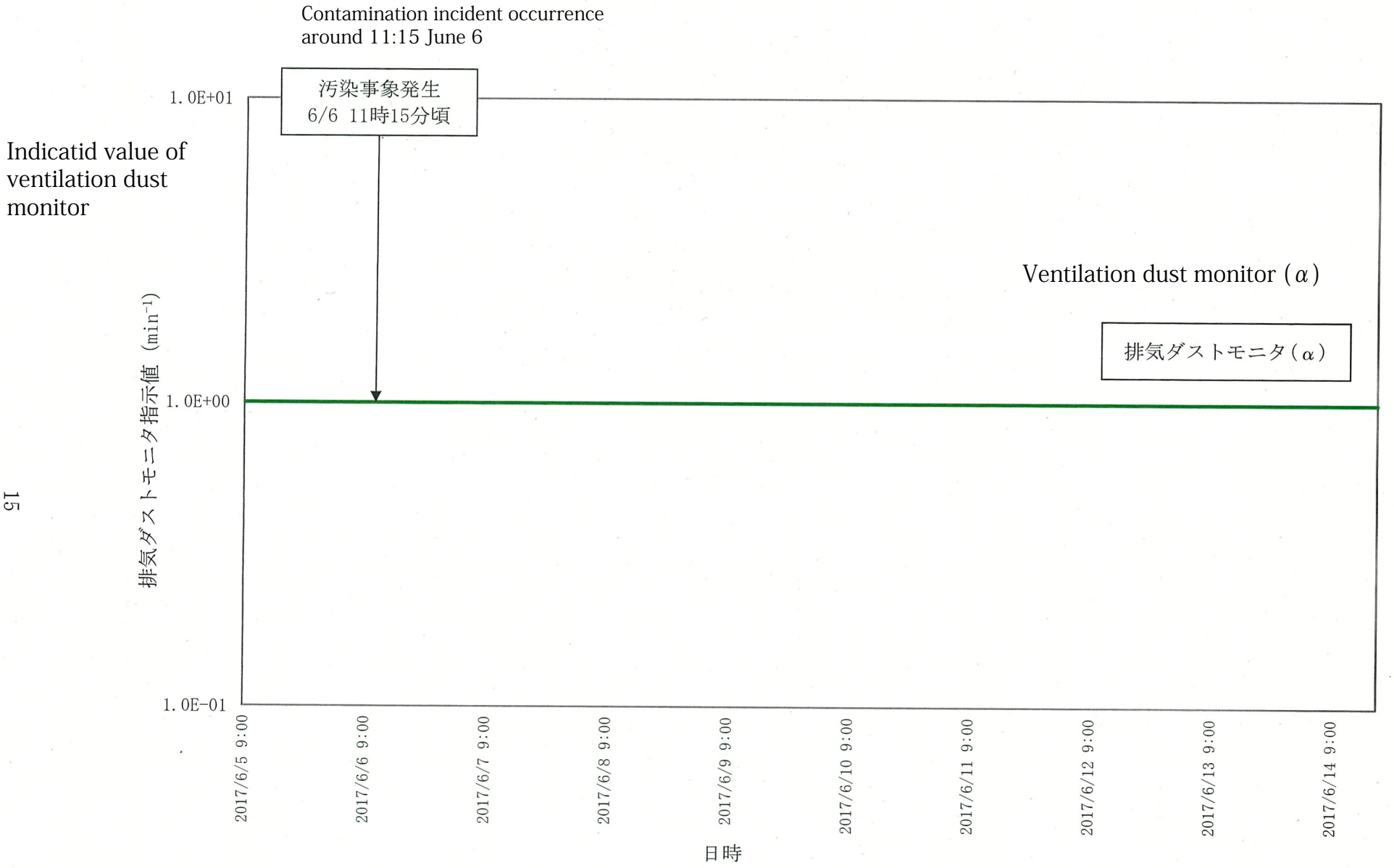


図10　燃料研究棟の排気ダストモニタ指示値のトレンド

Fig.10 Indicated value trend of ventilation dust monitor at PFRF

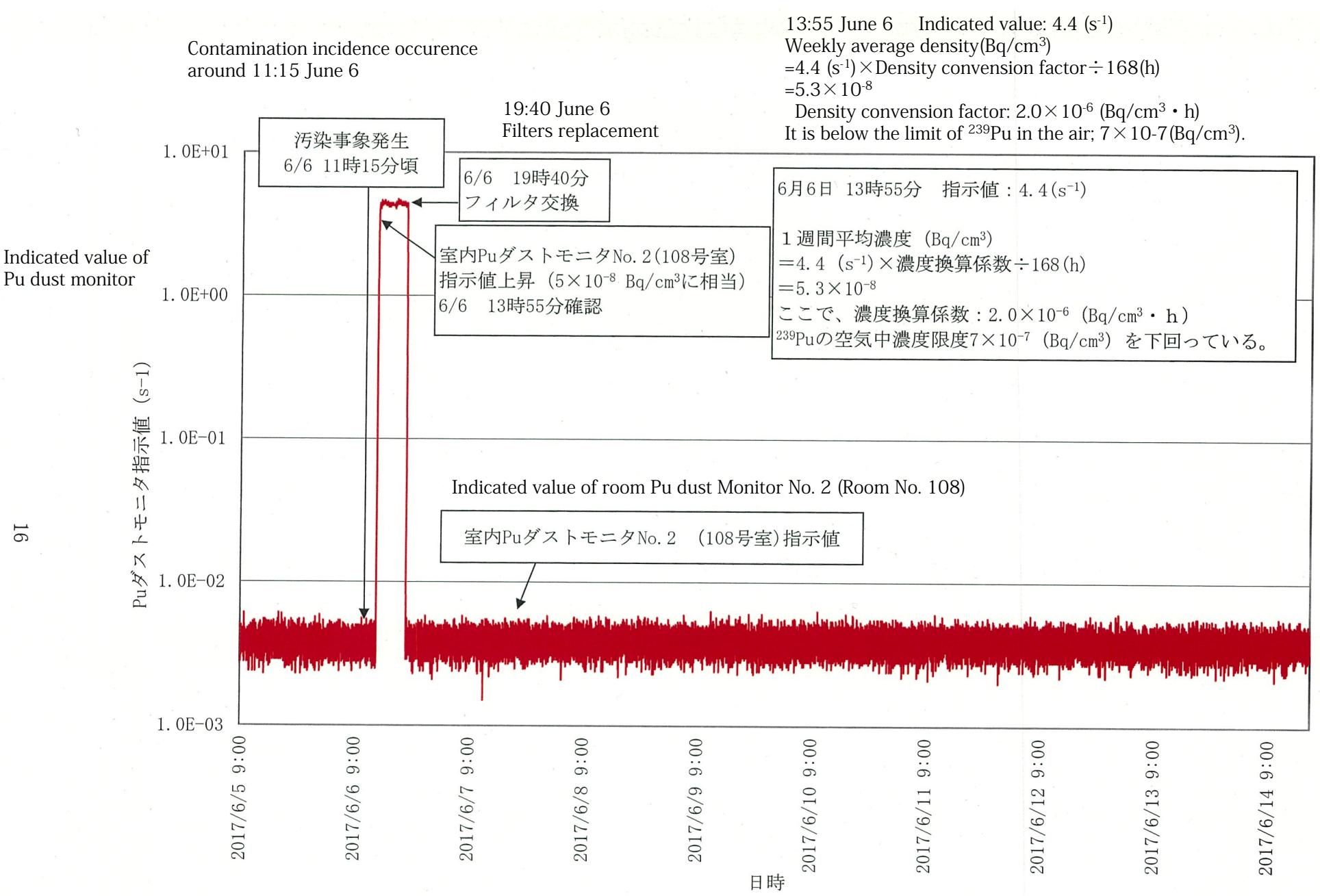
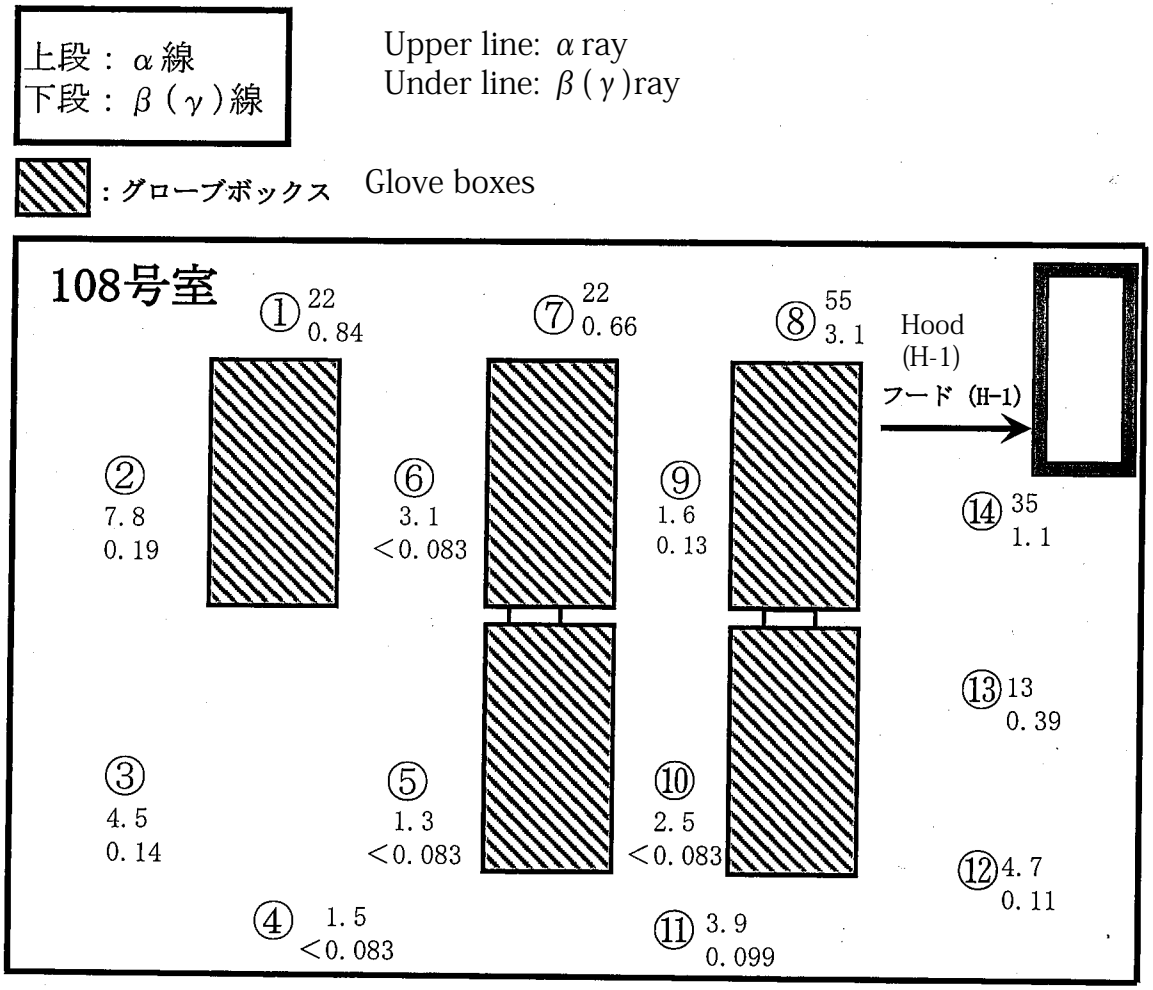


図11 燃料研究棟の室内Puダストモニタ No. 2 (108号室) 指示値のトレンド

Fig.11 Indicated value trend of room Pu dust monitor No.2 (Room No. 108) at PFRF

Room No. 108



表面密度測定記録	
建家名	燃料研究棟
測定日時	平成29年6月7日　18：36～18：55
測定線種	■α線　■β（γ）線
測定器	Next page 放射能計測装置 （ ES-7284 ）
測定方法	スミヤ法
単　位	Bq/cm²
測定条件	拭取効率：10%
備考	
記　事	①～⑭：測定ポイント

図12　表面密度測定結果

Fig. 12 Measurement results of surface density

Surface Concentration Measurement Records	
Building	Plutonium Fuel Research Facility
Measurement Date and Time	18:36 – 18:55, June 7, 2017
Measurer	
Ray type for measurement	☑ α ray ☑ β (γ)ray
Measuring Instrument	Radioactivity Measurement Device (ES-7284)
Measuring Method	Smear
Unit	Bq/cm^2
Condition of measurement	Wiping effect: 10%
Remarks	(No) : Measuring Points
Notes ①～⑭ : Measuring Points	

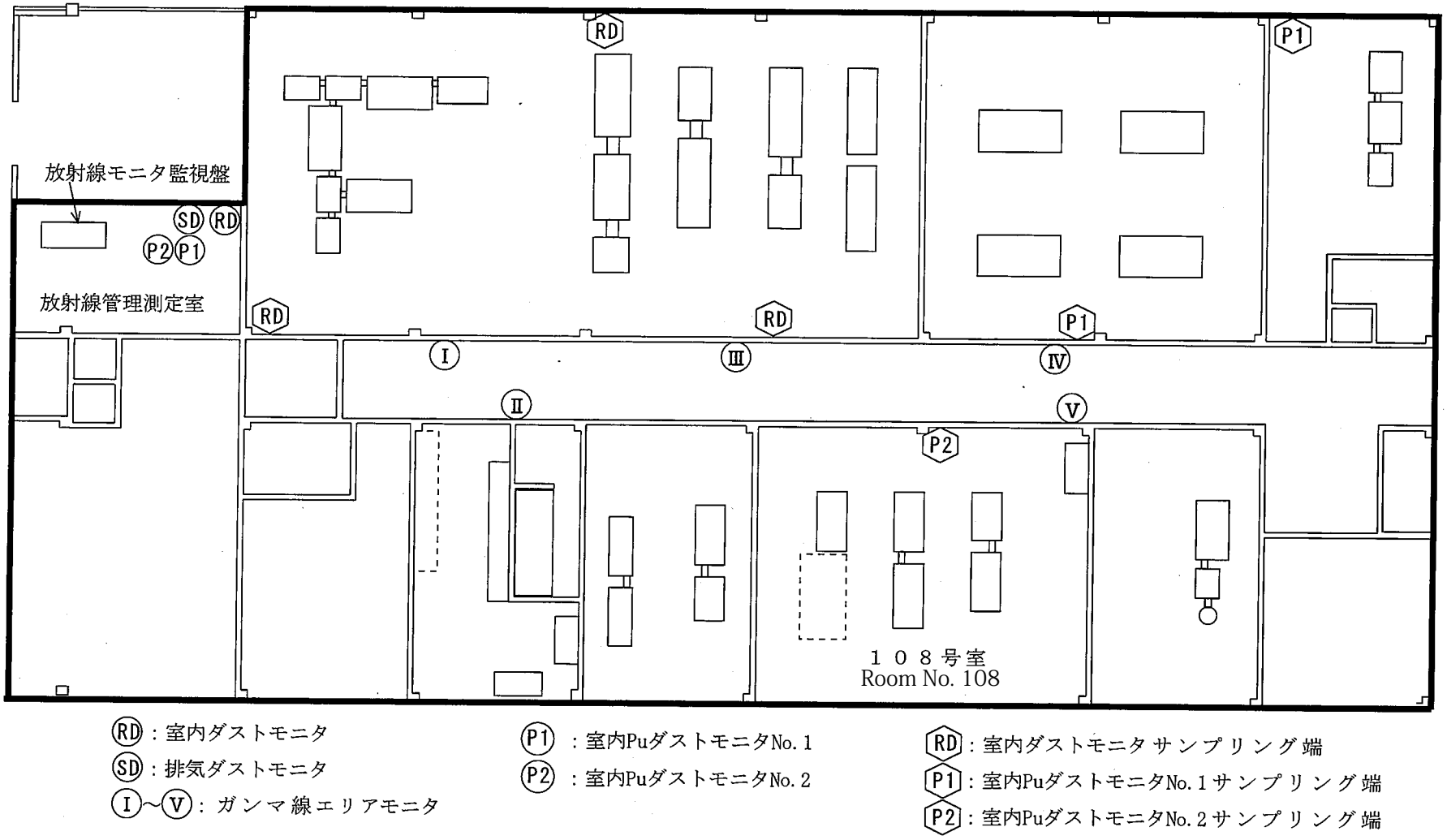


図１３　燃料研究棟の放射線管理モニタの配置図

Fig.13 Placement of radiation control monitors at PFRF

RD: Room dust monitor
P : Pu dust monitor
SD: Ventilation dust monitor
I～V: γ ray area monitor

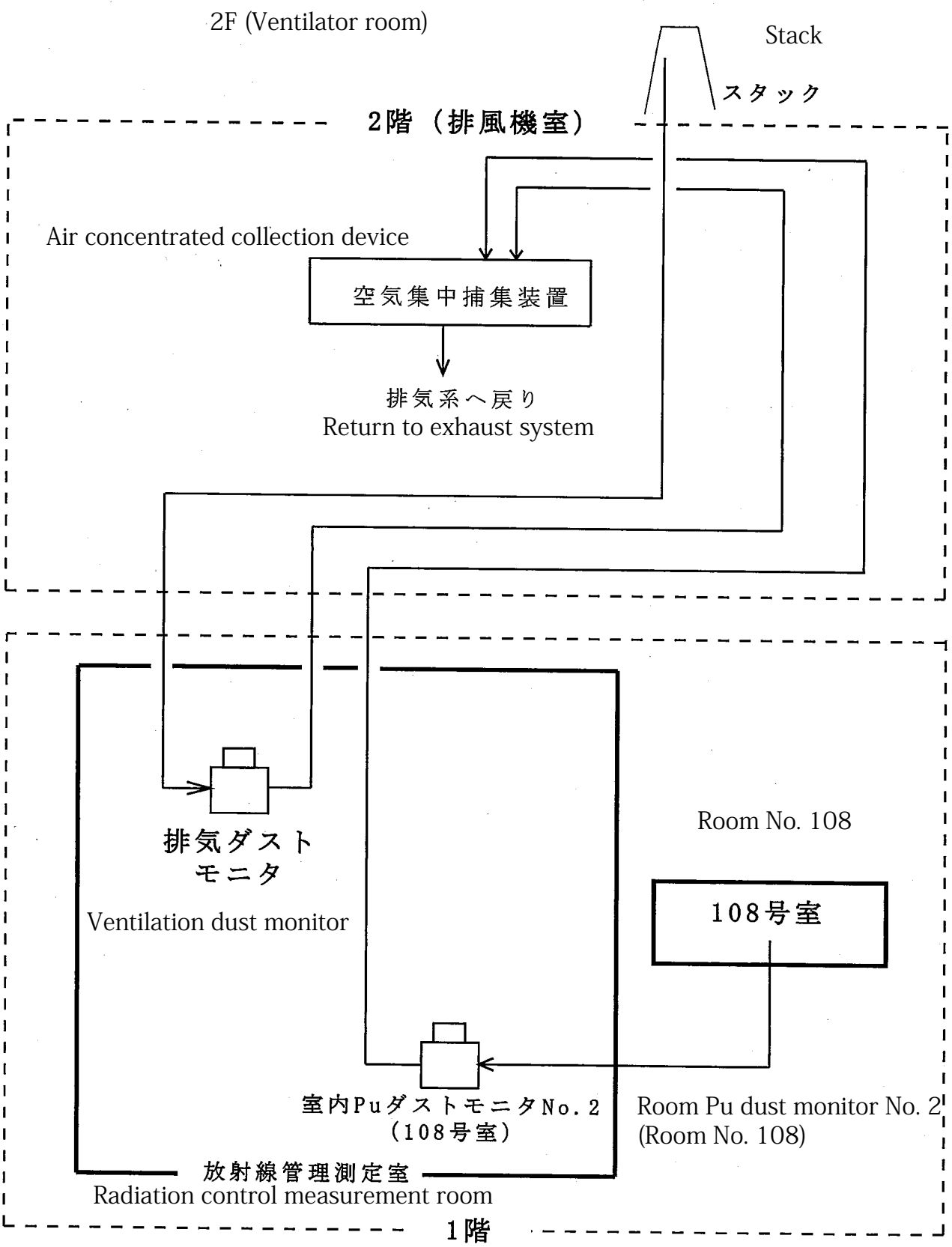


図14　燃料研究棟の排気ダストモニタ及び
室内Puダストモニタ No. 2（108号室）の系統図

Fig. 14 System diagram of ventilation dust monitor and room Pu dust monitor No.2 (Room No. 108)

※排気第1系統は2系統あり、1系統は予備である。
H29/6/6(火)は排気第1-2系統が運転されていた。

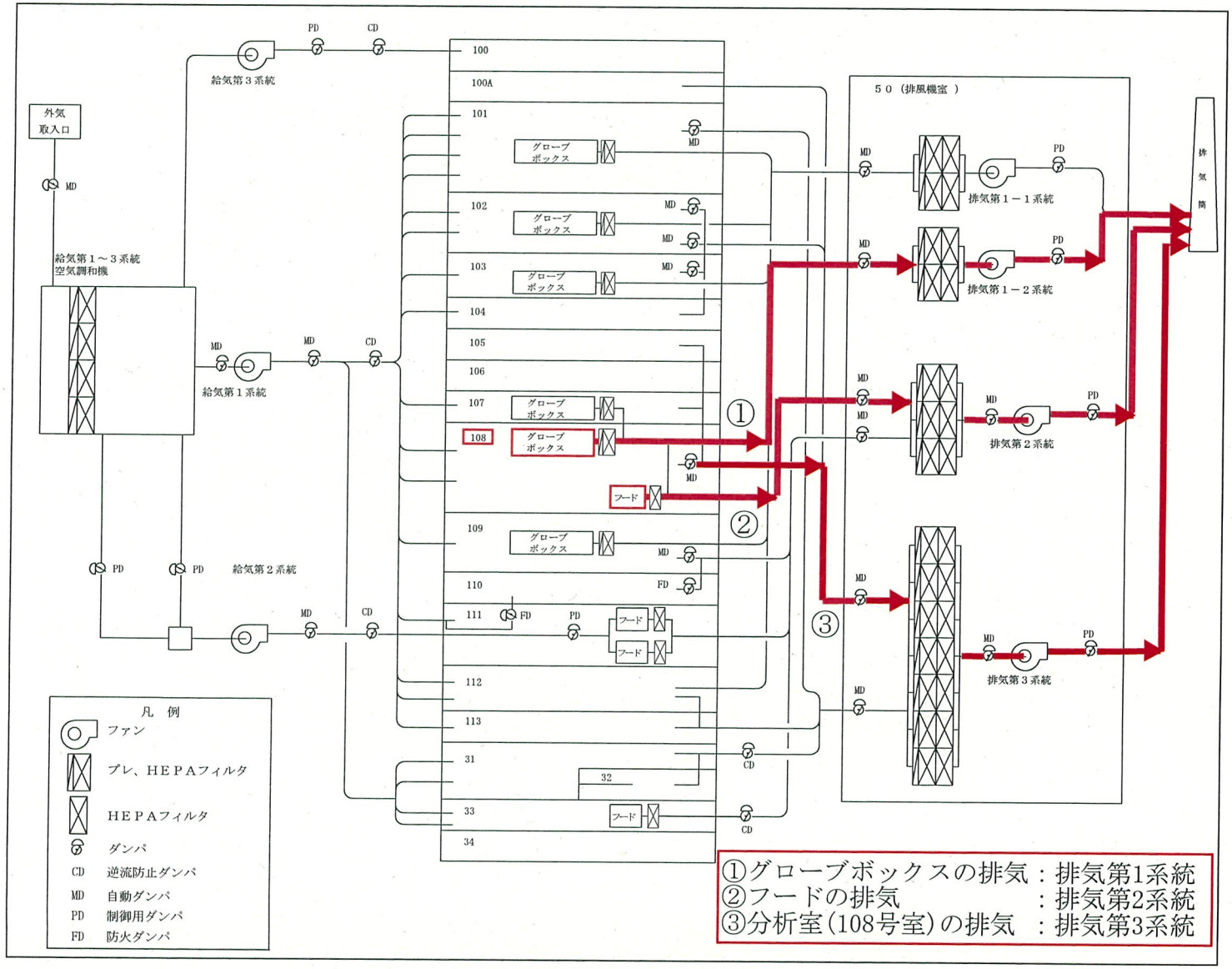
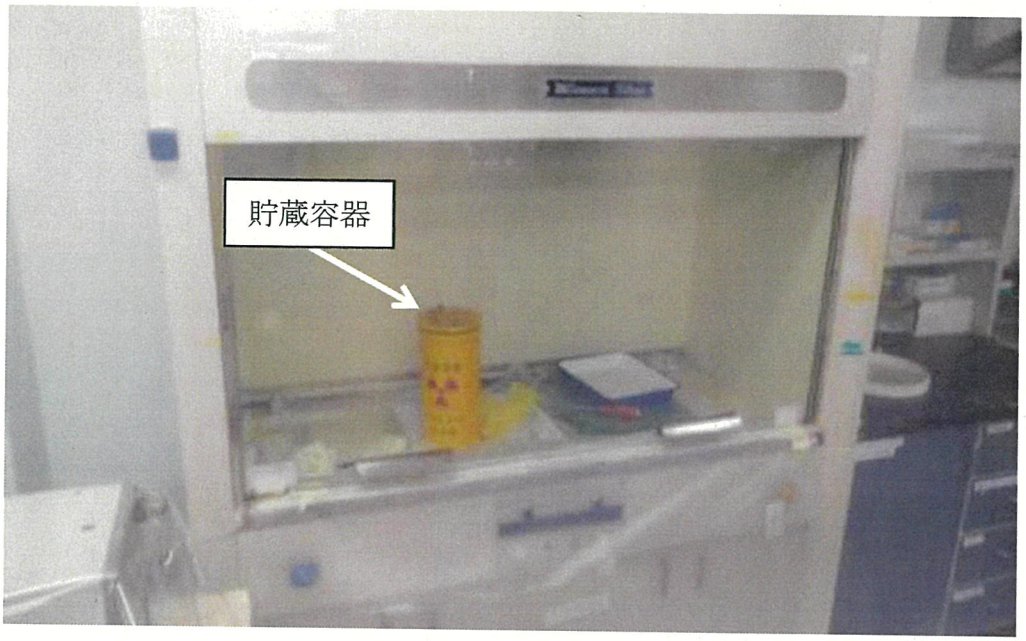


図15　燃料研究棟の排気系統図

Fig. 15 Ventilation system at PFRF

①1st system: Ventilation of glove boxes
②2nd system: Ventilation of hoods
③3rd system: Ventilation of Room No. 108

Storage container



フード内

Inside the hood

フード前床

Floor in front of the hood

(H29. 6. 7 撮影)

Photos taken on June 7, 2017

図 16　事象発生後のフード（H-1）周辺

Fig. 16 Situation around the hood (H-1) after the incident occurrence

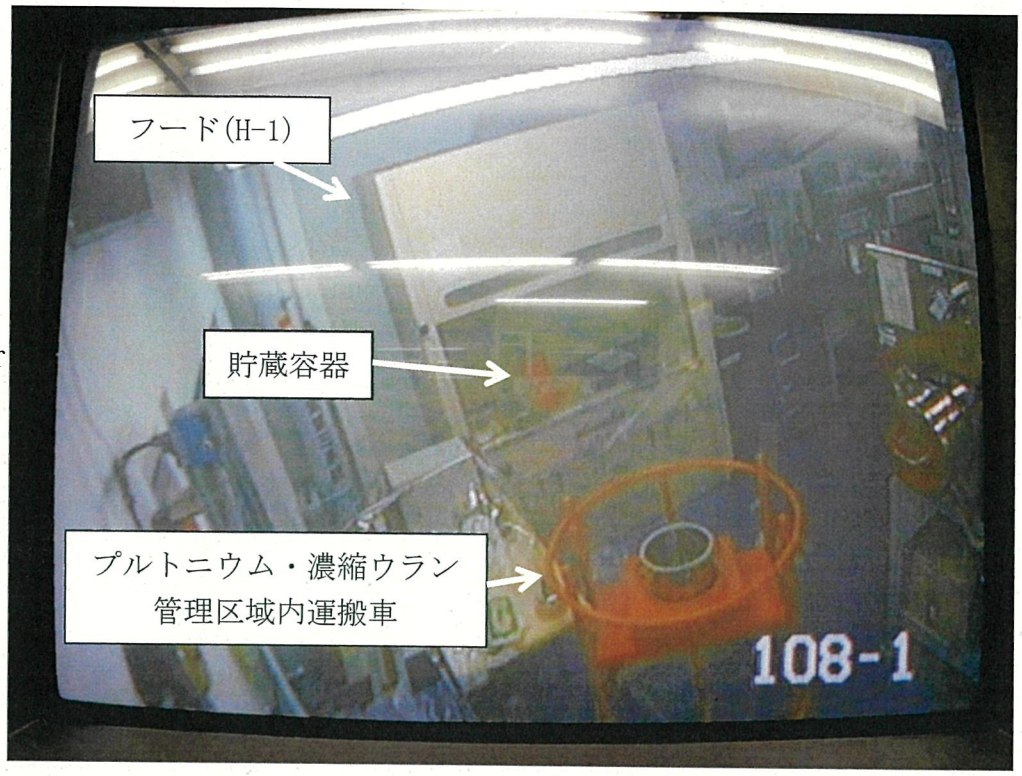


図 17　TV カメラによる貯蔵容器の監視

Fig. 17 Continuous monitoring of the storage container by TV camera

Table 1　Intranasal Contamination Check Result

Worker	α radioactivity (Bq)
A	N/A
B	N/A
C	13
D	3
E	24

*　Measuring instrument and result for this intranasal contamination check are shown in Attachment 6.

Table 2　Measuring Result of Lung Monitor
at Nuclear Fuel cycle Engineering Laboratories

(June 6, 2017)

Worker	Radioactivity (Bq)	
	Pu-239	Am-241
A	$< 2.2\times10^{3}$	$< 7.1\times10^{0}$
B	$< 5.6\times10^{3}$	8.5×10^{0}
C	$< 6.0\times10^{3}$	1.2×10^{1}
D	$< 1.4\times10^{4}$	1.3×10^{2}
E	2.2×10^{4}	2.2×10^{2}

Note 1: "<" means no detection of radionuclides, that is, the nuclide is below the value. This value differs by amount of natural radionuclide in measured person's body, etc.

Note 2: The table values are as of June 6, and the values might be changed by future measurements.

Note 3: Specification and measuring methods of lung monitor are shown in Attachment 7.

Note 4: NIRS, QST announced about the measuring result of lung monitor on June 12, 2017, "Lung monitor measurements have been implemented 3-4 times. No clear energy peak of Plutonium can be confirmed for all by any measurement. Energy peak of Americium can be confirmed in measuring data of some persons though, the level is decreasing."

Table 3　Events in chronological order

Date	Time	Event
June 6, 2017	Around 11:15	During inspection work of storage container containing nuclear fuel materials (work with a hood (H-1)) in Room No. 108 (controlled area) at PFRF, it is confirmed the resin bag in the storage container was broken, and the possibility of radioactive contamination of five worker's bodies was confirmed. The five workers wore half-faced masks. They wore cloth gloves, rubber gloves①, rubber gloves② from inside in triplicate for the protection gloves for this work.
	Around 11:20	The worker in Room No. 108 requested to interrupt the operation of molten salt electrolysis furnace in Room No. 101 in the controlled area by telephone.
	Around 11:23	Worker A reported to the director of Fukushima Fuels and Materials Department who is the facility management supervisor on the occurrence of contamination by telephone.
	Around 11:25	Two staffs of the Radiation Safety Management Section II arrived at PFRF. The staff of Radiation Safety Management Section II confirmed Pu dust monitor No.2 (Room No. 108) indicated a normal value.
	Around 11:30	The section staff confirmed radiation monitor showed no abnormality.
	Around 11:35	The section staff (one of the two above) entered the controlled area.
	Around 11:37	The section staff confirmed no contamination in the corridor of the laboratory.
	Around 11:37	The 5 workers confirmed contamination of all members as a result of using an α ray surface contamination checker for themselves.
	Around 11:48	The facility management supervisor reported to the liaison in charge (the general manager of Emergency Management Section), and on-site Command Post was set.
	Around 11:54	The facility management supervisor directed setting a greenhouse in the corridor in front of Room No. 108.
	12:00	Values indicated by Pu dust monitor No.2 (Room No. 108) and ventilation dust monitor were normal.
	12:00	The Oarai on-site Response Headquarters was set up.
	12:20	Value indicated by monitoring post (P-2) is normal. No impact on the environment.
	12:22	Values indicated by Pu dust monitor No.2 (Room No. 108) and ventilation dust monitor were normal.

Date	Time	Event
June 6, 2017	12:23	Radiation Safety Management Section II was requested to enter the area to check contamination of the setting place of the greenhouse.
	12:27	FAX (the 1st report) was sent. → 12:52 FAX acceptance was confirmed.
	12:43	Greenhouse materials were ready.
	12:45	Preparation for carrying in greenhouse materials was started.
	12:52	One staff of Radiation Safety Management Section II and one staff of Alpha-Gamma Section entered the controlled area. They confirmed no abnormality on the workers' health condition.
	13:05	No contamination of walls etc. of Room No. 108 (outer boundary) was confirmed. Gaps were sealed.
	13:10	Values indicated by Pu dust monitor No.2 (Room No. 108) and ventilation dust monitor were normal.
	13:15	Five staffs (two from PFRF, three from other facilities) to construct the greenhouse entered the area, construction of the greenhouse at the entrance of Room No. 108 started.
	13:22	FAX (the 2nd report) was sent. → 13:40 FAX acceptance was confirmed.
	13:45	Additional staffs (one from Alpha-Gamma Section, one from another section) to construct the greenhouse entered the area.
	13:55	Rise in the indicated value of the "Pu dust monitor No.2 (Room No. 108)" was confirmed (circa 5×10^{-8} Bq/cm^3 (average concentration of a week)). The indicated value of "ventilation dust monitor" was confirmed to be within the range of normal.
	14:00	Framework of the greenhouse was completed. The work to put vinyl sheet, etc. started.
	14:20	Value indicated by monitoring post (P-2) is normal. No impact on the environment.
	14:29	Construction of the greenhouse at the entrance of the Room No. 108 was completed.
	14:30	Values indicated by Pu dust monitor No.2 (Room No. 108) and ventilation dust monitor (cir. 5×10^{-8} Bq/cm^3(average concentration of a week)): unchanged
	14:30～	The workers started to leave the site (inspection of body contamination).
	14:44～	Inspection of Worker A's contamination: 100 min^{-1} (0.33 Bq/cm^2) at a maximum (α ray, special work cap), no body contamination after removing radiation protectors; Result of nasal cavity contamination test: normal
	14:53	FAX (the 3rd report) was sent. → 15:15 FAX acceptance was confirmed.

Date	Time	Event
June 6, 2017	14:59～	Inspection of Worker B's contamination: 3,000 min-1 (9.7 Bq/cm$^{2)}$ at a maximum (α ray, special work clothes); Body contamination after removing radiation protectors: body contamination was confirmed; Ears 500 min^{-1} (1.7 Bq/cm^{2}) (α ray); Result of nasal cavity contamination test: normal; Shower done.
	15:25～	Inspection of Worker C's contamination: 1,000 min^{-1} (3.3 Bq/cm^{2}) at a maximum (α ray, special work cap); Result of nasal cavity contamination test: 13 Bq (α ray); Shower done.
	15:30	Value indicated by monitoring post (P-2) is normal. No impact on the environment.
	16:00～	Inspection of Worker D's contamination: 1,800 min^{-1} (5.8 Bq/cm^{2}) at a maximum (α ray, coverall); Result of nasal cavity contamination test: 3 Bq (α ray, special work clothes); Shower done.
	16:07～	Inspection of Worker E's contamination: greater than 100,000 min^{-1} (322 Bq/cm^{2}) at a maximum (α ray, special work clothes); Result of nasal cavity contamination test: 24 Bq (α ray)
	16:17	Value indicated by monitoring post (P-2) is normal. No impact on the environment.
	16:27	Room No. 108 was designated as the entry restriction area. (17:05 the 4th report)
	16:51	Workers in the greenhouse left the place.
	17:05	FAX (the 1st report, the 4th in total) was sent. → 17:40 FAX acceptance was confirmed.
	18:15	Value indicated by Pu dust monitor No.2 (Room No. 108): unchanged
	18:52	Decontamination of all the five workers completed.
	18:55	All the five workers left the area.
	19:05	The five workers left for Nuclear Fuel Cycle Engineering Laboratories.
	19:08	Press release document was faxed.
	19:40	Dust collection filters of the "Pu dust monitor No.2 (Room No. 108) were replaced.
	19:41	The five workers arrived at the Nuclear Fuel Cycle Engineering Laboratories.
	19:59	Measurement of Worker E using a lung monitor started.
	20:04	After the replacement of dust collection filters of the "Pu dust monitor No.2 (Room No. 108), the value was confirmed to be within the normal range (Since then the value remain unchanged). Ventilation dust monitor: within the normal range

Date	Time	Event
June 6, 2017	21:47	Workers clearing protection materials left the controlled area.
	22:05	Injection of chelating agent to the workers started.
	23:33	Inspection of the five workers using a lung monitor completed. As a result of the measurement, 2.2×10^4 Bq and 2.2×10^2 Bq at maximum were confirmed regarding Pu-239 and Am-241 respectively. (as of June 6)
	1:05	Injection of chelating agent to all the workers completed.
	1:42	The 5 workers arrived at Oarai Research and Development Center.
	10:00	The five workers left Oarai Research and Development Center for the National Institute of Radiological Science (NIRS).
	10:16	Work to expand the greenhouse started.
	10:42	Value indicated by monitoring post (P-2) is normal. No impact on the environment.
June 7, 2017	11:55	The five workers arrived at NIRS. Body contamination check and measurement with lung monitor started after decontamination.
	12:12	Work to expand the greenhouse completed.
	12:18	FAX (the 2nd report, the 5th in total) was sent. → 13:01 FAX acceptance was confirmed.
	13:27	JAEA reported the Nuclear Regulation Authority (NRA) judging it as the one which report is required by laws and regulations.
	16:41	Two workers entered the controlled area for inspecting the contamination of the Room No. 108 (collection of smear sample).
	17:05	FAX (the 3rd report, the 6th in total) was sent. → 17:56 FAX acceptance was confirmed.
	17:05	One of the worker left the area.
	17:09	The other worker left the area.
	18:36	Measurement of the smear sample started.
	18:55	Measurement of the smear sample completed. Contamination of 55 Bq/cm^2 (α-ray) at a maximum was confirmed.
June 8, 2017	10:43	FAX (the 4th report, the 7th in total) was sent. → 11:20 FAX acceptance was confirmed.
	16:40	Clearance and decontamination in the greenhouse was completed.
June 13, 2017	11:51	The five workers left NIRS for Oarai Research and Development Center and arrived there at 13:52. Then interview with them started.
	14:37	Collection of OSL dosimeters started.
	14:58	Collection of OSL dosimeters completed.
June 14, 2017	14:01	Entered the site of the incident.
	14:37	Carried out a SD card from the controlled area.

Date	Time	Event
June 14, 2017	14:46	The SD card was brought to On-site Response Headquarters
	14:50	The SD card arrived at On-site Response Headquarters
	15:25	Check of the image contained in the SD card started.
	15:29	Check of the image contained in the SD card completed.

＊These events in chronological order are as of June 14, and there may be additions.

Attachment 1

Outline of Plutonium Fuel Research Facility (PFRF)

PFRF was completed in 1974 with the aim of conducting R&D on new fuels for fast reactors, etc. Test using plutonium started in 1977.

In this facility, fabrication and research on physical property of new fuels such as uranium-plutonium mixed oxide fuel, nitride fuel, long-lived minor actinide nuclear transmutation fuel and metallic fuel for fast reactors, fabrication of fuel pins for irradiation test aiming for verification of fuel soundness and research concerning dry type separation using electrolysis of molten salt.

In FY 2013, a policy to abolish this facility was decided, and planning for treatment for stabilizing the nuclear fuel materials used in experiment and decommissioning of the facility is moved forward with.

Facility outline:

two-story building, fire-resistive construction with reinforced concrete, 1518 m^2 of total floor space (controlled area is 570 m^2)

Main equipment:

Main facility

glove box: 36 (air atmosphere: 25, high purity argon atmosphere: 11)

argon circulation generator: 4

Hood: 4

Major test device

powder molding press, sintering furnace, X-ray diffraction device, electron beam analysis device, oxygen/nitrogen analysis device, carbon analysis device, fuel pin welding device, etc.

Special facility

gas disposal equipment, liquid disposal equipment, power supply equipment, air compression equipment, etc.

Attachment 2

Position of inspection work with hood

1. Outline

The accident occurred during the work for appropriately control the nuclear fuel materials stored in glove boxes, etc. of PFRF. This work is divided into below three steps.

① Check the storage situation of each storage container

② Encapsulate nuclear fuel materials taken out from the glove boxes

③ Store recovered containers in storage containers

The accident occurred during the work ①.

2. Work plan

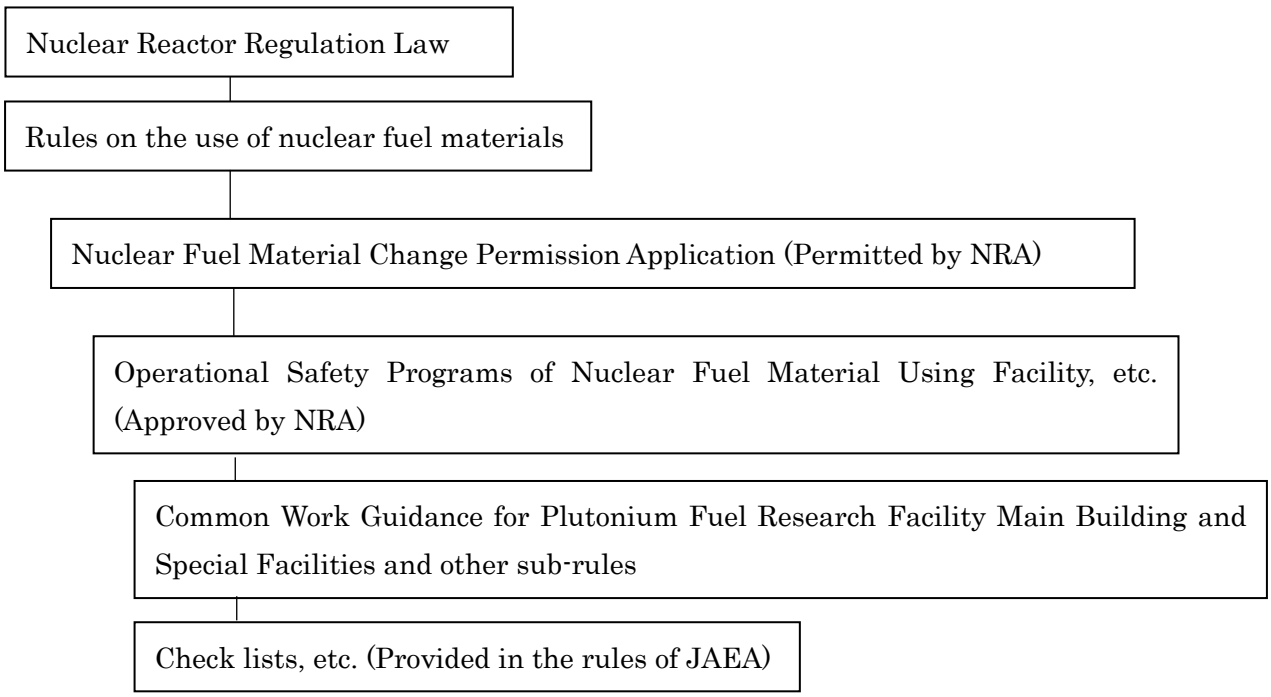
The work shown above falls into work carried out in a controlled area, and the radiation work slip is supposed to be made as a radiation work plan based on the Chapter 2, Article 16 of the "Operational Safety Programs of Nuclear Fuel Material Using Facility, etc., Oarai Research and Development Center (North Zone), Japan Atomic Energy Agency" *1.

When making the radiation work slip, it is required by the "Common Work Guidance for Plutonium Fuel Research Facility Main Building and Special Facilities" which is a sub-rule of the operational safety programs to attach the following documents: the safety work manual ("storing work of nuclear fuel materials"*2 in the case of this work), the general safety check list, the risk assessment, the check list of the operational safety programs, the use permission check list and the radiation safety check list.

The accident occurred during the work falling into "check of the storage container and contamination inspection with Hood-1 in association with transporting nuclear fuel materials to nuclear fuel storage" which is written in the third line of "2. work method (1) check and store nuclear fuel materials" of the safety work manual. The inspection work with Hood-1 is permitted in the "Nuclear Fuel Material Change Permission Application of Oarai Research and Development Center (North Zone), Japan Atomic Energy Agency"*3 with aimed use being "contamination inspection" and outline of use being "carry out work such as check of storage container".

3. Work procedure

The work with hood H-1 is provided in the manual "Safety Work with Hood" attached to the "Common Work Guidance for Plutonium Fuel Research Facility Main Building and Special Facilities". The work was carried out following this manual.



*1:

Chapter 3 Work, work management, etc. in a controlled area

Article 16

Radiation work plan

1. The General Manager is responsible for the radiation management concerning the work of radiation workers.

2. The General Manager shall take measures for safety, taking into the items below consideration:

(i) Place of work and period or work

(ii) Contents of work

(iii) Wearing necessary personal dosimeter and protection

(vi) Measures to lower the dose

(v) Dose associated with work

3. When radiation work of the preceding paragraph is conducted, the General Manager shall obtain consent from the Controlled Area Manager on the place of work and period of work in advance.

*2

"Check of storage container and contamination inspection shall be carried out with Hood H-1 in association with transporting nuclear duel materials to the nuclear fuel storage."

*3:

Table 2-1 Use method (hood) (continue 5)

Place of use	Hood	Purpose of use	Outline of use
Room No. 108 (Analyzing room)	H-1	Contamination inspection	1) Carry out work such as inspection of the storage container

Attachment 3

Inspection work, etc. of Plutonium・Enriched Uranium storage containers

<table>
<tr><td>Storage containers on which implemented inspection work, etc.
(February – June, 2017)</td><td>Storage container which led to this incident
(June 6, 2017)</td><td colspan="2">Storage containers on which are not implemented inspection work, etc.</td></tr>
<tr><td>Contents:
Exception of “M compound/Scrap”</td><td colspan="2">Contents: “M compound/Scrap”</td><td>Contents:
Exception of “M compound/Scrap”</td></tr>
<tr><td>30</td><td>1</td><td>20</td><td>29</td></tr>
<tr><td colspan="4">Total 80 (All possessed storage containers)</td></tr>
</table>

“M compound (Chemical form) / Scrap (Physical form)”: Scrap sample having be experimented including compound of U and Pu, etc.

Note: JAEA have reported on June 9 that the number of containers which are not abnormal after completed inspection so far is 31 though, properly it turned out to be 30 in the confirmation work afterwards, because counting in the container which led this incident during the inspection.

Attachment 4

Summary of the interview with the discharged workers

The five workers were divided in three groups and interview with them was held led by the Director General and Deputy Director General of Oarai Research and Development Center.

The main worker opened the lid of the brought-in storage container and inspected the inside situation. The roles of the five workers are as below.

【Role】

Worker A (Assistant worker): Support the work at the left rear of the Worker E and carry the container from the Room No. 110

Worker B* (Assistant worker): Measure smear at the right of the Worker E and carry the container from the Room No. 110

Worker C* (Keeping record): Take photos of the inside of the containers and do a sketch of respective containers at the right of the Worker E

Worker D (Assistant worker): Support the work at the Right of the Worker E and carry the container from the Room No. 110

Worker E (Main worker): Open the container and inspect the inside

【Summary of the interview】

When the Worker E slowly removed the four of the six bolts fastening the container diagonally and then loosened the other two, he heard hiss like the one made when gas comes out. He collected the smear from the lid and all the circumferences of the gaps and confirmed that there was no contamination. Because in the past air came out in the situation where the room temperature was high, and no smear contamination was confirmed, the Worker E decided to continue work.

When the Worker E removed the remaining two bolts holding the lid with one hand, the resin bags burst. Then he put the lid in the hood.

At the time of the burst, the Worker E sensed wind pressure in the stomach, and all the other workers heard the sound of burst. Mist-like leakage was observed coming from the burst container. Though wearing a mask, the Worker E confirmed no abnormal odor. Though wearing rubber gloves, he touched the metal container and confirmed no rise of temperature. The Worker E, paying attention to the situation of the inside of the container, inspected the room for more than one hour to confirm that there was no signs of progress in the accident, etc. and replaced the outside rubber gloves with new ones.

After that, thinking it is better to put the lid on the container and close the shatter of the hood, he did so.

Immediately after the burst, judging that it was a serious incident and all the workers and plutonium contamination must be contained inside the room, he ordered to lock the entrance of the Room No. 108 from inside and seal up the gaps of emergency exit of the room.

Communication with people outside has continuously made with the telephone installed in the Room No. 108 by the Worker D.

Each of the workers checked contamination and confirmed that high dose levels were detected with people who were near the hood. To prevent expansion of contamination to the entrance door and emergency exit, they stayed at the place where they were at the time of the accident, and to prevent body contamination by sweat, they stood still.

They took photos of the inside of the container, etc. after the accident with the digital camera they had brought in the room for recording the work, which they left in the greenhouse.

They had checked situation of the items such as the half-faced mask and rubber gloves and wearing condition of them before starting work as an indispensable process. During the work and after the occurrence of an accident became obvious, no one put off the half-faced mask to prevent internal exposure.

When leaving the room, the Worker E suggested that in order to prevent the contamination in the greenhouse, the workers leave the room in an order of less contamination based on the contamination situation of the five workers, and the other workers agreed.

The Worker E feels responsible for causing a serious accident, and feels sorry for causing inconvenience to many people.

While waiting in the room, all the five workers knew that many people were making effort outside the room by setting a greenhouse, etc. and were calm rather than anxious.

*) The roles of the Worker B and Worker C written in the June 13 press release was each for the other. The description is corrected in this Attachment.

Attachment 5

Photos taken with the digital camera withdrawn from the scene

The inspection of storage containers started in February, 2017. Inspection of 31 containers had been inspected with no abnormality such as contamination, etc. before this incident occurred. A digital camera brought in the room for recording the work recorded inspection situation of the storage container. As a result of checking collected data, 5 images taken on June 6 were confirmed.

On June 6, inspection work of storage containers were carried out. The storage container 1010 in which resin bags ruptured is the fifth one, it was confirmed recording times coincide with what discharged workers told.

<Chronology of withdrawal>

June 14 (Wed)

14:01 Staff entered the scene.

14:37 SD card was brought out from the controlled area.

14:46 SD card was sent to the on-site Response Headquarters.

14:50 SD card was received in the on-site Response Headquarters.

15:25 Check images recorded in SD card was started.

15:29 Check images was completed.

- The safety inspector was a witness to a process of drawing out the SD card and checking images.
- The digital camera in the greenhouse have not been decontaminated, the SD card was drawn out.

<Collected data>

Photo images taken from May 2, 2011 to June 6, 2017 were recorded in SD card. There were 5 images taken on June 6.

<Detail of 5 images>

① Photo 1 (Tool Box Meeting (TMB) board, before the work) taken at 8:54 (No relation with the work)

② Photo 2 (Storage container 1007) taken at 10:59

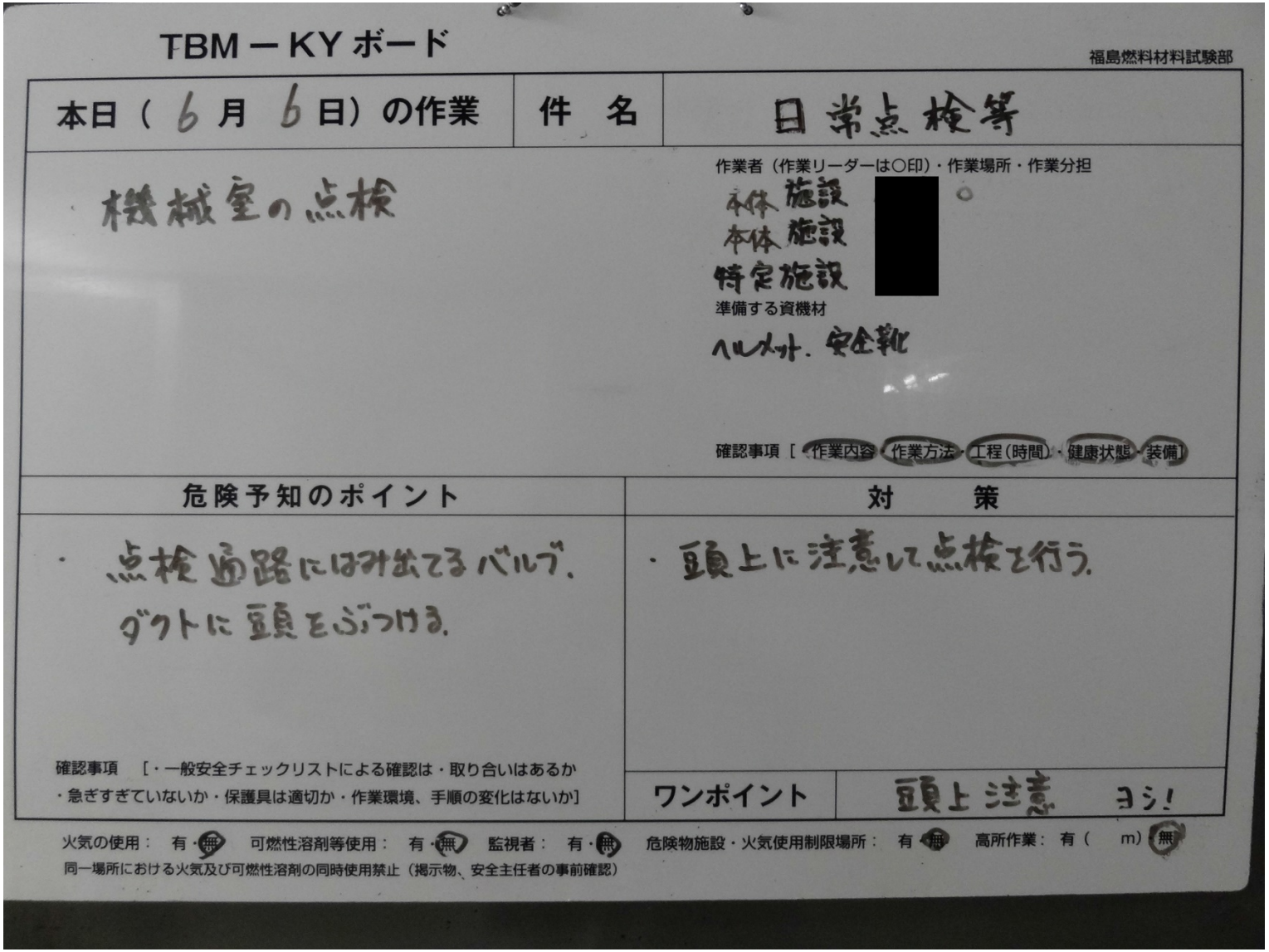
③ Photo 3 (Storage container 1007) taken at 11:00

④ Photo 4 (Storage container 1008) taken at 11:13

⑤ Photo 5 (Storage container 1010) taken at 12:55 (Storage container after the incident occurred.)

- Taken times were recorded by setting of the digital camera. (Confirmation of consistency with the real time have not been implemented.)

Photo 1


TBM－KY ボード

福島燃料材料試験部

本日（6月6日）の作業	件名	日常点検等

機械室の点検

作業者（作業リーダーは○印）・作業場所・作業分担

本体施設 [redacted] ○

本体施設

特定施設

準備する資機材

ヘルメット．安全靴

確認事項［作業内容・作業方法・工程（時間）・健康状態・装備］

危険予知のポイント	対策
・点検通路にはみ出てるバルブ．ダクトに頭をぶつける．	・頭上に注意して点検を行う．

確認事項 ［・一般安全チェックリストによる確認は・取り合いはあるか ・急ぎすぎていないか・保護具は適切か・作業環境、手順の変化はないか］

ワンポイント：頭上注意 ヨシ！

火気の使用： 有・無 可燃性溶剤等使用： 有・無 監視者： 有・無 危険物施設・火気使用制限場所： 有・無 高所作業： 有（ m）無

同一場所における火気及び可燃性溶剤の同時使用禁止（掲示物、安全主任者の事前確認）

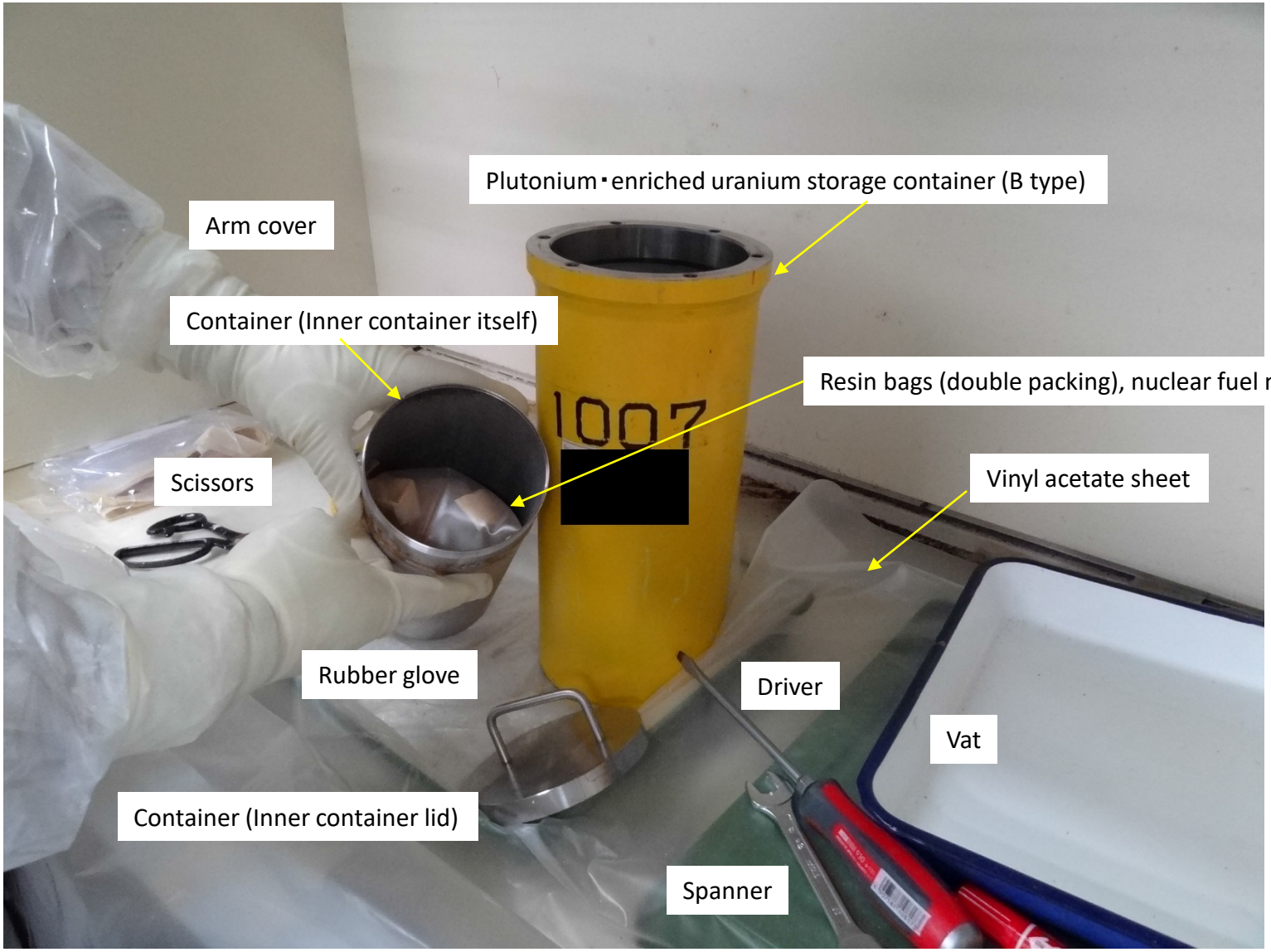
TBM (Tool Box Meeting) Board in the Machine Room (in Radiation Cold Environment)

No relation to this radiation work

Photo 2

There is an inner Container in storage container.

Spanner and driver were used to open the storage container.



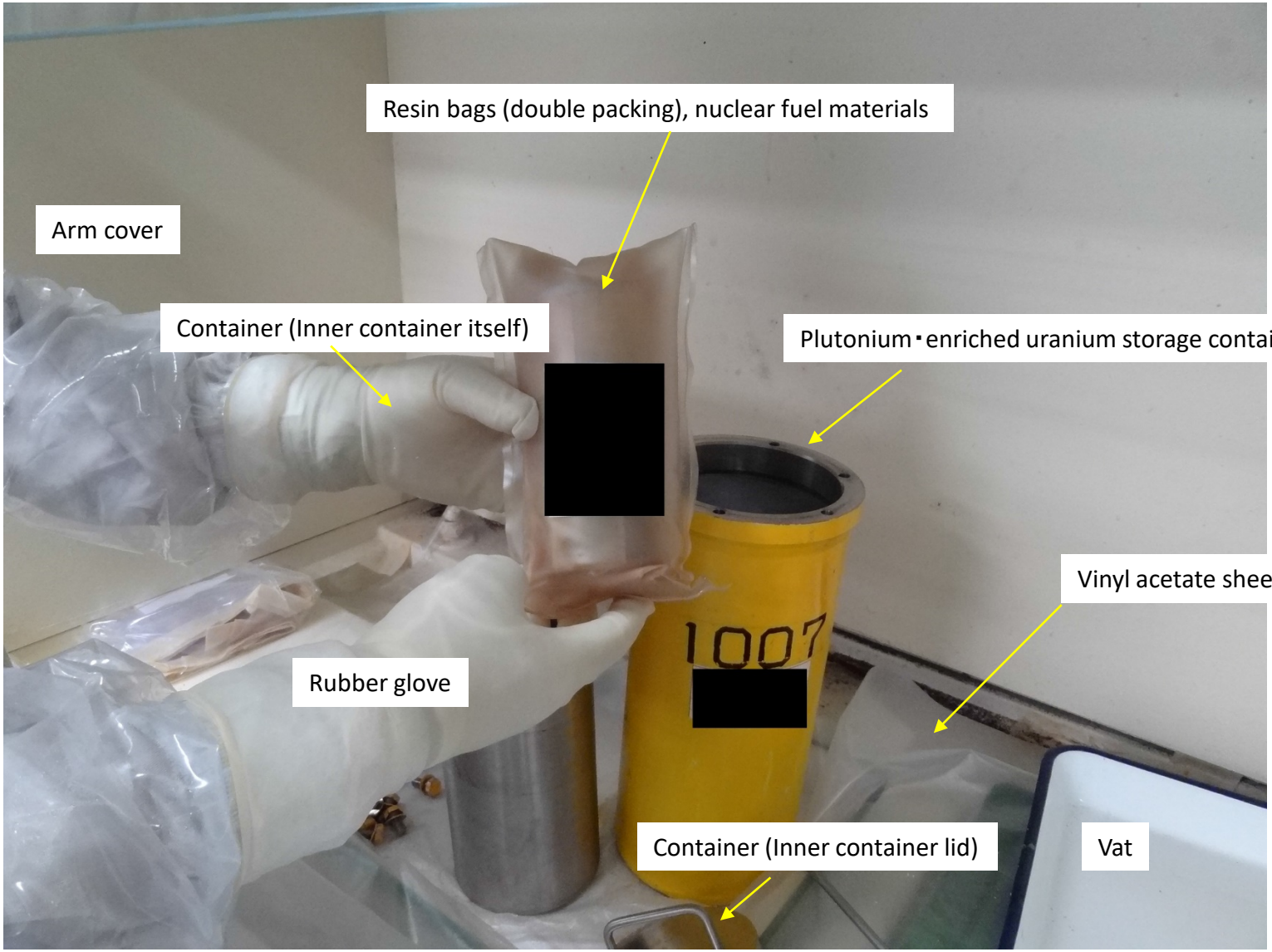
The vat and scissors were not used for this work.

Instead of using a bat, the inner floor of the hood is cured with the vinyl acetate sheet.

Photo 3

There is an inner Container in storage container.

Spanner and driver were used to open the storage container.

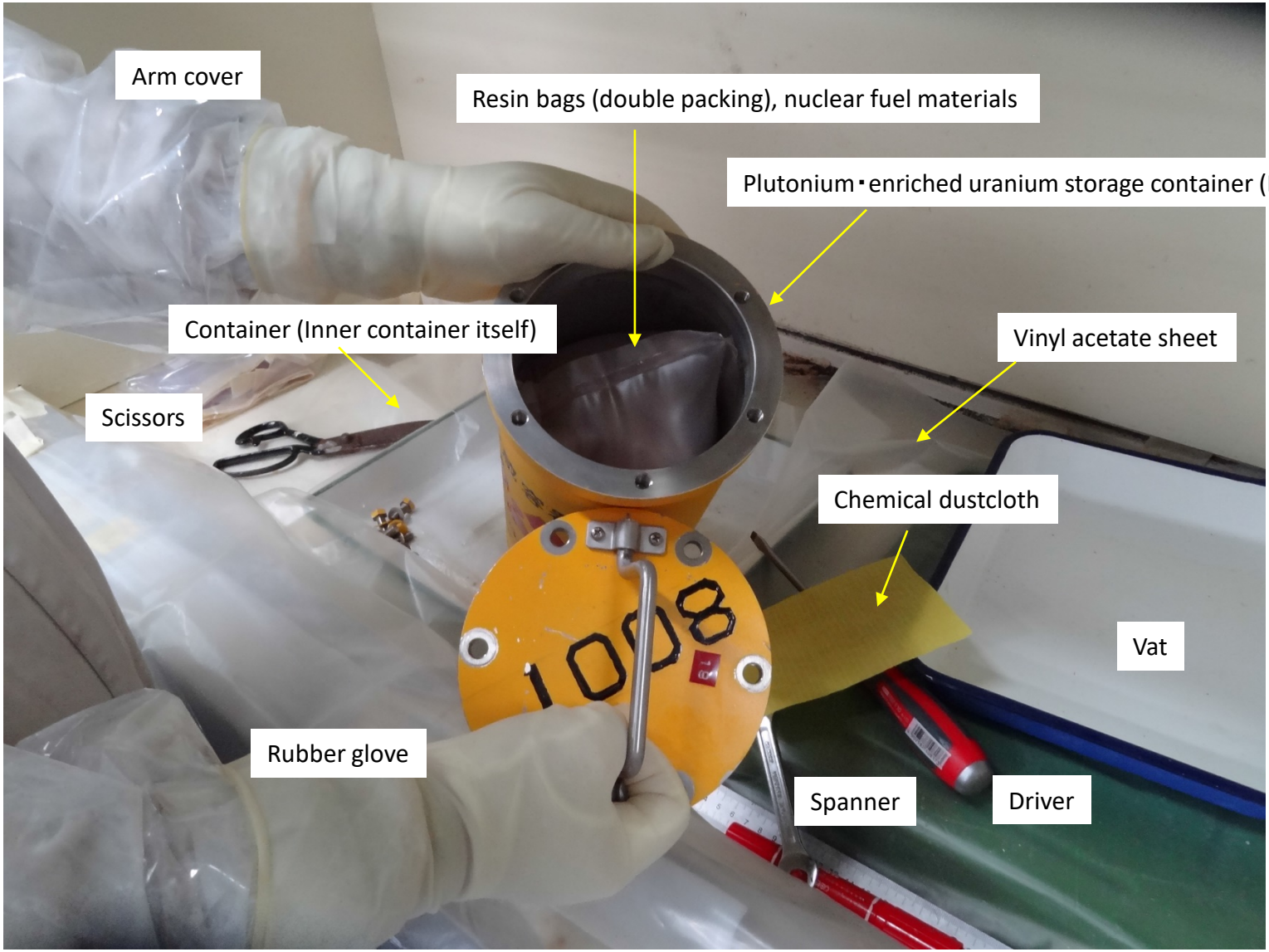


The vat and scissors were not used for this work.

Instead of using a bat, the inner floor of the hood is cured with the vinyl acetate sheet.

There is an inner Container in storage container.

Spanner and driver were used to open the storage container.



The vat and scissors were not used for this work.

Instead of using a bat, the inner floor of the hood is cured with the vinyl acetate sheet.

Photo 5

There is an inner Container in storage container.

Spanner and driver were used to open the storage container.

The vat and scissors were not used for this work.

Instead of using a bat, the inner floor of the hood is cured with the vinyl acetate sheet.

Attachment 6

Measuring instrument and result for intranasal contamination check

1. Sampling and measurement

Samples for intranasal contamination (nasal smear samples) were taken by smearing the left and right nostrils of the workers with swabs. Two nasal smear samples were put together (Photo 1) to measure α radioactivity and β radioactivity with the α β scintillation measuring instrument.

2. Measuring instrument and result

Measuring instrument: α β scintillation measuring instrument (ES-7284) (Photo 2)
Detector: Plastic scintillation detector coated with ZnS (Ag)
Measuring time: 1 minute
Lower limits of detection: α; 0.57 Bq, β; 1.7 Bq

Worker	α radioactivity (Bq)	β radioactivity (Bq)
A	N/A	N/A
B	N/A	N/A
C	13	N/A
D	3	N/A
E	24	N/A

Photo 1 Nasal smear sample
Put in a polyethylene bag
to prevent contamination

Photo 2 α β scintillation measuring instrument
(ES-7284)

Attachment 7

Specifics of the lung monitor of the Nuclear Fuel Cycle Engineering Laboratories and measurement, etc.

1. Specifics of the lung monitor

Below is the specifics of the lung monitor used for the measurement of the workers.

- Lund monitor body: BE 5020, manufactured by CANBERRA (US) (photo 1)

  Detector　　Ge semiconductor detector × 2 sets

  Size of the detector　　5000 mm^2 × 20 mm (L)

  Range of measured energy　　10 ~ 400 keV

  *Lung monitor body is stored in an iron shielding room.

- Analysis software: Apex-InVivo, manufactured by CANBERRA (US)
- Iron shielding room (photo 2)

  Inside dimension　2.0 m (W) × 2.0 m (D) × 2.0 m (H)

  Total weight　　52.3 t

  Shielding material　　iron 200 mm, lead 3 mm, copper 0.5 mm, vinyl chloride 3 mm

Photo 1　Lung monitor

Photo 2　Iron shielding room

2. Measurement

The worker wears white gown over the underwear and lies on his side on a bed in the iron shielding room. Measurement continues for 30 minutes after adjusting the place of the detector of the lung monitor.

3. Calculation of committed effective dose

Though the purpose of the measurement with lung monitor conducted immediately after the accident is to contribute to the medical decision on immediately necessary

treatment (prompting egestion by injecting chelate agent, etc.), and obtaining the individual's exposure dose is not the purpose of the measurement, the calculation of the dose is shown below supposing that the value of Pu-239 obtained in the measurement of the Worker E on June 6 all reflects radioactivity in the lung.

As conditions necessary for dose analysis, it is assumed that the intake route is inhalation, type of absorption into the respiratory airway is the type M (unspecified compound), and activity median aerodynamics diameter (AMAD) is 5 μ m.

○Effective dose=(Value measured with lung monitor/ rate of resigual radioactivity in the lung)×effective dose coefficient

- Result of measurement with lung monitor conducted 0.4 days after the intake: 2.2×10^{4} Bq
- Rate of residual in the lung 0.4 days after the intake: 6.06×10^{-2} (Bq per intake Bq)
- Effective dose coefficient: 3.2×10^{-5} Sv/Bq

According to the above results

Intake: $2.2 \times 10^{4} \div 6.06 \times 10^{-5} = 3.6 \times 10^{5}$ (Bq)

Effective dose: $3.6 \times 10^{5} \times 3.2 \times 10^{-5} = 1.2 \times 10^{1}$(Sv)

Attachment 8
June 8, 2017
President Kodama

Directions from the president of the JAEA

○ All the executive directors of the JAEA must let the people they supervise know the points below by today and ensure their compliance.

① Reconfirm the principle of "putting safety first"

- Check again to make sure safety before handling nuclear fuel materials.
- To prevent the same kind of accident, suspend similar tasks handling nuclear fuel materials until directions to allow their restart are issued.

② Reaffirm the social responsibility of the JAEA as an expert group in the field of nuclear energy

- Have an awareness as an expert and reaffirm that your behavior has social responsibility

③ Ensure risk prediction activities

- Predict potential risks and act in the way to reduce risks

○ Promptly check again if there is room for improvement in your way of management and if there are issues which the governance does not cover effectively

○ This accident has a significant meaning that can influence the continuance of the JAEA. With this in mind, place the highest priority on addressing this accident.

○ Specifically, give directions below to the each of the work-sites

- Have an awareness and sense of tension regarding handling radioactive materials
- Check completely the facility/equipment, work environment and work process before starting work
- Supervisors must not allow starting work until the above requirements are all fulfilled