

## **A summary of the accident at the Hadron Experimental Facility on May 23 2013**

(This summary was prepared based on the Japanese documents published at the J-PARC website on May 25 and May 29. Some of the numbers are preliminary.)

### *Outline of the accident:*

In the Hadron Experimental Facility experiments were conducted with the elementary particles that had been generated by irradiating gold target with proton beam. Due to the malfunctioning of the beam extraction system of the 50 GeV synchrotron,  $2 \times 10^{13}$  particles were extracted for a very short period (5 milliseconds whereas a normal period was 2 seconds). As the result, the gold target was overheated, causing possible damage to the gold target. As a result radioactive materials leaked out into the experimental hall, and researchers were exposed to the radiation. The dose levels have been measured for all the people in the area.

The Hadron Experimental Facility has been closed since May 23 2013.

The contamination level in the Hadron Experimental Facility is estimated roughly 30 Bq/cm<sup>2</sup>.

34 out of the 102 people had the internal exposure up to 1.7mSv dose (preliminary figure) for two while the others were lower or not detectable level.

The radioactive materials were also leaked to the outside of the radiation controlled area of the Hadron facility.

The radiation monitors around the Hadron hall showed a slight increase, but monitoring posts at the site boundary did not show any meaningful increase. One of the two monitoring posts in the neighboring laboratory observed an increase of radiation level for 30 min (6 nGy/h increase whereas the normal averaged level is 70 to 130 nGy/h). The amount of emission of the radioactive materials by integrating the number was estimated to be 3nGy (or 0.003 μSv).

The cause(s) of the malfunction of the beam extraction system and the delay in evacuating researchers from the Hadron Experimental Facility is under investigation.

### *Time sequence of the accident*

May 23rd

- 11:55  $2 \times 10^{13}$  protons were extracted for a 5 milliseconds period, which is normally done for 2 seconds. As a result, the intensity was 400 times higher than normal. The machine protection system (MPS) worked and beam stopped.
- 12:08 MPS was reset. The number of the secondary particles decreased. Therefore, the beam trajectory was adjusted.
- 12:30 User operation restarted after tuning. The K1.8BR group noticed an increase in background rate of the detector for their experiments. Started to investigate the cause.

- 13:30  $\gamma$ -ray monitor in the hall indicated 10 times higher than normal level of 0.4  $\mu$ Sv/h.
- 14:26 Stopped beam. The value of  $\gamma$ -ray monitor decreased.
- 15:15 Turned on wall mounted fans of the hall to check if the monitor worked properly. The value of  $\gamma$ -ray monitor decreased.
- 15:32 Restarted providing beam after  $\gamma$ -ray level became sufficiently low. At the same time fans were turned off.
- 16:00 Ambient radiation level in the hall was found to be high (4 - 6  $\mu$ Sv/h).  $\gamma$ -ray monitor value started to rise again.
- 16:15 Stopped beam.
- 16:30 Radiation safety section staff arrived at the hall and measured the radiation level.
- 17:00 Confirmed contamination by radio active materials.
- 17:30 People in the hall exited after the body radiation level was confirmed to be below 4 Bq/sq.cm.
- 19:00~20:00 Detailed check was carried out working with radiation safety section.
- 23:30 All the people exited from the radiation management and controlled area and the controlled area was sealed off.

#### May 24th

- 9:00 The head of the Safety Division reported the situation to J-PARC Director and Deputy Director.
- 10:00 Meeting was held to discuss the situation and the discontinuation of the Hadron experiments was decided.
- 17:30 Safety Division was notified by the Nuclear Fuel Cycle Engineering Laboratories a monitoring post in their site recorded a small increase of radiation level after 15:00 on the 23rd.
- 18:00 Record of the  $\gamma$ -ray monitor placed adjacent to the radiation controlled area was analyzed closely. It appeared that the timings of the radiation level increase were coincident with the timings the fans were turned on.
- 19:00 Recognized the strong possibility of the emission of radioactive materials to outside of the Hadron radiation controlled area and reported to the emergency contact at the JAEA Tokai site at 21:10.
- 21:11 Special task force was organized to take care of various issues of this accident.
- 22:15 Recognized that this corresponded the case required an official report by law.

22:40 The accident was reported to relevant authorities.

May 25th

01:00 Measurements with a whole body counter for four researchers were conducted, showing that the total internal exposure dose reached to 1.7 milli Sv for one of four.

## Measurements of dose equivalent rate and surface contamination density (the experimental hall of the Hadron Experimental Facility)

**Location:** observation deck and crane area (the upper part of the facility building)

**Measurement time and date:** 19:20-20:00 on May 23, 2013 (after operation shutdown)

### Measurement methods

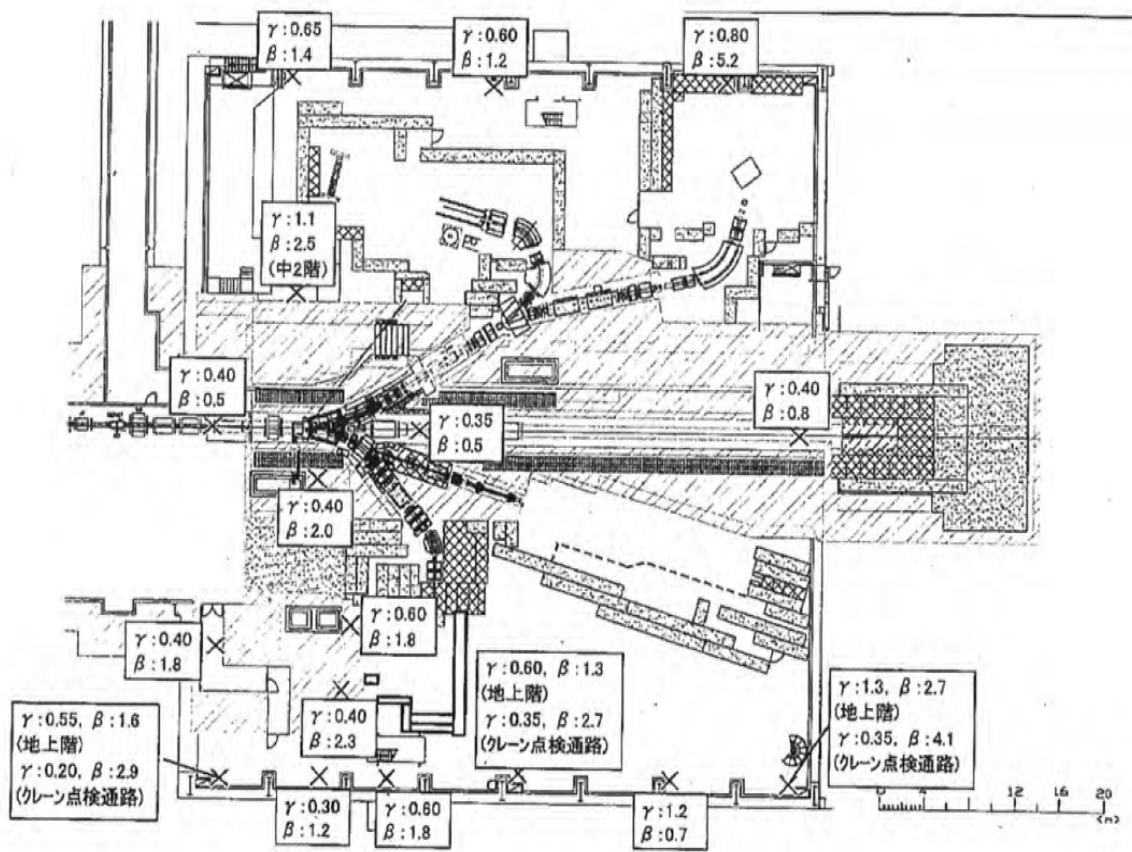
Dose equivalent rate ( $\gamma$ ): NaI survey meter

Surface density ( $\beta$ ): smear method

### Measurement unit

Dose equivalent rate ( $\gamma$ ):  $\mu\text{Sv/h}$  (1cm dose equivalent rate)

Surface density ( $\beta$ ):  $\text{Bq/cm}^2$



## Measurements of dose equivalent rate and surface contamination density (the experimental hall of the Hadron Experimental Facility)

**Location:** Experimental hall (Ground floor of the facility building)

**Measurement Time and Date:** 19:20-20:00 on May 23, 2013 (after operation shutdown)

### Measurement methods

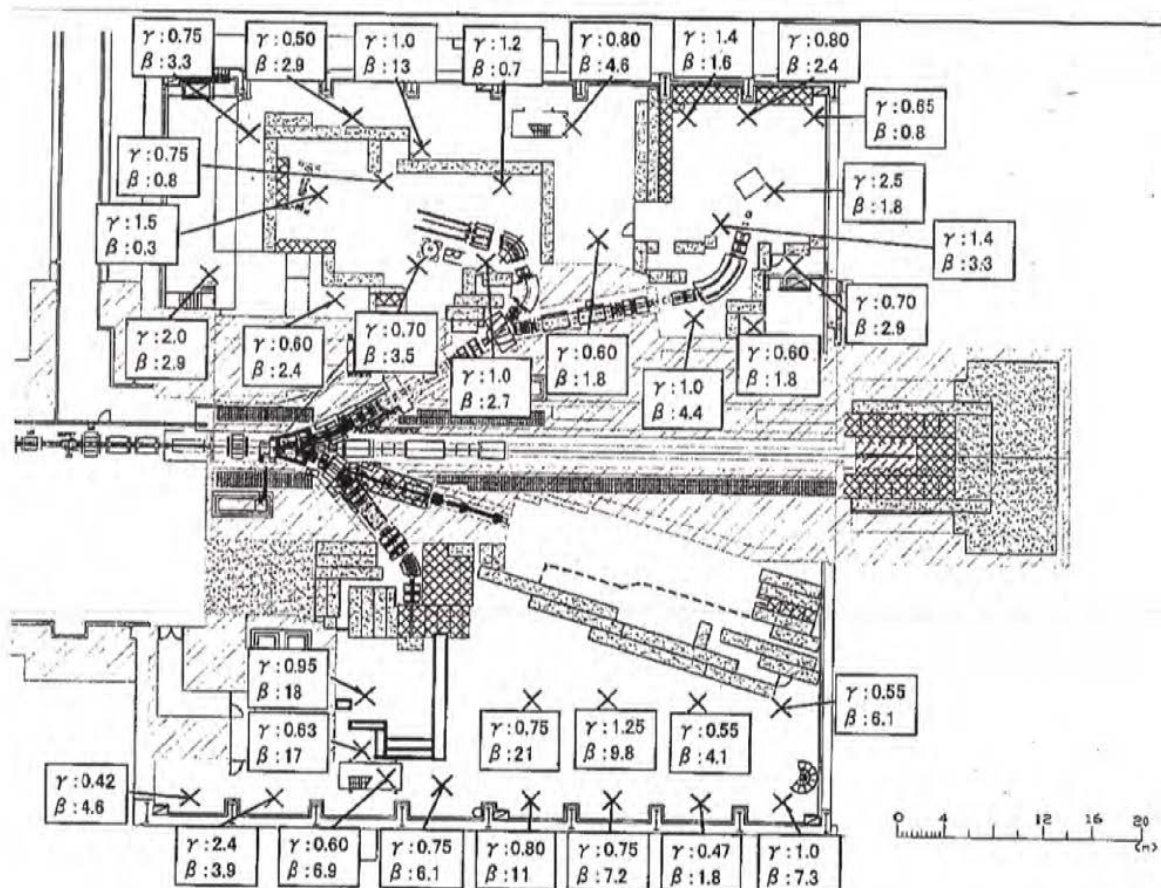
Dose equivalent rate ( $\gamma$ ): NaI survey meter

Surface density ( $\beta$ ): smear method

### Measurement unit

Dose equivalent rate ( $\gamma$ ):  $\mu\text{Sv/h}$  (1cm dose equivalent rate)

Surface density ( $\beta$ ):  $\text{Bq/cm}^2$



## Measurements of dose equivalent rate (Hadron Experimental Facility)

**Location:** Outside of the facility building in the radiation management area of the facility.

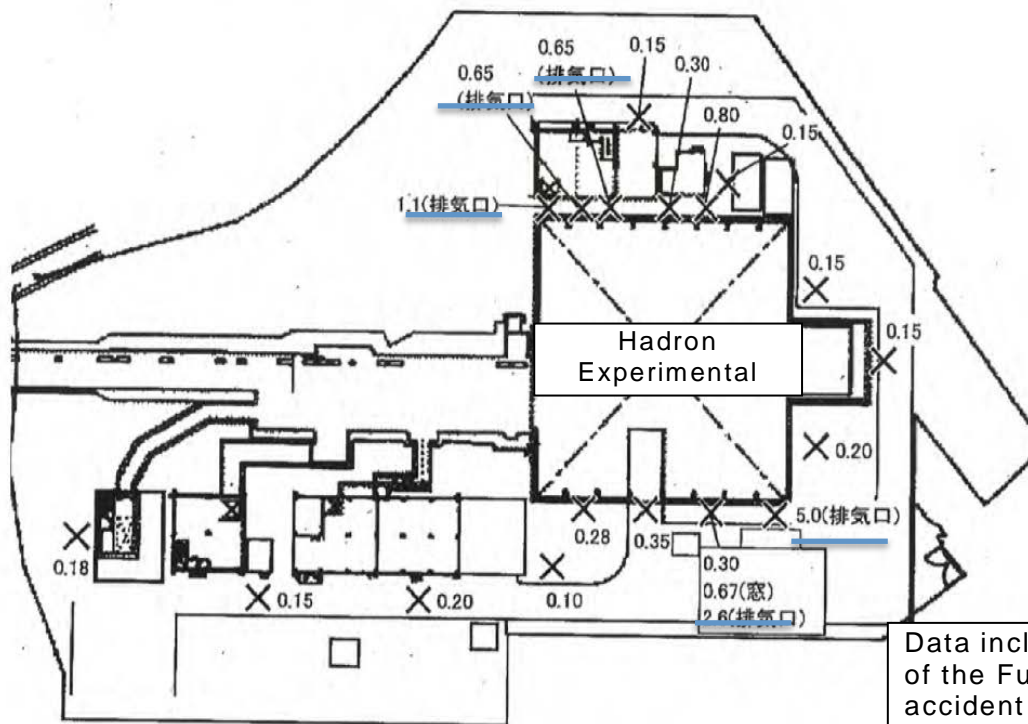
**Measurement Time and Date:** 19:20-20:00 on May 23, 2013 (after operation shutdown)

### Measurement method

Dose equivalent rate ( $\gamma$ ): NaI survey meter

### Measurement unit

Dose equivalent rate ( $\gamma$ ):  $\mu\text{Sv/h}$  (1cm dose equivalent rate)



            
: exhaust vent

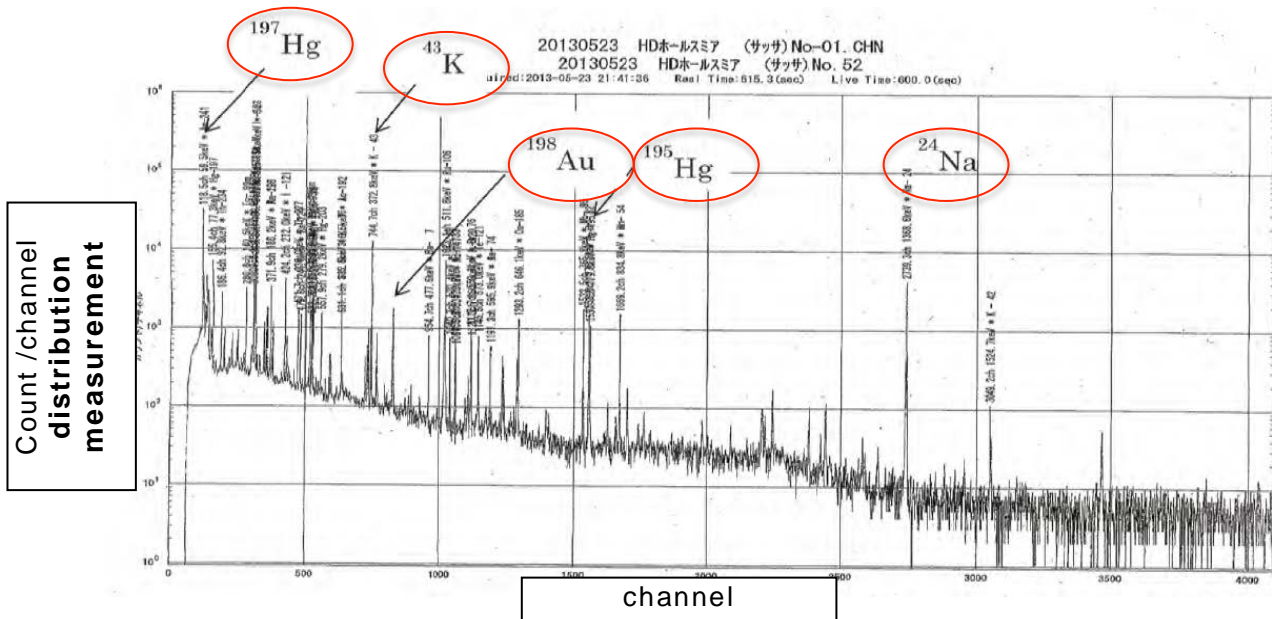
# Hadron Experimental Facility · distribution of $\gamma$ -ray nuclide

**Location:** Experimental hall

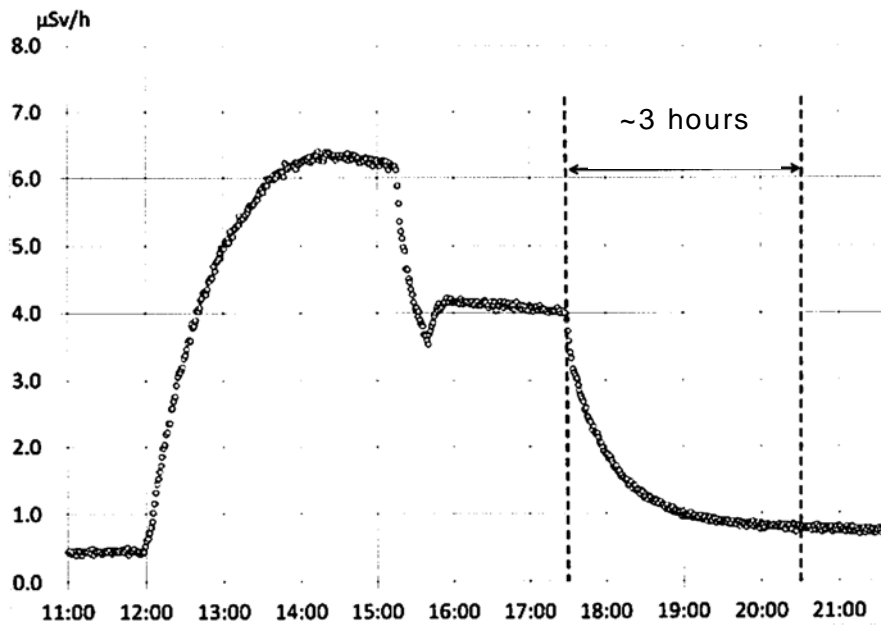
**Measurement time and date:** 21:41 on May 23, 2013 (after operation shutdown)

**Measurement method:** HP · Ge detector (smeared sample of the floor)

Radioisotopes in red circles are considered to be responsible for causing the internal exposure.



**Changes in  $\gamma$ -ray dose with time:** measured by an area monitor installed in the Hadron facility building



**Changes in  $\gamma$ -ray dose with time:** measured by area monitors installed at an edge of the radiation controlled area of the Hadron Experimental Facility

