# Management of JMTR hot laboratory without operation of system of air supply and exhaust

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**Abstract**

The Japan Materials Testing Reactor (JMTR) is a testing reactor for nuclear fuels and materials. The JMTR hot laboratory is a facility to perform post irradiation examinations (PIEs) such as tensile test, impact test and IASCC test of samples irradiated in the JMTR. The hot laboratory is connected with the JMTR by a water canal. Irradiated samples are transferred through the canal safely without transportation cask. However, thinning of anchor bolts of the exhaust stack of the hot laboratory were found in 2015. The exhaust stack was removed. All PIEs in the hot laboratory have been stopped. The system of air supply and exhaust have been stopped. It is impossible to keep negative pressure. To manage the hot laboratory safely under this condition, the hot laboratory have been managed as follows. Gaps between outside cells and inside cells, between radiation controlled area and non-controlled area have been sealed up to prevent spreading of contamination. The sealing is checked every day. Surface concentration of contamination around the sealing is measured every week to confirm the effect of the sealing. These management will be continued until a new exhaust stack will be rebuilt.

## 1. Introduction

The JMTR hot laboratory has been operated since 1971, and PIEs of nuclear fuels and materials were performed over 40 years [1]. The hot laboratory is connected with the JMTR by a water canal. It is possible to transport samples irradiated in the JMTR without transportation cask. Usually, negative pressure was kept to prevent leaking out of radioactive substances. The system of air supply and exhaust kept negative pressure. The exhaust air was discharged by the exhaust stack in the hot laboratory. Figure 1-1 shows the exhaust stack of the hot laboratory. The exhaust stack consisted of steel part of 33 meters in height and concrete part of 7 meters in height. In 2015, corrosion and thinning of the anchor bolts which fixed the steel part of the exhaust stack were found. It is concluded that the thinning was caused by water infiltration over a long period of time and the gaps were caused by elongation of thinning part of anchor bolts by earth quakes start from the 2011 earthquake off the Pacific coast of Tohoku. The exhaust stack was removed for safety. The system of air supply and exhaust has been stopped since the exhaust stack was removed. Under this condition, the hot laboratory has been managed by several maintenance methods.

This paper reports the methods of management without the operation of the system of air supply and exhaust. Sealing and measurement of surface concentration of contamination are introduced in this paper. Sealing is performed to prevent spreading contaminations and surface concentration of contamination is measured to check the effect of the sealing.


Fig.1-1 Exhaust stack of hot laboratory

## 2. Management

2-1. Sealing

The system of air supply and exhaust has been stopped since the exhaust stack was removed. It is not possible to keep negative pressure without exhaust stack, but it is necessary to prevent spreading contamination. Following places were sealed up by tape and vinyl acetate sheets.

- Gaps between outside cells and inside cells
- Gaps between radiation controlled area and non-controlled area
- The doors between radiation controlled area and non-controlled area

When the area of sealing was too large to seal by tape, the area was covered by vinyl acetate sheets and the around of sheets was sealed. Figure 2-1 and 2-2 show the pictures of the sealing. Figure 2-1 shows the sealing using tape and Figure 2-2 shows the sealing using tape and vinyl acetate sheets. The electric power of entrance doors of radiation controlled area was shut down to prevent opening carelessly. Temporary isolation rooms made of vinyl acetate sheets and plastic pipes were settled to separate radiation controlled area and non-controlled area. Figure 2-3 shows one of the isolation room and the seals. The doors and the isolation rooms must not be opened at the same time. The seals are checked every day by visual checking and the results are recorded.

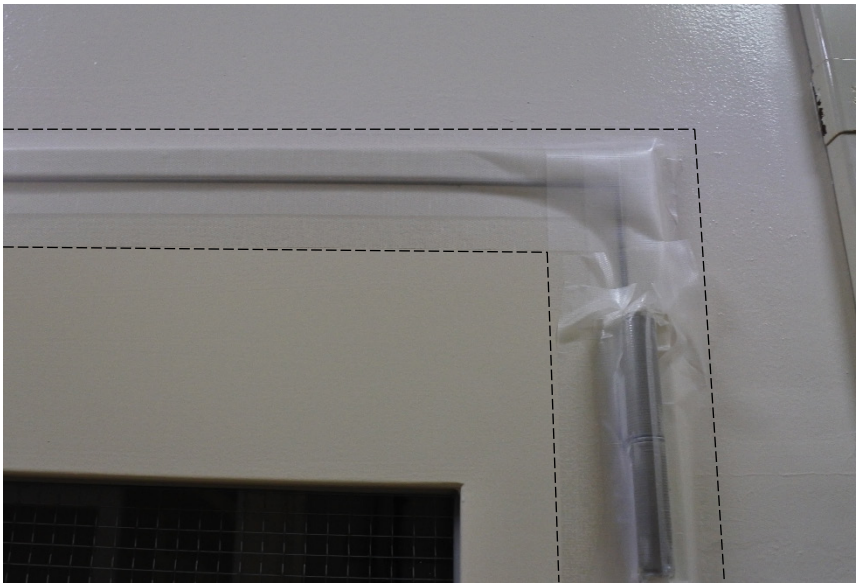

Fig.2-1 Sealing by tape
Dotted line shows edge of the seals.

Fig.2-2 Sealing by tape and vinyl acetate sheet

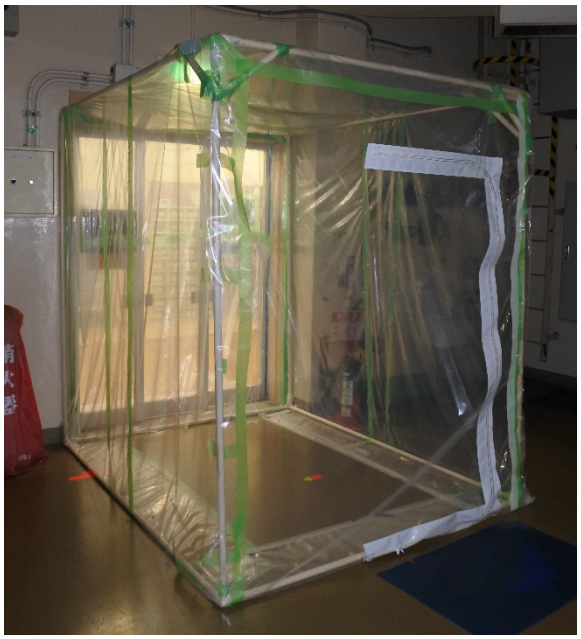

Fig.2-3 Entrance of radiation controlled area

2-2 Measurement of surface concentration of contamination

To prevent spreading contamination, the gaps in the hot laboratory were sealed and the seals are checked every day. In addition to this checking, surface concentration of contamination around the seals is measured every week to confirm the effect of the sealing. Usually, surface concentration of contamination is measured by smear wiping method. Measurement condition is as below.

- Equipment : ALOKA SSC-101
- Number of measured area : 89
- Measurement area : the doors of isolation rooms, ceiling hatch, walls and entrances of cells, isolation rooms entrance of cells
- Wiped area : over 200 $cm^2$ per 1 sample
- Measurement targets : alpha ray and beta (gamma) ray
- Measurement time : 1 min per 1 sample
- Upper limitation : 3 $Bq/cm^2$ (alpha ray), 33 $Bq/cm^2$ (beta (gamma) ray)

An equality which calculates surface concentration of contamination is as below.

$$A_s = \frac{N - N_b}{\varepsilon_i \cdot W \cdot \varepsilon_s}$$

$A_s$ : Surface concentration of contamination ($Bq/cm^2$)
N : Counting rate of measurement ($s^{-1}$)
$N_b$ : Counting rate of background ($s^{-1}$)
$\varepsilon_i$ : Appliance efficiency
W : Effective opening area ($cm^2$)
$\varepsilon_s$ : Pollution source efficiency
The results of the measurement are recorded.

## 3. Discussion

The tapes used for the sealing are checked every day to prevent leaking out radioactive substances. In Law Concerning Prevention from Radiation Hazards due to Radio-Isotopes, the upper limitations of surface concentration of contamination are prescribed that alpha ray is 4 $Bq/cm^2$ and beta (gamma) ray is 40 $Bq/cm^2$. In the hot laboratory, we decided that the upper limitations of surface concentration of contamination were 3 $Bq/cm^2$ and 33 $Bq/cm^2$ from the viewpoint of safety. From the results of measurement of surface concentration of contamination, contamination has never been confirmed. Therefore, it is effective to prevent spreading contamination by sealing. By these management, the hot laboratory is managed safely without the operation of the system of air supply and exhaust. It is necessary to continue these management until a new exhaust stack will be rebuilt.

## 4. Conclusion

This paper reported the management of the hot laboratory without the operation of the system of air supply and exhaust. Gaps which might leak out the radioactive substances were sealed up, because the system of air supply and exhaust has been stopped. Surface concentration of contamination of the seals and around the seals are measured periodically. These management will be continued until a new exhaust stack will be rebuilt.

## References

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