Minutes of the Second External Expert Panel Meeting to Review the Radioactive Material Leak Accident at the Hadron Experimental Facility of the J-PARC (Summary)

1. Time and Date: 10:00-12:20 on July 5, 2013

2. Venue: KKR Hotel Tokyo

3. Attendees:

・Members of the External Expert Panel:

Dr. Yasushige Yano (Nishina Memorial Foundation), Mr. Naoyuki Uchimura (Journalist), Mr. Yukiya Sato (Tokai Village Office), Prof. Kenichi Takano (Keio Univ.), Prof. Takashi Nakano (Osaka Univ.), and Prof. Hiroko Nagahara (Univ. of Tokyo)

・Members of the Working Group:

Prof. Makoto Inoue (Professor Emeritus at Kyoto Univ.), Prof. Mitsuo Tosaki (Kyoto Univ.), Prof. Mamoru Baba (Professor Emeritus at Tohoku Univ.), and Dr. Noritaka Kumagai* (Japan Synchrotron Radiation Research Institute)

*: absentee

・Members of J-PARC Center, JAEA and KEK:

Dr. Yujiro Ikeda (J-PARC); Dr. Naohito Saito (J-PARC), Dr. Takashi Kato (J-PARC); Dr. Takayuki Sumiyoshi (KEK), Mr. Kazuo Hasegawa (J-PARC), Dr. Tadashi Koseki (J-PARC), and Dr. Kazuhiro Tanaka (J-PARC); others

Agenda (1) Approval of the Minutes of Previous Meeting

With corrections proposed below by the secretariat, the minutes of the 1st EEP meeting (Appendix 1) was approved.

- Sessions from this meeting on would be open to the public.
- The correct half-life of iodine-125 is 60 days.

Agenda (2) Report from the Working Group

Prof. Inoue, the leader of the Working Group (WG) reported on the work of the WG (Appendix 2).
Summary of report:

Technical details on the causes of the radioactive material leak accident were discussed by

following through five stages of the accident: (1) Delivery of an abnormal beam, (2) Damage of the gold target, (3) Leakage of radioactive material in the primary beamline (class 1 controlled area), (4) Leakage of radioactive material into the Hadron experimental hall (HD hall), and (5) Leakage of radioactive material to the area outside the Hadron Experimental Facility (HD Facility).

The abnormal beam extraction in Stage 1 was caused by a sudden large current brought by a magnet power supply, which incorrectly responded to the command signal in driving a magnet for slow beam extraction.

- Two error status conditions have been logged in coincidence with the accident: an overvoltage error whose cause had been determined in the past, and a current deviation error. In the 1.25 millions of instances of slow extraction at the MR, this was the first occurrence of this type of error condition on this power supply. The reason for this error is currently being investigated.

The damage of the target in Stage 2 is considered to have been caused by melting of a portion (diameter 1mm, length 40 mm) of the target due to an extremely high temperature which was brought about by a large energy deposit in a short period of 1/200 of a second. While this scenario is supported by simulation and collateral evidence from observations at the time when the beam was injected to the target right after the incident, the confirmation of the state of damage must await visual inspection of the target. To begin investigation of the target, due steps have to be taken, such as preventive measures against secondary accidents and consent of local authorities. Since the temperature of the target returned normal after the accident, the released amount of radioactive material is considered fixed in the first 1/200 of a second, and believed not to have increased subsequently.

Inoue reported that leakage of the radioactive material into the primary beamline in Stage 3 was caused by the fact that the target was not sealed. His report also covered the considerations led to the use of such a target system and a comparison with the target systems at other accelerators.

- History of the installed target at the HD Facility: Initial design involved a rotating nickel disk target which is directly water-cooled to cope with the design beam power, and the target assembly has to be enclosed by a hermetic structure because of radio-activation of cooling water. However, in operation with low beam power, this target offered too small yield for producing secondary particles, and the presence of cooling water was not essential; and as a consequence,

it was replaced by an air-cooled platinum target placed in the atmospheric environment. It was then subsequently replaced by an indirectly-water-cooled platinum target, and then by the indirectly-water-cooled gold target, which was being used at the time of the accident. As the intensity the proton beam was improving, use of the initially designed type of a target was being contemplated.

The cause of leakage of radioactive material into the HD hall in Stage 4 was reported to be the sealing performance of the concrete shielding walls which was insufficient to contain radioactive material in case of an accident involving damages to the target.

Regarding leakage of radioactive material to the area outside the HD Facility in Stage 5, the cause was reported to be operation of ventilation fans. The report also covered the sequence of events involved and the decisions therein.

Inoue's report also addressed the actions taken by the people at the time of the accident. The interruption of the accelerator operation due to a malfunction of a device (power supply) did not lead the staff to recognize a radiation safety problem. The rules were unclear as to who should report to whom, and the persons in charge were not available on site. Written procedures and training were not optimal. The following issues were raised in discussion:

- Information on radiation dose rates, as required by the staff involved in work, was not available in a consolidated fashion for constant viewing. The radiation alarm system was not configured to set off well before operation of accelerators had to be stopped.
- A system for delegating the authority was in place. However, at the time of the accident the managers were in Tsukuba, about one hour away, and no representatives were designated on site to act on their behalves. In addition, a person to oversee the whole situation had not been defined.

As an issue with the layout of radiation monitoring equipment, Inoue reported that the system did not serve well for information sharing, that it did not allow quick recognition of pre-warning situations, and that the monitors were not installed at all risk spots for radiation leaks.

Regarding the radiation exposure accident and the radioactive material leakage accident, Inoue expressed his hope for smooth integration of experiences of KEK and JAEA, and for development of

a new partnership among KEK, JAEA and the J-PARC Center in areas of radiation and general safety management.

Agenda (3) Discussion

Regarding the mandate of the External Expert Panel (EEP) meeting, Chairperson Yano iterated the following:

- As aided by reports from the WG, the panel will request the J-PARC Center the subjects to review.
- The panel will evaluate the descriptions on the safety management system, plans for improving the safety and emergency procedures, as provided by the J-PARC Center, and assess how they satisfy the requirements set by the EEP meeting.

The discussion ensued and the following remarks were made.

- Improved safety measures must be designed to prevent not only this but also future potential accidents in worst case scenario under the assumption of “scientists may make mistakes.”
- In the light of promoting the safety culture, the top priority should be on “no release of radioactive materials” and “no unnecessary radiation exposure”. Doing the best experiments comes only next to them. This culture has to be in the shared value system at JAEA and KEK.
- J-PARC Center has to work with Tokai Village to build its safety culture. In addition to scientific dissect of the accident, timely and accurate communication with the local community has to be established.
- Confidence in the J-PARC Center will be restored only after the local community is convinced how the J-PARC Center is forthcoming in disclosing unfavorable information and how the center is working hard to overcome the problems.
- Homework of the WG for the next meeting: Among many other issues, the biggest cause of the accident was in the set-up of the class 1 controlled area. A thorough review is required regarding the current status of class 1 controlled areas in other facilities such as: accelerators, the Materials and Life Science Experimental Facility, and the Neutrino Experiment Facility at J-PARC. With regard to the safety management system, we would like to hear a report on what sort of improvements to the system will be made, and when they will be made.

Other opinions were as follows:

- From the standpoint of accident prevention, worst-case scenarios and risk assessment should be

carried out for various device failure modes.

- Improved sharing of information and signatures from radiation monitors has to be realized, including monitoring stations and counters from experiment groups. Procedures for handling the alarms also should be reviewed. The work should proceed in parallel to establishing an improved safety management organization.
- J-PARC is a research facility where a large number of visiting users from other institutes conduct their experiments. This necessitates a special safety management scheme with a strong authority of the on-site manager.
- The authority for judging whether accelerators can be operated or not should be at the hands of the radiation safety management. A wrong hierarchy in the order of experiments, accelerators and safety managers is not acceptable.
- A hotline between the J-PARC Center Director and Mayor of Tokai Village would be very useful.

Next, Director Ikeda of the J-PARC Center requested for a moment to provide an overview of the method of investigating the gold target (Appendix 3), to which the chair concurred.

- The primary beamline is contaminated with iodine-125 and other nuclear spallation products from gold. After the contamination is captured by using charcoal filters and others, the air will be discharged into the atmosphere, prior to initiating investigation of the target.
- Next, the shielding around the gold target will be opened. At that time, a close attention must be paid to ensure that the contamination is not spread, and care must be taken to ensure the safety of working personnel. The shielding blocks will be covered with a sheet. The blocks will be momentarily lifted by about 10 cm to confirm, with a dust sampler, that there are no problems with concentration with radioactive material. Then, the shielding block will be removed, and further contamination testing will be carried out through surveys, smears etc.
- When the shielding is opened, the air flow will be arranged to pass from outside to inside the primary beam line and to go through the machine room equipped with filters, before leaving for the outer environment. Spread of contamination will be prevented by using local ventilation devices with an air cleaner and filter. To keep the openings made in the shielding as small as possible, a framed sheet with adjustable opening will be used for crane work.
- The target body will be observed with a fiberscope. Guides for the fiberscope, and scaffolding to support those guides, will be set up. An old-type fiberscope, not a CCD camera, has been intentionally chosen for superior robustness against radiation.
- The schedule runs for about one month, from the start of air discharge to target observation.

After observation, the target will be left as is, and the shielding blocks will be brought to their original locations. This restoration work is expected to take two weeks.

Subsequently, the following discussions ensued.

- The WG also is discussing the importance of consent by the local community for this investigation. The WG feels that the work procedure is technically sound.
- Immediately after the accident, it was thought that it would be essential to actually look at the target. However, simulations and analysis of the data during operation now allows reasonably convincing estimates of temperature distribution and melting during the accident. The fact that the yield of secondary particles was restored when the beam was shifted by 1 mm corroborates that the extent of melting was about 1 mm. Therefore, the importance and priority of actual observation of the target is not very acute at present.
- The central problem in the recent leak accident was the soundness of sealing and air-tightness, and the question is how best to improve it. However, in order to investigate all aspects of the accident, the direct observation of the target is needed ultimately.
- At present, it is more important to reduce the radiation level in the facility where the leak of radioactive material occurred than to view the gold target
- We will have to interact with the local communities, such as Tokai Village and Ibaraki Prefecture, and gain their consent concerning the contents and format of our report.

Agenda (4) Miscellaneous

The next EEP meeting will be held in Tokyo from 10:00 a.m. on July 20 (Saturday).