

Change of Radiation Safety Control on Synchrotron Radiation User at Experimental Hall

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Abstract

In general, the radiation level at the experimental hall of all Synchrotron Radiation (SR) facilities is sufficiently low. But SR users who perform their experiments at the same place are in radiation safety control according to the radiation safety regulation of each country or each facility. The control is too serious in a few countries, even though the exposure dose of SR users is very low down to the Public level. SR beam lines are not classified to a radiation generator and no radiation safety control against the experimental hall is required or implemented in some countries. Recently a part of Korean radiation safety regulation (Nuclear Safety Act) is enforced because of the other issues which are not related to SR facilities and Pohang Accelerator Laboratory (PAL) should change the control condition of SR users. Previously, the SR users were classified to “person with frequent access (frequent-visitor)”, which term might be unique in the world at present and is a middle condition between a radiation worker and the general public. Now PAL radiation safety policy has assigned them to the general public and some of beamlines are not the radiation generator according to the exemption condition of radiation source. We have proved the condition by a long-term record of radiation levels at the experimental hall and personal exposure of SR users. The new PAL policy is still in a process of negotiating with Korean government authority. In this paper, the background of this change and the basement conclusion of our study are introduced.

Introduction

In Korean Nuclear Safety Act, only radiation control area is defined for dividing from general public area. It is not enough to implement the access control at large accelerator facility like Pohang Light Source or PAL X-ray Free Electron Laser. The recent change of radiation safety regulation related to a frequent-visitor was done for avoiding insufficient protection of non-radiation workers at medical center or nuclear power plant but it gave rise to a trouble in PAL radiation protection policy. The policy has been updated based on real data of radiation monitoring and operation experience.

Fact Check and Change of PAL Policy

Pohang Light Source (PLS) had been operated since 1994 and was upgraded successfully to Pohang Light Source II (PLS-II) in 2011. The third hard X-ray free electron laser, PAL-XFEL, was constructed in 2016 as the third X-ray free electron laser in the world and its beam line has been opened for general users since June in 2017. The fact checks for practical radiation environment and personal dose were carried out using measured data in 2015 and 2016 after enhanced monitoring even though all historical data were already recorded at PAL safety system.

1. PAL Policy before Update

The dose limits of radiation worker and general publics are 20 mSv and 1 mSv a year at PAL. One of frequent-visitor is 6 mSv a year, which is the same to recently announced Korean nuclear safety act. At buildings of PLS-II and PAL-XFEL, the base dose level is very low and only limited area can be assigned as the radiation control area defined by the Korean nuclear safety act even during accelerator operation. Because of above reason but for enhanced safety control, all areas in PAL have been classified as shown in table 1 and figure 1. The frequent-visitor were mainly synchrotron radiation users and contracted worker in PAL. They should wear the personal dosimeter in Generally-Controlled Area(GCA) and higher level areas.

Especially the GCA is introduced only at PAL for our own purpose and it is similar to a supervised zone in other country's regulation. The access to GCA is allowed only when the worker wears a personal dosimeter after passing proper radiation safety training. So they were usually classified to a radiation worker or a frequent-visitor. However the dose level at mainly accessible area like the experimental hall was lower than the dose limit of the general public.

“Radiation Control Area at Korean Nuclear Safety Act: Area where workers can be exposed over annual dose limit of radiation worker”

	Dose Level	Remarks
Restricted Area	$0.25 < D < 1 \text{ mSv/y}$	
Generally-Controlled Area	$1 < D < 20 \text{ mSv/y}$	Dosimeter required
Radiologically Controlled Area	$20 \text{ mSv/y} < D < 1 \text{ mSv/h}$	
High Radiation Area	$1 \text{ mSv/h} < D$	Access is not allowed

Table 1 - Area Classification of Radiation Protection Policy.

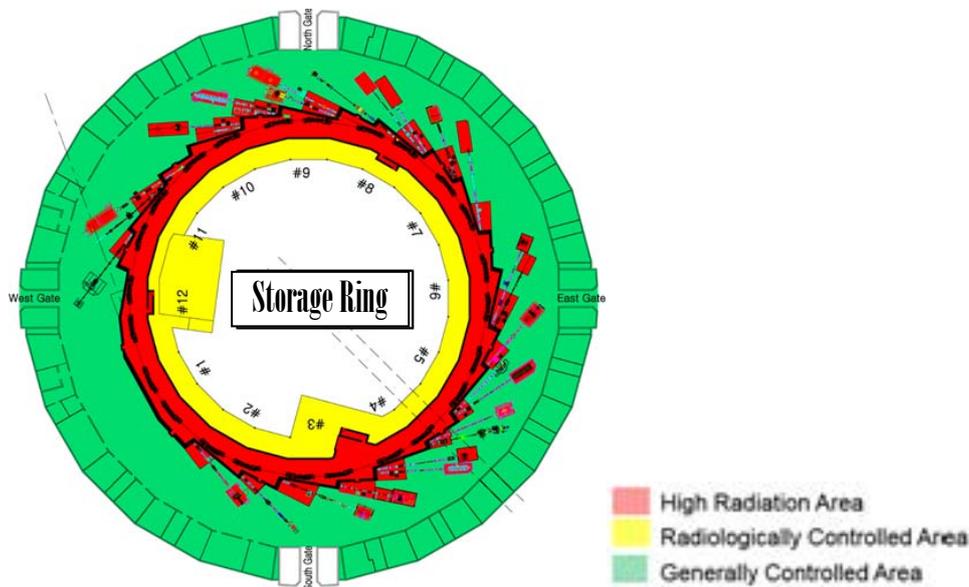


Fig.1 - Area classification in storage ring of PLS when electron beam is operated with synchrotron radiation beamline.

2. Facts: Radiation Level and Personal Dose

The PAL area radiation monitoring consists of an active system (figure 2) and a passive system (figure 3). Totally 24 monitoring posts and 32 posts are operating at PLS-II and PAL-XFEL, respectively for the active system. The number of environmental monitoring posts is seven. The OSLN dosimeters are installed at places more than 150 for the passive monitoring system. The OSLN dosimeters measure three-month integrated doses at specific places.

All radiation workers and frequent-visitors wear the same type of OSLN dosimeters at the area above GCA. All SR users should wear the dosimeter because they were classified as frequent-visitor.

For example, annually accumulated dose (in 2015) of area radiation monitoring system in PLS-II storage ring building is shown in figure 4. In the plot, the posts of higher dose above 1 mSv are located at RCA. All other monitors located at GCA like experimental hall showed lower dose level than 1 mSv. The personal doses of all SR users were very low at records in figure 5. It also confirm surely that the radiation

environment of PLS-II and PAL-XFEL is sufficiently safe and some assigned area can be re-assigned as a zone for the general public like restricted area of PAL standard.

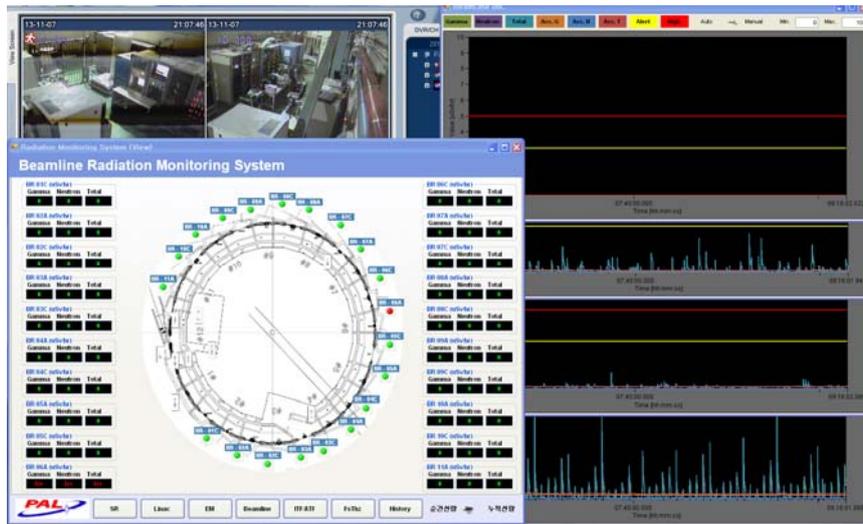


Fig.2 - Area radiation monitoring system for PLS-II storage ring and beamline.

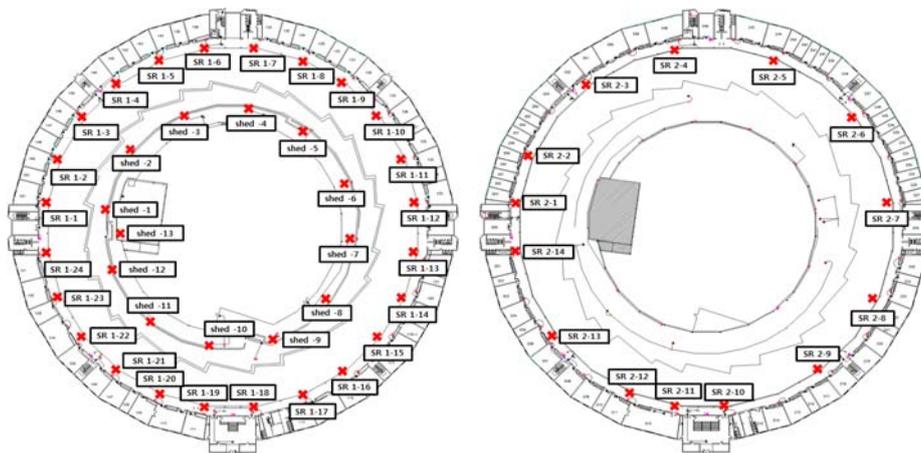


Fig.3 - Passive radiation monitoring posts using OSNL at PLS-II storage ring building.

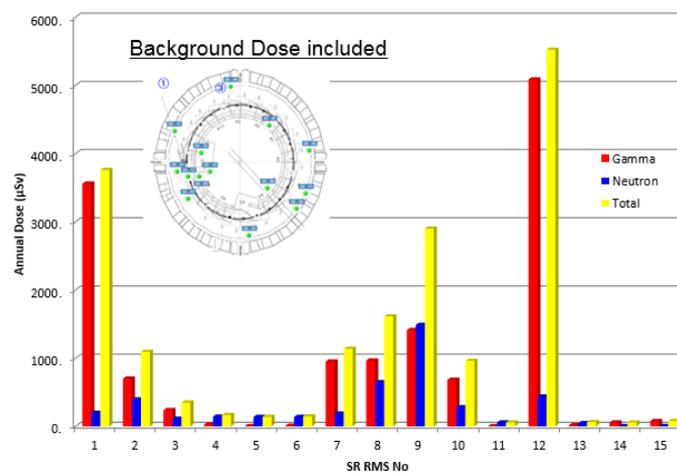


Fig.4 - Annually accumulated dose measured by area radiation monitoring system in PLS-II storage ring building (including background radiation).

in 2015			in 2016		
	< 0.1 mSv	> 0.1 mSv		< 0.1 mSv	>0.1 mSv
Feb	364		Feb	399	
Mar	675	1 (0.11)	Mar	747	
Apr	532		Apr	713	
May	436		May	684	
Jun	668		Jun	645	
Jul	609		Jul	616	
Aug	12		Aug	1	
Sep	160		Sep	258	
Oct	770		Oct	604	
Nov	709	1 (0.12)	Nov	679	1(0.31)
Dec	344		Dec	543	
Total No of Dosimeters	5279	1	Total No of Dosimeters	5889	1

Fig.5 - Records of personal dose of synchrotron radiation users in 2015 and 2016. All users except of unexpected three cases were exposed less than 0.1 mSv, which is a reporting level of OSLN dosimetry system.

3. Updated Policy of Radiation Protection

Because of enhanced requirements for frequent-visitor by recently-announced Nuclear Safety Act, PAL could not keep the previous PAL rule for SR users and short-term outside workers to access GCA that they are frequent-visitors. Considering their risks expected by accessing to GCA, a long-time training and a medical check which are requested at newly-announced Korean Nuclear Safety Act are not fair. So PAL decided to classify such SR users and short-term workers into the category of general public. However the fundamental requirements of radiation protection for accessing to GCA are not changed: short-time radiation safety training and wearing a personal dosimeter, OSNL badge, are required continuously. And long-term outside workers and workers in regular maintenance period are classified to frequent-visitor continuously because they can access to accelerator tunnel in maintenance period, where is assigned as RCA.

Summary

According to the Korean Nuclear Safety Act, a frequent-visitor or a general public cannot work with any radioactive isotopes and radiation generator. But SR users need to handle the safety shutter or hatch shutter of each beamline to lead the synchrotron radiation to their samples. Such activity of SR users and rule make the authority be in confusion because of contradictory concept. The updated PAL policy is still in a review step.

However it is a fact that the radiation protection has to be operated by considering its risk, even with the worst assumption. The latest announced government regulation does not consider it carefully. PAL should change the own policy of radiation protection to avoid over-requests and confusion. In this paper, the PAL response and detail consideration of policy change were introduced and the survey campaign to make some consensus for radiation protection standard of synchrotron radiation facility was suggested.

References

- [1] Korean Enforcement Decree of the Nuclear Safety Act, Dec. 2016, NSSC.
- [2] Radiation Safety Control Rule of PAL, 2017 (in Korean)