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Insights into operational radiation protection at PSI

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Introduction

The Paul Scherrer Institute (PSI) consists of a wide range of different facilities such as accelerator facilities, nuclear facilities and radioactive waste treatment. At PSI East premises, a free electron laser, the Hotlab facility and the Centre for Radiopharmaceutical Sciences are situated where on the one hand highly activated samples are investigated and on the other hand short-lived radionuclides for medical research and patient application are produced. Additionally, at PSI West premises, a proton accelerator, a spallation source, a synchrotron and a proton accelerator for medical treatments are operated. Furthermore, four former nuclear installations are being dismantled: Three former nuclear research reactors and one incineration plant for radioactive waste material.

The diversity of these facilities with the different experiments and tasks is quite challenging for the operational radiation protection teams.

Controlled and supervised areas at PSI

In Fig. 1 an overview of the PSI East and West premises is shown. Highlighted in green color are buildings with controlled and/or supervised areas. The section for operational radiation protection is responsible for the radiation protection in all of these buildings. Examples of the section's activities are: Monitoring of the radiological status of the workplaces during operation and shutdown, measuring dose rate and contamination in and around the facilities, taking radiation protection measures (for example using personal protective equipment (PPE)) and supervising radiological work.

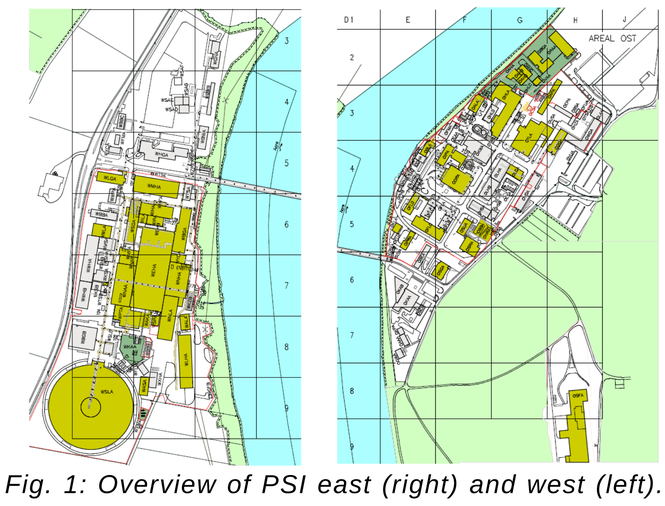

Fig. 1: Overview of PSI east (right) and west (left). In green are the buildings with controlled or supervised areas.

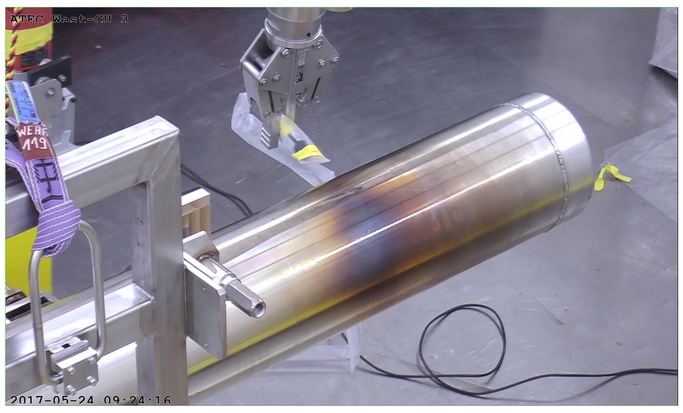

Fig. 2: The target of the Swiss Spallation Neutron Source is examined in the hot cell at PSI West. The dose rate at the target surface is > 100 Sv/h.

Radioactive material

At PSI a broad spectrum of radionuclides and activities are used and produced, e.g.: In the proton accelerator facilities the activated components can reach dose rates of hundreds of Sv/h and have to be handled in dedicated hot cells (see Fig. 2); scientists of the center of radiopharmaceutical sciences produce and perform experiments with radionuclides such as Thulium-163, for which neither the Swiss Radiation Protection Ordinance (RPO) nor the publications of ICRP have any reference values; in the Hotlab facility spent fuel rods and other samples from nuclear power plants are investigated with destructive and non-destructive tests; at the center of proton therapy new FLASH therapy experiments are performed with the compact proton accelerator COMET. And these are only a few examples. The diversity of the PSI facilities is quite challenging for clearance measurements of potentially activated or contaminated material for the release from regulatory control. For a clearance measurement according to Art. 106 of the RPO, three criteria must be fulfilled: (1) the measured dose rate (DR) must be less than 0.1 µSv/h (netto); (2) the surface contamination and (3) the specific activity must be below a nuclide-specific guidance value resp. clearance limit.

Radiation protection planning

For work in areas with high dose rates a radiation protection planning is required. The radiation protection personnel has been measuring the dose rates and the requested time for specific interventions since more than 15 years. This allows PSI to asses the doses for the PSI staff during maintenance works very accurately. In Fig. 3 the overview of the collective and the maximum individual doses for the yearly maintenance (shutdown) of the proton accelerator facility (HIPA) and the Swiss Spallation Source (SINQ) is shown. The collective dose depends on the type of maintenance work that have to be carried out resulting in a variation between 20 and 60 man-mSv from year to year. Since more than 10 years the maximum individual dose is less than 5 mSv.

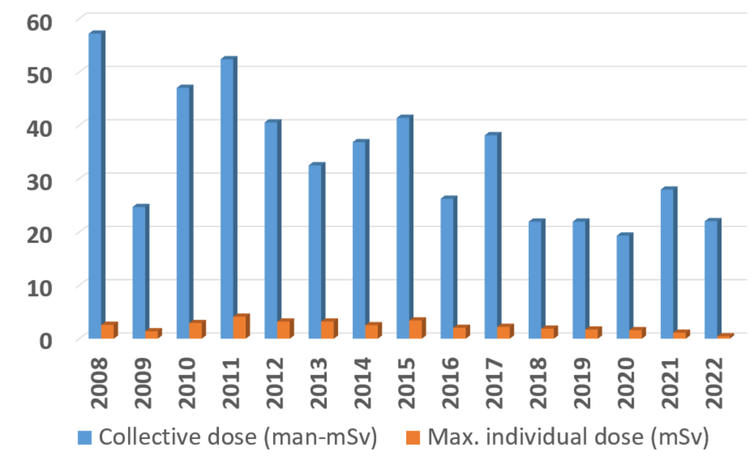

Fig. 3: Overview of the collective and maximum individual doses during shutdown of the proton accelerator HIPA and the Swiss Spallation Source SINQ.

Fig. 4: Dose rate mapping in the region of target M (HIPA).

Radiation protection supervision

The work in areas with high dose rate and/or high radiological contamination are supervised by the radiation protection personnel: Dose rate and contamination monitoring are performed before the planned work and discussed with the technical staff. If necessary the monitoring is performed again during and after the work. In Fig. 4 as an example a dose rate mapping performed by the radiation protection personnel is shown which is used to decide on the radiation protection measures.

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