RADIATION PROTECTION IN A UNIVERSITY TRIGA REACTOR

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Abstract

Radiation protection in a university institute operating a research reactor and other installations has different constraints as a larger facility. This is because the legal requirements apply in full, but the potential of exposure is low, and accesses has to be made available for students, but also for temporary workers. Some of the problems in practical radiation protection are addressed and solutions are discussed. In addition, experience with national radiation protection legislation recently to be issued is addressed and discussed.

1. General

From the view of radiation protection, a university institute operating a research reactor, radiochemical labs, and other radiation facilities has some unique characteristics as an institution where occupational exposure may occur, because standards [1] and [2] are designed for somewhat larger facilities with different operational constraints. Some aspects on this issue will discussed below.

2. General

The "Atominstitute of Austrian Universities" was founded in 1959 and started operation 1962. The Atominstitute is part of the "University of Technology" in Vienna. It is a multidisciplinary institute comprising many research fields. Radiation protection is developed with the field with time, and at present they is a broad range from low-temperature physics to theoretical nuclear astrophysics. Most of the institute is located apart the main buildings of the Technical University of Vienna in a separate area. The major task of the institute is, as for a university institute, teaching and research. This scopes leads to operational constraints occasionally not in full agreement with radiation protection standards as they are designed for larger facilities and steady state conditions.

The **TRIGA Mk II** Reactor has a full power of 250 kW and is in operation since 1962. Technical upgrading proves continuation of the operation for the next future. The equipment (beam holes, irradiation facilities) provide the basis for neutron physics, sample irradiations, and neutron activation analysis. **Radiochemical Labs** with complementing facilities (liquid waste treatment plant) are in operation as well as **X-ray equipments** and accelerators. **Sealed sources** used for different purposes. Obviously, all equipments are subject of licensing. The staff consists of 50 persons with permanent contract (25 professionals), 30 scientist with temporary contract, and about 70 students and guests.

3. Formal issues

As the Radiation protection law was issued in Austria in 1969, and the corresponding ordinance in 1972, there were very few relevant regulations in the first years of operation. The institute applied for licence in 1976, and after some time of contemplation, a license based upon the radiation protection law and ordinance was issued in 1987. This licence is subject of periodical annual inspections, which lead to some minor amendments.
The development of Radiation protection Standards as Council directive 96/29/ Euratom 13.5.96 *laying down basic safety standards for the protection of the health of workers and the general public against the dangers of ionizing radiation* [2] required a change of the Radiation protection law, being issued as adaptation to the EU- directive and issued in 2002. The radiation protection law can be found in http://www.lebensministerium.at/umwelt/ ⇒ Atomenergie&Strahlenschutz ⇒ Strahlenschutzgesetz. The relevant ordinance is still pending. Drafts of two ordinances (General and medical) as well as an amendment of the law were distributed for comments and expected to be set in force in 2005.

The consequences of the new regulations are to be expected in general within an acceptable frame. Some problem may arise as releases (e.g of Ar-41 were limited by dispersion calculations in the licence, but the draft of the ordinance regulates activity concentration in the exhausting air before release. The reduction of the annual dose lead to no problems at all, as the doses, as shown in 7., are still well below the new limit.

4. Radiation Protection Staff

The staff of the operational radiation protection group is small: the **radiation protection officer**[1] (with substantial tasks in university teaching and research), one **radiation protection engineer**[2], and some technicians as part time staff for sampling, measurement, and control tasks. As this staff is just able to manage general radiation protection, it is too small to fulfil the legal requirement that a person in charge of radiation protection is being present during operation of equipment and handling of radiation sources. For that reason, all members of the scientific staff who work with sources are, after appropriate training courses, assigned as **acting radiation protection officers**[3]. Another persons are assigned as acting radiation protection engineers for routine control and measurements.

5. Organisation of Occupational Exposed Persons

5.1 General

In addition to specific issues dependent on working conditions, the following consequences are associated with classification as an occupationally exposed person:

- physical surveillance
- medical surveillance
- attendance in general instructions

5.2. Access Control

[1] Qualification required by law (radiation protection ordinance) and approved by authority
[2] Qualification approved by law and assigned by the licensee
[3] Qualification approved by law and assigned by the licensee

As only occupationally exposed person have to have access to a controlled area, access has to be under control. The size of the institute justifies only one checkpoint, located at the entrance, where a guard is present permanently. This implies that the total area of the institute has to be classified as controlled area, although only required in specified rooms. This in turn lead to the condition that, for formal reasons, persons just being in the controlled are without any handling of sources or staying in an area with enhanced radiation or contamination level have to be classified as occupationally exposed persons. However, the reactor hall is a separate unit, where access is limited to a particular group of persons.

5.3. Classification of Occupationally Exposed Persons

The classification of persons being in the institute as occupationally exposed person is difficult for a number of reasons:

- duration of work: the duration of work ranges from permanent to temporary, where frequently some persons work in the institute for a short and in some cases even for a not predefined period
- mode of work: some people work simultaneously in different institutes or are changing institutes for short term fellowships.

Solution: For these reasons, an agreement was found with the authority interpreting the working conditions A [1] rather in terms of possible dose than in terms of duration staying in an area. Type of "workers" (rather students or guests) are is distinguished in terms of the working time scheduled:

- Very short (less than one month)
- Short (less than six month)
- more than six month
- permanent

The interval of medical investigations, set as two years by the authority, serves as a constraint.

6. Radiation Level and Workload

6.1. Dose Rate Level in the Reactor Hall

The (photon and neutron)- dose rate during operation is well below a few μSv/h. This is because shielding design was consequently changed from small heavy- concrete bricks to the use of specially designed large shielding blocks for long-term use. In addition, the shielding of scattered radiation was significantly improved.

6.2. Radiochemical Laboratories' Work Load

In neutron activation analysis, the radionuclides are gamma-emitters and are mainly short lived, the activity range being 1 - 10 MBq. About 500 samples per year are irradiated in the TRIGA-reactor and handled in the laboratories. In addition, about 500 samples per year are irradiated externally and handled. Waste management is not a significant problem as most of the samples are shortlived. The residual material is delived in the Austrian Nuclear Waste Treatment plant Seibersdorf.

7. Dose Records

The general progress in previous years of replacing radiation sources by computers suggests declining personal dose levels. This development is proved by dose records.

External monitoring, records: In 2003, 3285 TL from two approved dosimetry services were issued to staff and students, where the staff associated with the reactor is also supervised with neutron dosimeters (147 dosimeters). The dosimeters (two different TL systems) are still calibrated to photon dose equivalent H_x. The systems are approved by the BEV and hence represent legal measurements. The evaluation show that all dosimeters well below the limit of 20 mSv/a (reactor staff 0,8-1,7 mSv). The distribution of dose in 2003 period was: 99,96 % of the reading were below 10 % of the dose limit of 20 mSv, representing background

Routine internal monitoring (whole body counting and gross urine measurements by LSC) is carried out for persons working in the reactor or radiochemistry field, being about 15 persons. The annual measurements show no detectable incorporated activity.

Medical surveillance indicated no objections of occupationally exposed person

8. Temporary Problems

Constructional work (mainly electrical installations and computer network and replacing ceiling elements in the floors) was scheduled from January to December 2001, but lasted eventually until March 2003. All rooms of the institute as except the reactor hall were affected. The problem was that diverging requirements had to be taken into account:

- up to some 20 workers hat to enter the "controlled area" per day
- the workers were different as they were from different companies (total about 100)
- a classification of "occupationally exposed person[4]" was neither reasonable nor possible because of
  - no enhanced background level
  - short working period (few days or only occasionally)
- a classification of a controlled area could not maintained, as cleanliness as required for handling radiation sources was not proved

As the work in the institute could not interrupted for more than on year, a solution was needed to comply with formal requirements. A solution was to be expected, because parts of the institute were not affected for longer periods. The following solution was suggested to the authority and eventually accepted, where the reactor hall was not affected. After

- the labs for handling unsealed sources were subject of additional thorough contamination control to prove no contamination
- all radiation sources were locked into storage facilities
- all the operation of radiation producing equipments was subject of special approval

the classification of the "controlled areas" was declared invalid temporarily.

However, work subject to control was approved by the radiation protection officer when the following issues were confirmed by the responsible persons, where a separate sheet has to filled out for each procedure: the lab fulfils the requirements and the transport in the institute is under supervision that no exposure can result.

[4] EU Guideline 90/641/EURATOM requires in addition to other issues assessment of medical fitness for workers working before access in controlled areas

These issues had to be proved in advance for irradiation of samples in the reactor and for externally irradiated samples and for the operation of radiation producing equipments. The constructional work is not yet completed.

9. Conclusions

The issues reported above are subject of annual report to the authority. Occupational doses recorded in the last year are well below the limit and rather in the range of natural background. The EU- guideline did not affect any substantial changes. A modern university style requires flexibility and mobility of the staff and of students. International standards do not pay sufficient attentions to this. The effort is not considered to be fully justified, even taking into account that good radiation protection practice has to be demonstrated for educational purposes.

References

[1] FAO/I/AEA/ILO/NEA/PAHO/WHO *International Basic Safety Standards for Protection against ionizing Radiation and for the Safety of Radiation Sources*, IAEA 1996

[2] European Commission*, Council directive 96/29/ Euratom 13.5.96 laying down basic safety standards for the protection of the health of workers and the general public against the dangers of ionizing radiation*