Regulations on radioactive waste from practices using unsealed radioactive sources

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Abstract

Regulations on handling and disposal of waste from non-nuclear facilities have been in force in Sweden since 1985. These regulations are applicable on the handling of solid and liquid wastes from laboratories covered with licenses granted by the Radiation Protection Authority, SSI, for work with radioactive substances and where work results in production of radioactive wastes. Patient excreta is exempted from the regulations and free to release. The regulations are now being revised and will include liquid as well as solid waste as before but also releases of radio nuclides to air. The new regulations will also require documentation of waste management routines and the amount of waste produced in a laboratory. The work also aims at creating regulation that is simple and practical to use for the laboratories. The new regulation will be in force in December 2009.

Regulation

The Radiation Protection Act (SFS 1988:220) [1] gives the overall requirements for use of radiation in Sweden. According to the Act, every producer of radioactive waste is responsible for its safe handling including disposal. The Swedish Radiation Protection Ordinance (SFS 1988:293) [2] empowers SSI to be the competent authority in the field of radiation protection including the management of radioactive waste and to issue regulations. All users of unsealed radioactive material above exemption levels have to have a licence from SSI. The licence conditions include requirements for safe management of radioactive materials. For practices with extensive laboratory work with unsealed radio nuclides certain requirements for the safe management of radioactive materials are in force, for example; organisation and responsibility, design of premices and equipment, storage of waste, record keeping and documentation.

Regulation on waste management

The existing regulation on the handling of waste not related to the nuclear power sector, dates back to 1983 (SSI FS 1983:7) [3]. In the waste flow at a laboratory, this regulation is used when it is time to dispose the waste. Even though the regulation has been in force for decades it is still useful. The regulation is very practical and simple to use but there is a need for modernisation. The requirements on waste management should also, as far as possible, be identical to the ones for nuclear power facilities, concerning dose restrictions for members in the critical group.

Release of radio nuclides

The environmental objective, decided by the Swedish Parliament in 1999 states that the additional individual dose to members of the public should be lower than 10 µSv/a per person from releases from each individual practice [4]. Dose estimations made for different pathways from non nuclear practices show that doses to the public are well below 10 µSv/a from each pathway. As the supervising authority, SSI will raise the question of optimization if a release from a practice results in doses above 10 µSv/a to a member of the public. The licence holder will also need to present a realistic dose estimation to the authority.

Exposure pathways

The exposure pathways for waste from using unsealed radioactive sources are water through the municipal sewer system, solid waste to incineration and airborne releases.

Water

The major activity to the water pathway relates from the use of unsealed sources in diagnostic and therapeutical purposes in medicine. There are two types of waste; patient excreta and other liquid waste. A fair assumption is that all of the administered activity is found in patient excreta and found in the waste water treatment plant (WWTP). Three exposure scenarios have been tested; exposure to workers in the WWTP, exposure to the public from eating fish and exposure to the public from eating crops from soil fertilized with sludge [5]. The WWTP-worker scenario is the critical one. According to the results from a model created for this purpose the maximum dose to workers is up to 0,2 mSv/a. When studying the exposure from a realistic point of view, it is also known that the contact workers have with sludge is very limited [6]. Earlier studies have shown that the exposure to WWTP-workers is negligible [7]. The estimated doses to the public are well below 10 μSv/a for both scenarios. The use of sludge as fertilizer is also prohibited in Sweden because of its content of chemical substances.
Other liquid waste is only a small part of the activity that enters the WWTP.

Solid waste

Solid waste follows the same waste stream as non-contaminated waste with similar fraction, it is sent for incineration. Hospitals do not have incineration plants instead the waste is transported to plants for municipal solid waste incineration. The activity of the waste must be below nuclide specific activity levels, though. Incineration gives the next two pathways: handling of ashes and air borne pollution. Calculations on the critical incineration plant in Sweden gives estimation of doses to members of the public in the range of a few μSv/a from the airborne exposure. Ashes from the incineration plant will be deposited in landfills.

Air

Today the licence for some practices includes conditions on release to air. Releases need to be controlled from some research institutions, pharmaceutical or biotechnical industries and accelerators producing radio nuclides. Doses are estimated by the licence holder and reported to the authority. In order to create a complete regulation, releases to air will be included in the regulations this time.

Limiting releases

Optimization is a central principle. Handling of the waste must be taken into consideration at an early stage when planning a new practice or when making substantial changes in an existing practice. As all other parts of the practice, the waste management must be optimized!
In general, limiting releases can either be done by restricting releases according to nuclide specific activities or by forcing the licence holder to make calculations on doses to an individual in the critical group. To decide on the best solution for this, focus has been to find a way that is simple to use for the licence holder. Therefore the new regulation will contain a combination of the both: a list of nuclide specific activity limits for the solid and liquid waste, and requirements on dose calculations for air borne releases.

For airborne releases the licence holder needs to make a dose calculation and requirements aim at reducing releases resulting in doses as low as reasonable. This is not necessary for small scale releases through basket funnels but for licence holders for manifold systems where H-3 and C-14 is released and accelerators producing short lived radio nuclides.

Patient excreta will also be exempted from further requirements in the future. Decay tanks are neither considered necessary nor an option. ALI-values have been successfully used for many years for liquids and solid waste. There is no actual need to change the activity limits for reducing doses to the public, but it is suggested to use the same activities as listed in the Radiation Protection Ordinance as

exemption levels. For most of the radionuclides the ALI values are higher than the exemption value but for some nuclides the ALI-value and the exemption level in the Ordinance are the same. Even though the activity limit might be reduced for some nuclides it is only a small reduction and it is not likely to cause any major practical problems for the license holder. When the activity of the waste is below these limits the solid waste may be sent for incineration and liquids may be released to the sewer system. For waste containing higher activity, the waste needs to be sent to the treatment plant for radioactive waste, Studsvik Nuclear AB for processing and treatment by incineration or storage. It will also be possible to give a special authorisation for release for some radio nuclides after application of the licence holder.

Documentation and quality control

The new regulation will require documented routines on waste management and how the activity in the waste is estimated. The amount of waste that is stored, the amount of waste sent to incineration and liquids released to the sewer system need to be registered. The motive for these requirements is that the licence holder is responsible for the waste and must make sure that the activity levels not are exceeded.

Consequences of a new regulation

The new regulation will cause a bit more administrative work for the licence holder due to stricter requirements on documentation on the waste management. This is however a way to make sure that releases from the practise are below the given activity limits. The licence holder can with that show the supervising authority how the work complies with the regulations. Activity limits for release will be reduced for a number of radio nuclides. This is likely to cause a longer storage period before release, but it could also cause a more precise estimation of the activity in the waste.

SSI is aiming at using the same dose limits for non-nuclear and nuclear practises. When looking into the regulations it is soon obvious that the possibility of using the exact same requirements is difficult due to different risks for a release from the practices. In order to simplify the use of the regulation for both the licence holder and the authority, it is still important to have separate regulations for the different practices. The licence holders are working with completely different radio nuclides with very different half lives, activities and exposure scenarios.

References

[1] Radiation Protection Act (1988:220)
[2] Radiation Protection Ordinance (1988:293)
[3] Regulation of the Swedish Radiation Protection Institute of Radioactive Waste Not Associated with Nuclear Energy (SSI FS 1983:7)
[4] Swedish Environmental Quality Objectives-An Environmental Policy for a Sustainable Sweden. Government Bill 1997/98:145
[5] Rodolfo Avila, Idalmis de la Cruz, Synnöve Sundell-Bergman, Serena Hasselblad; Radiological consequences of radionuclide releases to sewage systems from hospitals in Sweden. SSI rapport 20007:10
[6] SSI dnr 2008/100-22
[7] Sören Mattsson, Bengt Erlandsson; Medicinskt använda radionuklider i avloppsvatten och rötslam. SSI/P105 1981-12-31

Dose calculations referred to from incineration will be published during 2008.