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Current practice for clearance in the Nordic Countries

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Abstract

An overview of the current practice for clearance in the Nordic countries has been made. The results from the overview are presented in this report. Authority requirements for clearance are presented and information on clearance experiences is given. Both practices from nuclear and non-nuclear activities are presented.

Key words

Clearance, clearance experience, clearance levels, clearance policies, clearance procedures, radioactive waste, radioactive material, radioactive contaminated metals, radiation protection criteria

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1 Introduction

International recommendations regarding clearance are e. g. given by the IAEA and the Commission of the European Communities (CEC).

IAEA TECDOC 855 [1] includes nuclides specific levels of activity concentrations intended for unconditional clearance of solid material in bulk quantities. These figures are more restrictive than nuclide specific exempt activity concentration levels in IAEA Safety Series No 115 [2] primarily intended for small scale practices and limited sources, not entering the regime of regulatory control.

CEC Radiation Protection 89 [3] includes nuclide specific clearance levels for recycling of metals from dismantling of nuclear installations, recommended for application by the competent authorities in the European member states.

National requirements on clearance in the Nordic Countries and the application of the requirements are presented below.

2 Practices in Denmark

2.1 Radioactive waste from nuclear activities

The national authority in Denmark that issues the requirements for any clearance of waste containing radioactive substances from a controlled area in accordance with Article 5 and Article 1 in The Council Directive 96/29/EURATOM is The National Institute of Radiation Hygiene (NIRH), part of The National Board of Health.

There have only been a very limited number of clearances involving waste from the only nuclear facility in Denmark: Risø National Laboratory (Risø) with the research reactors DR 1 and DR 3. Denmark has not by law applied any constraints for such clearances. Permission will be granted from NIRH on a case-by-case basis.

As a consequence Risø has to submit an application to NIRH for approval before any clearance.

When estimating whether waste may be cleared NIRH follows the basic criteria given in Annex 1 in The Council Directive 96/29/EURATOM and takes into account any other technical guidance provided by the Community.

The approval of clearance will always be given on the condition that the recipient is informed that the waste is cleared from a controlled area and additionally there shall be a written approval from the recipient accepting the waste.

Clearance experiences

The National Institute of Radiation Hygiene has dealt with two applications from Risø concerning clearance of metal scrap contaminated with small amounts of radioactive material. In both cases NIRH has cleared the material on the condition that the recipient, a Danish steel-melting company, was informed, that the material was cleared from a controlled area. In both cases the steel-melting company refused to receive the metal scrap. As a consequence the metal scrap is still situated at Risø. Conditional clearance for use inside the Risø area has been issued for other materials; sewage sludge and crushed concrete.

2.2 Radioactivity in waste from non-nuclear activities

An order on the Use of Unsealed Radioactive Sources at Hospitals, Laboratories etc. issued by The National Board of Health regulates the amount of solid radioactive waste from non-nuclear activities, which may be sent to municipal dump. The maximum concentration for municipal dumping is 0.01MBq/kg waste.

The order also regulates the amount of radioactive waste that can be discharged to the public sewage systems or sent to incineration plants. The maximum activity for liquid waste to be discharged in the public sewage system per month per authorisation is 5 MBq, 50 MBq and 500 MBq, respectively for radionuclides ranked after radiotoxicity with the additional condition that the concentration must not exceed 0.1 MBq/l. For solid waste sent to incineration plants the maximum activity in every waste bag must not exceed 5 MBq, 50 MBq, repectively 500 MBq ranked similarly and with the

additional condition that the dose rate on the outer surface of each bag must not exceed 5 μSv/h.

The regulations mentioned above are given in accordance with The Council Directive 96/29/EURATOM and with Regulations for the Safe Transport of Radioactive Material, Safety Series No. 6, IAEA 1985.

3 Practices in Finland

3.1 Origin of low level radioactive waste in Finland

In Finland, the main sources of low level radioactive waste are the two nuclear power plants. The waste management strategy is based on conditioning, storage and disposal of this waste at the NPP sites. At both sites, rock cavity disposal facilities are nowadays in operation: the repository was commissioned in 1992 at the Olkiluoto site and in 1998 at the Loviisa site.

At the end of 1999, the accumulated low and intermediate level waste amounted to about 6000 m^3 and two thirds of this amount was in the repositories. The rest was stored at the NPPs. Annually, tens of tonnes of very low level waste is cleared from regulatory control.

The radioactive waste from small users of radioisotopes is collected and, as necessary, packed by STUK. The amount of such waste is currently about 40 m^3. Since 1997, the small producer waste has been stored in a rock cavity located in the premises of the Olkiluoto repository. This waste is packed into steel drums (with concrete backfilling as necessary) or in steel boxes and for storage, the waste packages are enclosed into concrete boxes of 6 m^3. Some bulky waste items are enclosed into concrete boxes as such.

The Technical Research Centre of Finland (VTT) has a small research reactor and some laboratory rooms, where radioactive sources are handled. The radioactive waste arising from those practices is packed into steel drums, which are stored in a purpose-built storage room in the premises of the VTT. The amount of stored waste is currently a few cubic metres.

3.2 Clearance policies

Part of the waste generated in the controlled areas of nuclear facilities is so low-level that it can be cleared from regulatory control, and disposed of or recycled like ordinary waste. Clearance of waste can be unconditional or conditional.

Unconditional clearance is applicable to waste that, due to its low activity, shall not be regarded as nuclear waste as referred to in Section 3 of the Nuclear Energy Act. Then the method for the disposal or recycling of the waste need not be defined and fixed activity constraints for the waste are applied.

In the case of **conditional clearance**, the transferee and the disposal or recycling method for the waste shall be defined and the activity constraints shall be set on the basis of case-by-case consideration. By virtue of Section 10 of the Nuclear Energy Decree, the provisions of the Nuclear Energy Act are then not applicable to the cleared waste.

Detailed requirements concerning clearance of nuclear waste are given in the Guide YVL 8.2, issued by the Radiation and Nuclear Safety Authority (STUK).

3.3 Radiation protection criteria

The general radiation protection requirements are consistent with the recommendations of IAEA, NEA and EU (IAEA Safety Series No. 89), the waste cleared from one nuclear facility, shall not give rise to radiation exposure of the public exceeding

a) an effective dose of 0.01 mSv in a year to the most exposed individuals (members of the so-called critical group), or
b) a collective dose commitment of 1 manSv per year of practice, unless if an assessment for the optimisation of protection shows that exemption is the preferred option.

The following activity constraints are applicable to **unconditional clearance**:

a) The total activity concentration, averaged over a maximum amount of 1000 kg of waste, shall not exceed 1 kBq/kg of beta or gamma activity or 100 Bq/kg of alpha activity. In addition, no single item or waste package weighing less than 100 kg may contain more than 100 kBq of beta and gamma activity or 10 kBq of alpha activity.
b) The total surface contamination of non-fixed radioactive substances, averaged over a maximum area of 0.1 m^2 for accessible surfaces, shall not exceed 4 kBq/m^2 of beta and gamma activity or 400 Bq/m^2 of alpha activity.

For **conditional clearance**, activity constraints based on a case-by-case approval by STUK are applied which, however, shall not exceed the following upper bounds defined in the Nuclear Energy Decree:

a) The average activity concentration in the waste shall be less than 10 kBq/kg.
b) The total activity of cleared waste received by a transferee in one year shall be less than 1 GBq and the alpha activity less than 10 MBq.

3.4 Clearance procedures

For **unconditional clearance** of waste from regulatory control, an application shall be submitted to STUK, in which the origin and characteristics of the waste and the methods to be used for the determination of the activity of the waste are described. After the approval of the application, the waste can be removed from the facility as soon as it arises. Unconditional clearance is not applicable to such waste as is highly volatile or flammable, is of significant practical value or can otherwise particularly easily cause radiation exposure.

For **conditional clearance**, an application shall be submitted to STUK. The application shall include the information required in Section 48 of the Nuclear Energy Decree, and identification of and approval by the recipient of waste. In addition, a description of i) the origin and characteristics of the waste, ii) the methods used to determine the activity of the waste, iii) the method to be used for disposing of or recycling the waste and iv) the radiation exposure arising from the clearance of the waste are required. Waste is removed from the controlled area occasionally, a fairly large amount of waste at a time. The clearance approval may either apply to a single batch of waste or be constantly valid in case waste arises repeatedly and its disposal or recycling method remains unchanged.

STUK supervises by inspections that the waste is disposed of or recycled in accordance with the approved application. A summary of all cleared waste shall annually be delivered to STUK.

3.5 Clearance experiences

In Finland, the cleared nuclear waste originates mainly from the repair and maintenance works of our NPPs. There are no decommissioning projects for nuclear facilities underway or foreseen in near future. On the basis of our experiences, the amount of very low level metal scrap cleared for recycling varies from some tons to a few tens of tons per year and per NPP. This is mainly iron-based material. Occasionally the amount can be considerably higher when large components are dismantled and cleared. For example, about 300 tons of brass was cleared after dismantling of the condensers of the Olkiluoto NPP.

The cleared metal scrap has been transferred to Finnish foundries to be used as raw material. There has been fairly little public concern about clearance of nuclear waste. The foundries have nowadays portal detectors for discovering any radioactive contamination in loads that enter the foundry.

4 Practices in Iceland

There are no nuclear reactors in Iceland and there is very limited use of radioactive sources with high activity (such sources are mainly used in medical therapy). No accidents involving radioactive contamination of metals are known to have happened in Iceland. So far no special rules have been set in Iceland for clearance of scrap metal and metal products. The possibility of radioactive contamination of scrap metal has nevertheless been receiving increased attention, both at Geislavarnir ríkisins (Icelandic Radiation Protection Institute) and amongst scrap metal dealers.

The current Icelandic recommendations concerning classification and handling of radioactive waste are based upon the joint publication by the radiation protection institutes in the Nordic countries, Application in the Nordic Countries of International Radioactive Waste Recommendations, published in 1986. The ALI values in the publication have, however, been replaced with the current corresponding values for e(50), the specific committed effective dose, and assuming a maximum yearly effective dose of 20 mSv. ALI = 20 mSv / e(50).

The more recent EU and IAEA recommendations are also taken informally into account. Geislavarnir ríkisins is following the growing concern over the possibility of radioactive contamination of scrap metal. This concern may make it necessary to introduce exemption levels for radioactive contamination of metal products. Such levels would be based upon international levels and they would be set after consultation with the other Nordic Radiation Protection Authorities.

5 Practices in Norway

5.1 Radioactivity in waste from non-nuclear activities

Radioactive waste and sources from hospitals, industry and laboratories

The order ”Radiation protection regulations for use and treatment of unsealed radioactive sources” issued by the Norwegian Radiation Protection Authority (NRPA) in 1981 with authorization in Act of 12 May 2000 on Radiation Protection and use of Radiation, regulates release of radioactive waste from hospitals, laboratories etc. One authorised user can each month release, according to authorisation, a maximum of 0,4 MBq, 4 MBq, 40 MBq or 400 MBq respectively, for radionuclides ranked after radiotoxicity to both the sewage system and the regular solid waste. Only water-soluble materials are allowed released into the sewage system. Excreta from patients can be supplied to the sewage system regardless how high the radioactivity is. Normally liquid-scintillation samples are not a radiation problem when they go to incineration.

Radioactive waste should be stored at a licensed depot, or after arrangement be sent to Institute for Energy Technology (IFE).

Acquisition and use of both open and encased radioactive sources is regulated by NRPA. When the source is discarded it should be returned to the distributor who forward it to producer abroad, or has an arrangement with IFE to take care of it. There is a lack of practice concerning return of sources. NRPA will work to improve this practice.

Small sources, as smoke detectors, gas chromatographs etc., are thrown in the regular dump site. They go to incineration and depositing. At some dump sites the waste is being separated. This can lead to accumulation of radioactive sources. At present there are no orders regulating these sources. In the future NRPA will issue regulations concerning disused sources and their disposition.

Scale from the oil industry

Deposits on the inside of tubes and other equipment in the oil industry can contain increased amounts of natural radioactivity. These deposits are often called LSA Scale (Low Specific Activity Scale) or NORM (Naturally Occurring Radioactive Materials). The amount of scale has increased, due to the age of the oil-production fields. Seawater is injected into the reservoir to maintain the pressure. Scale can occur on the inside of production tubes and other equipment that have been in direct contact with water used in the production. There are two main types of radioactive deposits in the production equipment in the oil industry; carbonate- and sulphate-deposits. Measurements show that deposits in the oil production can contain concentrations of radioactivity 100-1000 times higher than what is normal in bedrock and soil. The dose rate on the outside of the production tube, depend on the thickness and density of the deposits.

Scale with higher activity than 10 Bq/g of ^{226}Ra, ^{228}Ra or ^{210}Pb are classified as radioactive and must be taken special care of. Scale with lower activity than 10 Bq/g for all these nuclides can be released to the environment. This is in accordance to clearance

levels given by the EU. Scale is stored at the operator's own sites. Later the scale will be disposed in rock cavities. The measurements of classifying contaminated equipment are usually performed with handheld instruments measuring the dose rate from γ-radiation. The measurements are then compared to established standards.

5.2 Radioactivity in waste from nuclear activities

Norway has two research reactors, JEEP II at IFE Kjeller, and the Halden reactor at IFE Halden. Radioactive waste from these is stored at IFE's site before it is disposed in the combined storage and repository for low and intermediate level radioactive waste in Himdalen. At present there are no domestic regulations for classifying the waste. Therefore when deciding whether the waste is being considered as contaminated or not, NRPA will consider exemption levels issued by the EU (EU Basic Safety Standards (1996)) and IAEA (IAEA Safety Series No. 111-P-1.1 (1992)).

IFE is according to regulations for use and treatment of unsealed radioactive sources allowed to release radioactive waste to the sewage system. Per month IFE can supply both the sewage system and the regular solid waste with maximum 0,4 MBq, 4 MBq, 40 MBq or 400 MBq respectively for radionuclides ranked after radiotoxicity.

5.3 Current practice for clearance of radioactive contaminated metals

Due to their nuclear programmes, some countries have criteria for how much radioactivity scrap metal and produced metal may contain when released from regulatory control. In Norway there is no current practice for such clearance of scrap metal and metal products. While there in some other countries have been some large events with radioactive contaminated scrap metal, no such events have occurred in Norway.

Some smelting and recycling facilities may have clearance levels for their own use, but there are no regulations declaring limits of contamination, neither have recommendations been issued by NRPA.

The smelting and recycling companies in Norway have had some events where metal products or scrap metal have been detected as radioactive. But no incidents where radioactive contaminated metal/scrap metal/sources etc. have been melted in the production have occurred. This is detected because the portal the metal travels through on its way in and out of the area detects radioactivity. When radioactivity is detected, NRPA shall be contacted. NRPA may then control the product, which has been detected as radioactive. When controlling the metal, NRPA may use hand monitors, or portable Ge- or NaI-detectors.

In deciding whether the metal is being considered as contaminated or not, NRPA will consider exemption levels issued by the EU and IAEA recommendations, as there are no domestic regulations at present.

6 Practices in Sweden

6.1 General

Clearance is a well-established part of the Swedish system for radioactive waste management. Already in 1982 the Swedish Radiation Protection Institute (SSI) declared that clearance of scrap metal can be permitted if it does not result in significant enhancement of doses to the public or to the personnel handling the material. Present regulation, the Code of Statutes SSI FS 1996:2, sets the limits for the radioactive waste from nuclear facilities which can be released from further regulation under the Radiation Protection Act. The SSI FS 1996:2 comprehend unrestricted re-use, as well as deposition at municipal dumping sites and incineration of oil.

The following description of practices is mainly focusing on radioactive waste from nuclear facilities. A short description of clearance of non-nuclear radioactive waste is however provided in section 6.5.

6.2 Clearance levels and radiation protection criteria

The Swedish clearance levels are consistent with results from studies made by OECD/NEA and NKS and with the clearance levels suggested by IAEA and EU. One of the bases for these levels is the 10 μSv per year individual dose criterion. An individual can be exposed to radiation from several practices and in order to prevent the total dose to rise above the trivial dose level, each practice should not contribute with an annual dose to the individual exceeding the order of 10 μSv.

Clearance levels for material from nuclear facilities (SSI FS 1996:2):

	Activity concentration		Total activity
	gamma/beta	alpha	per NPP
Unrestricted use	40 kBq/m^2	4 kBq/m^2	No limit
	0.5 Bq/g	0.1 Bq/g	No limit
Deposition at nuclear facility or municipal dumping sites	5 Bq/g	0.5 Bq/g	1 GBq/year
Incineration of oil	5 Bq/g	0.1 Bq/g	0.5 GBq/year

Clearance can be permitted at higher activity levels after application to SSI. Melted material from Studsvik has for instance, depending on the nuclide composition, been cleared at levels up to 1 Bq/g. One of the conditions were that the material must be re-melted with other material at a commercial smelting plant. The dose criterion used in these cases is the same as mentioned above.

Since the Swedish clearance levels are only intended for small amounts of material, they will be revised in the near future in order to take into consideration larger amounts of waste emanating from the decommissioning of nuclear facilities.

6.3 Clearance procedures

No licensing procedure is needed if the activity levels are below the ones mentioned above. Besides clearance levels, the SSI FS 1996:2 contains requirements on measurements and reporting. The yearly amount of material being cleared for deposition or incineration have to be reported to SSI. No reporting is required for material being cleared for unrestricted use.

SSI supervises the clearance of radioactive waste in Sweden and has for instance verified, by measurements at the SSI laboratory, the activity concentrations in material coming from the Studsvik melting facility.

6.4 Clearance experience

Figure 1 shows the amount of material that was released from regulatory control by deposition, incineration or melting during 1993-1998. No collected data are available for material that was released from regulatory control for direct re-use.

Deposition

Radioactive waste with low activity content may be disposed of at ordinary municipal dump sites. The material is released from regulatory control in connection with the deposition at the dump site. Sludges from sanitary facilities at the nuclear facilities may be deposited on arable land in accordance with conditions stated by the SSI.

Incineration of oil and hazardous waste

Slightly contaminated oil may be incinerated in furnaces designed for destruction of chemicals or in large oil furnaces. In some cases, hazardous waste, e.g. scintillation liquid, has been destructed in the same way.

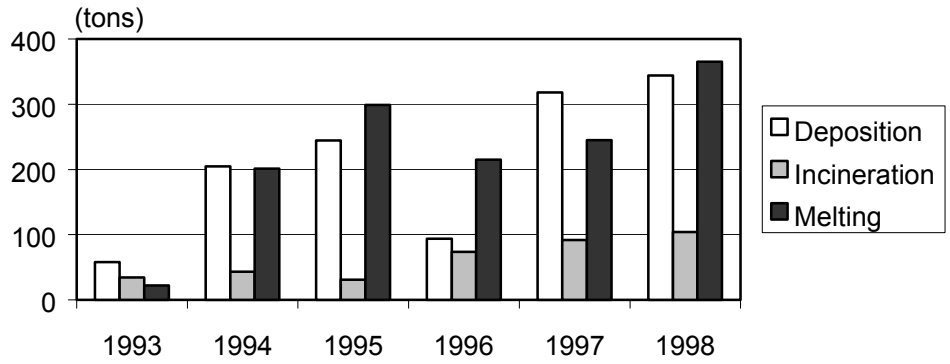

Figure 1. Diagram. Amount of material released from regulatory control by deposition, incineration of oil or melting of metals during 1993-1998.

Melting of metals

Melting of metals, mainly steel and aluminium, is performed at the nuclear facility in Studsvik. The resulting ingots are recycled in the metal industry. The melting of scrap material is regarded by the SSI as a suitable path for recycling of material. However, the steel industry has been reluctant to use the cleared material, and questions have been raised whether it would be possible to sell products that contain cleared material. This reluctance emphasises the need for broadly accepted clearance criteria.

6.5 Radioactive waste from non-nuclear activities

The Swedish Code of Statutes SSI FS 1983:7, regulates the amount of radioactive waste from non-nuclear activities (hospitals, research laboratories etc) which can be discharged to municipal sewage systems or sent to municipal dumping. The maximum discharge is 10ALImin/month and 1ALImin/occasion or package. A nuclide specific list of ALI values is attached to the Code of Statutes. Most of the nuclides have ALImin in the range of 10E6 to 10E9 Bq. The amount of solid material released under these premises is about 200-300 tons per year.

Occasionally areas in research laboratories, medical industry etc need to be released from further regulatory control. An application to SSI is then required and permission is granted on a case-by-case basis, but with the SSI FS 1996:2 as guideline.

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