

# The Swedish Radiation Safety Authority's regulations on exemption and clearance of NORM

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**Abstract.** Naturally Occurring Radioactive Material, NORM, is subject to radiation protection regulation. Because of this some natural activities are regulated overly strictly in some aspects. The Swedish Radiation Safety Authority, SSM, is proposing NORM regulations that present appropriate levels of specific activities both for exemption of NORM and for specific clearance. Few industries in Sweden give rise to NORM, and, as a rule, the amount is very small. Still, the discussion arises in management in connection with disposal or possible recycling of existing NORM and smaller fractions of NORM.

The proposed regulations define exemption levels for NORM, in line with the preliminary ideas for the expected next version of the BSS presented by the European Commission. For example, the exemption level is simply 1 Bq/g for any nuclide in the U-238 and Th-232 series, which is also the clearance level for bulk material. The regulations contain a restriction of < 100 tonnes of ash per year. Special regulations will be in force for management of ash from peat energy production facilities producing > 100 tonnes of ash per year.

For disposal on municipal landfill and similar disposal sites, specific clearance levels are ten times higher than the exemption values in BSS, i.e. 10 Bq/g for nuclides in the U-238 and Th-232 series. Also, certain products relating to alum shale, such as the shale itself and alum shale based concrete from demolished buildings, known not to exceed 3 Bq/g, are allowed for certain construction purposes other than for buildings, such as road construction.

**KEYWORDS: NORM, regulation, exemption, clearance**

## INTRODUCTION

When the EURATOM Basic Safety Standard, BSS, was implemented by amending the Radiation Protection Act in 2000, some practices required a licence although they represented very small radiation risks. Such extensive administration cannot be justified from the standpoint of radiation protection and the regulations, especially for NORM, have therefore been in need of simplification. Regulations on exemption and clearance of NORM up to a certain activity concentration have been developed and will enter into force in 2011. These regulations aim to simplify the management of NORM so that the material can be managed in a way that already is enforced in accordance with the environmental regulations. NORM is defined as "material containing naturally occurring radionuclides and which is in its natural state or has solely been processed or enriched for purposes other than for extraction of radionuclides and which is also not intended for processing in order to make use of the material's radioactivity".

## NORM IN SWEDEN

The draft version of the next BSS, expected to be in force in a few years, offers a list of NORM practices with possible radiation protection concerns. A review of such activities was carried out in Sweden between 2006 and 2007 (SSI ref. no. 2006/880-40) pursuant to the BSS Directive. There are few industries in Sweden giving rise to NORM, and, as a rule, the amount is very small. A few examples are given below. The main NORM relates to *drinking water filtration*. Both the National Food Administration and the National Board of Health and Welfare recommend that the uranium content in drinking water should be below 15 µg/l. Water filtration systems are becoming increasingly common for small single family water production and large municipal drinking water production plants. These filters, containing

uranium, may eventually need to be discarded. There are no industries generating large amounts of *scale* and it remains unnoticed until the metal is discarded and arrives at scrapyards, where sensitive dose meters are triggered. The slag produced in the *steel industry* does not contain activity concentrations that cause any need for protective measures. Peat enhances NORM and a concentration occurs in *peat ash*. Separate regulations are being drafted by SSM for peat burning installations consuming large quantities of peat and generating more than 100 tonnes of ash per year. This is discussed briefly in the last section of this paper.

There are large quantities of NORM from past activities, including the phosphate industry that produced *phosphogypsum* as well as practices going back several centuries, including residues from alum shale exploitation. The largest deposit of alum shale residue lies near the hamlet of Kvarntorp, containing 40 million m<sup>3</sup> of *burned alum shale*. Alum shale may have uranium content of up to 3.7 Bq/g. Also, about 20 million m<sup>3</sup> of alum shale-based lightweight *concrete* has been manufactured in Sweden. When buildings built using this concrete between the 1930s and 1970s fall into disuse and are demolished, large quantities of NORM are foreseen. The activity concentration in the concrete varies between only 0.6 to 2.4 Bq/g. Naturally occurring radioactive material can be in the form of *bore cores and drill cuttings* taken from bedrock as a result of drilling and rock sampling. Other examples include construction and agricultural work involving handling of excavated material containing naturally occurring radionuclides with a relatively high activity concentration.

## **EXEMPTION AND CLEARANCE**

### *Exemption*

Radioactive sources which occur in a licensed practice may be exempted from reporting, or exempted from regulation altogether, if the source has a low specific and total activity. For exemption based mainly on specific or total activity, a reference is used called 'exemption level'. Exemption levels to be used in the European Union are stated in an annex to the BSS and have been implemented in Swedish legislation. Sometimes a practice may be exempted due to the inherent safety condition of the practice, even if the sources used might exceed the exemption levels. Exemption always refers to human activities; the expression "a source is exempted" simply means that all human activity in connection with such source is exempted.

### *Exemption of NORM*

The regulations will exempt ceramic household products, decorative or utility goods and single unprocessed samples of rocks or minerals whose individual weight is below 10 kilogrammes and which are part of a geological collection from all provisions of the Radiation Protection Act. Also NORM that is present in private households is exempted. This material will be handled as waste in accordance with the Environmental Code.

For NORM arising in practices, exemption will depend on the activity concentrations of the material. NORM is exempted when the activity concentration is lower than 1 Bq/g per nuclide in the uranium or thorium series, and 10 Bq/g for potassium-40. The activity in slag from steel production is below 1 Bq/g and the material can be handled without any restrictions under the Radiation Protection Act. NORM is also exempted when it has been removed, deposited or reused in a manner as described in the regulations and discussed later in this paper. Licensing of the NORM practice is required when the activity concentration is ten times the concentration stated earlier. By this, as can be anticipated now, only a few water treatment plants will require licensing.

### *Clearance*

The term *clearance* is associated with a process in which a source previously subject to regulation may be exempted, i.e. taken out of the regulatory regime, for example due to radioactive decay. Another example is a certain part of a source, such as part of a wall from a nuclear installation, fulfilling the clearance criteria. Clearance levels must be lower than, or at least as low as, levels for general exemption. Otherwise, the source would enter into the regulatory regime again, after clearance. In the case of NORM, the regulations state that the clearance and exemption values are the same.

#### *The Radiation Protection Act, exemption and clearance*

After a source has been subject to clearance, the Swedish Radiation Protection Act is exempted completely. The same is not necessarily true for exemption. The Act has a requirement contained in Section 6, which stipulates that all aspects of a practice must be carried out in a safe manner in terms of radiation protection.

#### *Directed or specific clearance*

Sometimes a regulator can accept that a source exceeding the clearance level still may be subject to clearance for a certain waste stream, for instance if the source is disposed of at a disposal site. This is called *specific*, or sometimes *conditional* or *directed* clearance. In such a case, regulatory requirements may remain in effect until the source has been disposed of at a final disposal site. It should be mentioned here that other legislation, such as the Swedish Environmental Code, applies to disposal in municipal landfills. A meaningful specific clearance for a certain waste component therefore assumes that the suggested waste stream can be implemented without being blocked by other legislation. The waste may need to be stored until such assurances have been obtained.

#### *Specific clearance of NORM*

NORM having an activity concentration of no more than ten times the concentration stated for exemption and generated from practices may be delivered to a waste deposit site without taking the material's radioactive properties into account. This type of waste deposit site shall be arranged so that it gives at least the same level of protection as a waste deposit site for non-hazardous waste in accordance with the Landfill Ordinance (2001:512). Disused water treatment filters, zirconium sand and some scale can be disposed of in this way.

Certain types of NORM, such as building materials, burned alum shale, soil and rocks, may be deposited or reused for road construction. Waste from mineral prospecting should be managed in accordance with regulations on waste from extraction of minerals in *Utvinningsförrordningen* (2008:722), which is based on the EU directive on the management of waste from extractive industries (2006/21/EC).

## **DILUTION**

For practices using licensed sources, the rules normally imply that dilution is unacceptable. If an installation is dismantled in connection with decommissioning and a source is dropped into a container of scrap metal by mistake, it is necessary to recover the source for continued management according to the licence conditions. It is not acceptable to make a new calculation of the total specific activity of the container's scrap metal in order to determine whether the container's total content can be subject to clearance.

In the case of NORM, the situation is somewhat different. It is more natural to consider mean specific activity levels. If soil masses that partly consist of alum shale are transported in construction work, or if drilling for a drinking well removes a mixture of mainly inactive soil mixed with alum shale, it is not self-evident that the uranium-rich material must be separated from other material. When formulating the

rule, the Authority has already considered that specific radioactive concentration of alum shale is only moderately higher than the clearance value. For disposal of NORM, averaging is accepted for one truckload or for one occasion of disposal, e.g. at a disposal facility.

For naturally occurring radioactive material with an unevenly distributed activity concentration, an average value may be estimated for the activity in terms of the total quantity of material generated by the work, for example per transport or per deposit.

### **WASTE MANAGEMENT ACCORDING TO ENVIRONMENTAL LEGISLATION**

NORM is material that, when exempted from the Radiation Protection Act, will be managed as waste according to the Environmental Code. The NORM regulation has the aim of simplifying the management of NORM and legalising the management of the pre-existing material.

A person who generates waste must ensure that it is managed in accordance with the applicable environmental regulations. This requirement applies equally to households and industrial operators. For the household, it means sorting their waste and delivering it to the appropriate place. The owner of waste is responsible for its treatment as well. This nevertheless does not apply to household waste, which falls under the rules of local government authorities. The local municipality is responsible for the collection, handling and treatment of household waste, except waste covered by producer responsibility obligations. When NORM will be exempted from the Radiation Protection Act, materials owned by private persons, such as building material and water filters, will be managed this way.

### **OTHER REGULATION**

In addition to the Swedish Radiation Safety Authority's regulations concerning handling of naturally occurring radioactive material, other authorities may also have rules or regulations having an impact on the handling and use of such material. For instance, the Swedish National Board of Housing, Building and Planning has regulations concerning limits for radon and gamma radiation in new buildings. The National Food Administration has regulations concerning drinking water from major waterworks, and the National Board of Health and Welfare has general recommendations concerning drinking water from private wells as well as concerning radon in indoor air. The Swedish Work Environment Authority has regulations concerning radon in occupational environments. Material that is recycled should not be used as filler material on land where buildings may be constructed in the future.

### **SEPARATE REGULATIONS ON THE MANAGEMENT OF CONTAMINATED PEAT ASH AND WOOD ASH**

Since 2006, the handling of tree ash contaminated with  $^{137}\text{Cs}$  from the Chernobyl fallout produced in heating plants has been regulated in Sweden. Now a regulation is being drafted that will include both peat ash and tree ash. Peat ash can be contaminated with both naturally occurring radionuclides and  $^{137}\text{Cs}$ . The way of handling the ashes can be divided into two categories: recycling and depositing. The different scenarios considered consist of a deposit, a landfill, building materials, spreading ashes on forestland, farmland and on forestland where reindeer graze.

The regulation is valid for ash produced at heating plants that produce more than 100 tonnes of ash/y dry weight and when the  $^{137}\text{Cs}$  concentration  $> 1$  kBq/kg or  $I_2 > 1$ , where  $I_2 = \frac{C_{232Th}}{0,2} + \frac{C_{226Ra}}{0,3} + \frac{C_{40K}}{3}$ ,

where  $C_i$  is kBq/kg. At the  $^{137}\text{Cs}$  concentration  $> 10$  kBq/kg or  $I_1 > 1$ , where  $I_1 = \frac{C_{232Th}}{1} + \frac{C_{238U}}{1} + \frac{C_{40K}}{20}$ , the ash has to be deposited mandatorily. At the  $^{238}\text{U}$  concentration  $> 2.5$  kBq/kg, peat may not be used for

energy production. There are several possible ways to recycle the contaminated ash. All methods have a constraint on the dose impact on the general public from leakage of radionuclides from stored ash. Recycling is preferred for sustainability and economic reasons.

#### **REFERENCES**

SSI 2008/880-40. *Projekt "Uppåt" naturlig strålning till arbetstagare och allmänhet enligt miljömål och Basic Safety Standard.*