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**RECYCLING OF RADIOACTIVE MATERIAL**  
**CRITERIA FOR RELEASE FOR UNRESTRICTED USE**

*Shankar Menon*  
*Programme Co-ordinator*  
*OECD/NEA Co-operative Programme on Decommissioning*

**ABSTRACT**

Radiation protection and the management of radioactive material have hitherto been concerned mainly with artificial nuclides within the nuclear fuel cycle. During the last few years, there has been increasing awareness of naturally occurring radioactive material (NORM) that is technologically concentrated in many non-nuclear industries, to activity levels similar to those in low level waste arising in the nuclear industry.

One characteristic of the redundant material from the operation and decommissioning of such plants (both nuclear and non-nuclear) is that much of it is metal, most of which is surface contaminated.

A task group, within the OECD/NEA Co-operative Programme on Decommissioning, came to the conclusion that the major part of such material could be recycled and reused, without radiological restrictions, after suitable decontamination and treatment, if necessary. This would very significantly reduce the volume which would have to be disposed as radioactive waste and, at the same time, conserve the resources of valuable material. A major consideration, naturally, is the radioactivity level at which the material could be utilised without radiological restrictions.

Work has been going on in several international bodies on the radiological criteria for the release of such material for unrestricted use. Recommendations and interim criteria have been published. These are now being discussed in many fora, both by regulators and potential implementors.

**1. INTRODUCTION**

The OECD Nuclear Energy Agency's Co-operative Programme on Decommissioning was established in 1985 to exchange scientific and technical information between major decommissioning projects. Today the Programme, which is under the direction of the NEA Radioactive Waste Management Committee, has 35 participating projects from 12 countries thus representing the largest group of implementors of decommissioning. Technical experts directly involved in these projects meet regularly to report and discuss progress in the projects and problems of common interest. In 1992, the Programme set up a task group to study the recycling and reuse of redundant material from the decommissioning of nuclear facilities, in particular to provide information and insights into the practicality and usefulness of the criteria being developed for the release of such material from regulatory control, seen from the perspective of the implementors of decommissioning operations.

The management of the large volumes of contaminated materials arising from the decommissioning of nuclear facilities represents one of the most substantial cost fractions of such projects. Consequently, the minimisation of the volumes that have to be disposed of as radioactive waste is a high priority goal for decommissioners. The recycling of such material (or its reuse or disposal) without radiological restrictions is seen as a significant means of achieving this aim. Moreover, recycling has its beneficial aspects, such as conservation of natural resources and protecting the environment. However, the absence of consistent, internationally accepted criteria to regulate the release of recyclable material significantly restricts the utilisation of recycling and reuse as material management practices.

The OECD/NEA's Task Group on Recycling and Reuse made a survey of the current practices and national regulations in this area, studied the technologies associated with recycling and

analysed the proposed international recommendations and proposals for release criteria. A report of the work of the Task Group was published in 1996 [1].

This paper will focus on comparing the currently proposed international criteria with the results of the Task Group's analysis. The paper will then report on recent developments in the areas of management and regulation of very low level radioactive material both within and outside the nuclear industry. Finally, the paper will underline the need for consistency in the rules and criteria for exemption and clearance of all radioactive material.

## **2. RELEASE CRITERIA: RECOMMENDATIONS, DIRECTIVES, PROPOSALS**

The international discussions on release of materials for reuse or recycling are taking place mainly at:

- The International Commission on Radiological Protection (ICRP), which has supplied the basic recommendations regarding principles for protection from ionising radiation [2].
- The International Atomic Energy Agency (IAEA) which has tried to translate these general principles into recommendations on nuclide specific release levels [3].
- The European Commission (EC), who have prepared their own recommendations for countries within the European Union [3].
- The OECD/NEA's Task Group on Recycling and Reuse which can be considered as representing the potential users of the recommendations and criteria that are being drawn up by the IAEA and the EC.

In connection with the work and discussions in this area, a number of terms are used to denote specific events and conditions:

Exclusion covers activity sources not amenable to control, such as K-40 in the human body, cosmic radiation, etc.

Exemption had earlier been used to denote all radioactive material placed outside regulatory control because of the low risk they give rise to and because control would be a waste of resources. Later this term has been restricted to cover radioactive sources which never enter the regulatory regime, typically small sources such as "tracers used in research, calibration tracers and some consumer products containing small sources or low levels of activity per unit mass" [2].

Clearance, as mentioned earlier, is used to denote material that has been released from regulatory control. Clearance can either be unconditional or conditional.

## **3. RELEASE CRITERIA FROM THE DECOMMISSIONERS' VIEWPOINT**

The IAEA published TECDOC 855 in 1996, proposing nuclide specific clearance (release) levels for solid materials. It was issued on an interim basis for comment and will be revised (about 3 years after issue) to react to comments received and experience gained in its application. Earlier this year, the EC published Radiation Protection 89 [4], with nuclide specific clearance levels giving two options:

- direct release based only on surface contamination,
- melting at a commercial foundry followed by recycle and reuse. Mass specific and surface specific levels are provided.

The current recommendations of the IAEA and the EC are aimed solely at minimising radiological risks. No other risks have been considered. The Co-operative Programme's task group has looked at recycling in a broader context, evaluating both radiological and non-radiological detriments as well as social, economic and environmental aspects. This is seen to be fully in harmony with the ICRP concept that the justification of a practice should take into account the total detriment and not only the radiation detriment. The Task Group has found that, in comparing the "total risks" of recycling with disposal/replacement of the disposed metals, the non-radiol-

ological risks are much larger than the radiological and the non-radiological risks associated with the replacement of material are much higher (nearly twice) than those associated with recycling. Moreover, the Task Group has also qualitatively considered the beneficial aspects of recycling, such as conservation of natural resources and protecting the environment.

It is encouraging to note that the "total risk" approach of the Task Group seems to be gaining support in the regulatory world. In the foreword to the recently published EC document on radiological criteria for the recycling of metals [4], it is stated that "From a larger perspective it is reasonable to assume that metal recycling has a net positive impact on the health of workers and population compared to disposal as radioactive or ordinary waste and compared to the impact of metal ore mining to ensure replacement of spent metals. This net benefit should significantly outweigh the minor radiation detriment associated with the recycling of scrap with very low levels of radioactive contamination".

Radiation protection and the management of radioactive material have hitherto been concerned mainly with artificial nuclides arising within the nuclear fuel cycle. In the last few years, there has been an increasing awareness of naturally occurring radioactive material (NORM) and the enhancement of its concentration in various non-nuclear industrial (NNI) processes. This technologically enhanced NORM is of the same activity levels as low level waste and is very similar to the candidate material for exemption and clearance in the nuclear industry (NI), but occurs in quantities that are huge in comparison.

Both in the United States and in Europe, the radiological regulation of such NORM is under way. The EC came out with a new Directive in May 1996, with revised basic safety standards (BSS) for the radiation protection of both workers and the general public [5]. The Directive covers radioactivity in both nuclear and non-nuclear industries and will have to be ratified by member states within 4 years, i.e. by May 2000.

In the European Commission's BSS, industries are divided into "practices" (where radionuclides are, or have been processed in view of their fissile or fertile properties) and "work activities" (where the presence of radioactivity is incidental). Broadly speaking, "practices" refer to the nuclear industries, while "work activities" to the non-nuclear ones i.e. industries like oil and gas or phosphate industries, where naturally occurring radioactivity is incidental but is technologically enhanced.

The table of exemption values in the new EC-BSS covers only practices. The exemption values for work activities are not explicitly given. It is not clear from the text (and from other technical reports published by the EC) whether the same or different criteria would be considered for exemption/clearance in the nuclear and non-nuclear industries.

In the United States, a draft set of regulations for technologically enhanced NORM (TENORM) was given out in February 1997 by the Conference of Radiation Control Program Directors (CRCPD). The CRCPD is an organisation primarily consisting of directors and technical staff from state and local radiation control programs and functions as the common forum for state, local and federal regulatory agencies to address NORM-related health and safety issues. Several states have already regulations in place to meet their specific individual needs. There is, however, no uniformity in these regulations. One of the main aims of CRCPD is working towards uniformity in regulations governing radiation [6].

The current international recommendations for the exemption of radioactive material from being regulated and the clearance (release) of such material already regulated are both based on the criteria laid down by the IAEA Safety Series 89 regarding individual doses (10  $\mu$ Sv/year) and collective doses (1 person-Sv/year) [7]. Typically, exemption levels are a factor 10 higher than clearance values, the explanation being that exemption is intended to be applied to moderate quantities of material (say 1-10 t), while clearance concerns large quantities (10 000 t/year used in European studies). If radioactivity is to be regulated in a consistent manner, it will not be practically feasible to relate release levels to quantities, when the comparatively huge volumes of NORM material will be brought under regulation. So the resolution of the NORM issue is of the highest interest to nuclear decommissioners, whose projects, as mentioned earlier, are

characterised by the large volumes of very low level materials arising, very similar in radioactive characteristics to NORM.

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