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Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) and its Regulation

Aspects at Issue

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It has been known for quite a long time that mankind lives in a naturally radioactive world. Radioactivity is everywhere, in our own bodies, in practically all materials in the environment we live in and in the cosmic radiation from space. However, it is only during the last decade that it has become generally registered that naturally occurring radioactive material (NORM) is artificially concentrated ("technologically enhanced") in many non-nuclear industries. This concentration, termed TENORM, can be in the products, the by-products or the wastes arising from these industries.

The emergence of the NORM/TENORM issue has been of great significance for the discussions on clearance regulations in the nuclear industry. A task group of the OECD/NEA Co-operative Programme on Decommissioning has found that TENORM arisings occur in huge quantities; two to three orders of magnitude larger than those used in European studies on release of material from the nuclear industry. The activity levels in TENORM arisings are generally the same as in very low level nuclear waste. Their occurrence in a large number of industries, as well as their activity levels and quantities, have not been generally known, even to regulatory authorities, until fairly recently. Thus the regulation of TENORM is in its early stages.

The United States Environmental Protection Agency (EPA) was the first to make a systematic mapping of the occurrence of TENORM. A draft report from 1993 shows the following table of TENORM arising annually in the USA.

Table 1: Some TENORM Quantities

Waste Stream	Production rate (t/year)	U+Th+Ra (Bq/g)
Phosphates	5×10^7	Up to 3,700
Coal ash	6.1×10^7	up to 2
Petroleum production	2.6×10^5	up to 3,700
Water treatment	3×10^5	Up to 1,500
Mineral processing	10^9	Up to 1,100

Ra 226 with a half-life of 1,600 years is by far the most important radionuclide. These data are only shown to give an idea of quantities and activity levels. Other industries with significant radioactive waste streams are petroleum processing, geothermal plants and paper mills. Studies by the European Commission have shown that more or less comparable quantities of TENORM arise in Europe, with similar concentrations of radioactivity.

Two of the largest source industries of TENORM are the coal and fertiliser industries. According to UNSCEAR, 280 million tons of coal ash arise globally every year. 40 million tons are used in the production of bricks and cement and "a great deal" is utilised as road stabiliser, road fill, asphalt mix and fertiliser. Annual doses to residents can be up to several mSv. These doses are presumably only the gamma component. The main radioactive nuclide, as in most other TENORM, is Ra 226 and so, in addition to the gamma doses, there will also be a considerable dose from radon.

International organisations have earlier recommended an individual dose constraint of **10 µSv/year/practice** for the free release of material from radiologically regulated industries, and the removal of all subsequent radiological regulatory requirements. Because TENORM is, in many countries, regulated separately from the nuclear industry, the regulatory standards that are applied are in many cases different, and are often much less stringent for TENORM. It is not clear why national and international public health and safety recommendations allow what can be significant differences in public exposure from TENORM and from free-released materials. Recent draft European Commission and the International Atomic Energy Agency documents are, however, proposing to continue the **10 µSv/year individual dose** criterion for **the free release of material from radiologically regulated industries (mostly the nuclear industry)** while proposing a **300-1000 µSv/year for exemption/clearance of TENORM.** This can only complicate efforts to achieve consistency, harmonisation, ease of trans-boundary movement of material, etc. In practice, it also means that radioactivity from the nuclear sphere and from non-nuclear industries are treated on different scales of judgement, having extremely stringent release conditions for the material from the nuclear industries, while allowing up to 100 times higher exposures to the public from the much larger quantities of radioactive arisings from non-nuclear industries.

This "double standard" approach can have even wider implications than are obvious at first sight. For instance:

- The major TENORM radionuclide is Ra 226, with a half-life of 1600 years, while the dominating nuclides in scrap from the nuclear industry are Co 60 (half-life 5.4 years) and Cs137 (half-life 30 years). Current regulations at many near surface repositories have stringent limits on the quantities and concentrations of longlived nuclides in disposed material, limits that may well make it necessary – according to current regulations for nuclear industry waste – to condemn non-exempted TENORM to deep geological disposal. According to the currently proposed double standards, the same nuclide, at the same concentration, can either be sent to deep geological disposal or release for use in road repair, depending on whether it came from the nuclear industry or a non-nuclear one.

- The nuclear industry is living in a world where electricity is being deregulated and competition between various sources of power production is fierce. The double standards for clearance/exemption being proposed by the IAEA and the EC for material from the nuclear industries and for TENORM takes on a special significance when it is noted that two of the largest sources of TENORM are the coal and the oil & gas industries. Thus the double standards will be a blatant interference in the generally accepted rules for fair competition.

Finally, it can be noted that the US National Academy of Sciences has very clearly rejected any possible radiation protection reasons for treating radioactive material from the nuclear industry and that arising from the non-nuclear NORM industries on different risk evaluation standards. In its 'Evaluation of EPA Guidelines for Exposure to NORM', it states:

> *"The committee is not aware of any evidence that the properties of NORM differ from the properties of any other radionuclides in ways that would necessitate the development of different approaches to risk assessment.*

In the long term, it is absolutely necessary and very important for all the industries concerned, for international transport of material and for public acceptance, to have consistency in the regulatory requirements for radioactivity, irrespective of the industry it arises in.