

Radioactive waste management and sustainable development

The concept of sustainable development emerged at the end of the 1980s in response to the need to find a balance between economic development and the conservation of ecosystems. The Brundtland report defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.

Energy is an essential part of economic development, and contributes to increasing social stability by improving the quality of life. In order to achieve such improvement in the developing countries and to maintain it in the developed world, important increases in energy production will be required. Furthermore, it is probable that electricity production will increase more than that of other forms of energy, since it is convenient, versatile and clean at the point of use. As energy production and use will continue to increase, its effects on health and the environment must be controlled, in an attempt to reduce these effects to the extent possible, and thus meet the goals of sustainable development. Energy sources that do not pollute because of combustion gases, such as nuclear power and renewable energy sources, may be of vital importance as regards the reduction of emissions, but they are required to compete on a market in which fossil fuels are particularly abundant and at relatively low costs.

Radioactive waste is an unavoidable by-product of the application of ionising radiation in diverse areas, such as nuclear medicine, industrial applications and the conservation of foodstuffs, but is particularly important in electricity production due to its high level of radioactivity. However, the radioactive waste produced by the use of nuclear energy represents a very small volume – normally less than 1% – of the total toxic wastes generated in those countries that use nuclear energy to generate electricity.

In most OECD/NEA countries, short-lived, low- and intermediate-level wastes are disposed of using systems that guarantee the safety of people and the environment during the time that these wastes maintain their radioactivity. These wastes are duly conditioned and stored in facilities isolated from the environment by engineered barriers. High-level waste is first deposited in temporary storage facilities, under strict safety conditions, for several decades. These installations may be of the wet or dry storage type, and may be for a single nuclear power plant or for all those in a given region or country. Consideration should also be given to uranium mining tailings and to the waste materials from uranium concentrate manufacturing plants, which although not considered to be radioactive waste as such, are conditioned at the installations themselves and protected from meteorological agents by means of layers of different isolating materials.

Although there are no economic, technical or environmental incentives to speed up or hasten the construction of final disposal facilities for radioactive waste, temporary storage is not a permanent solution. In the interests of coherence with

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A transuranic package transporter on a forklift in the WIPP waste handling building in the United States.

the principles of sustainable development – of not passing burdens on to future generations – it is essential that the development of final disposal facilities be addressed.

The technology known as “deep geologic disposal” is now available for the final disposal of high-level waste. This is based on the stability and impermeability of certain of the geological formations in the Earth’s crust, in which the conditioned waste is placed, remaining isolated from the biosphere by a set of barriers, among them the geological barrier, for a sufficient period of time for its radiological activity to decay to harmless levels. The waste can be recovered, at least during the initial phase of the repository, and also during subsequent phases, albeit at increased cost.

The safety of geologic disposal has been demonstrated in nature itself. Almost two thousand million years ago a natural reactor operated discontinuously for millions of years, moderated by natural currents of water, at a uranium ore deposit in Gabon. The fission products produced during the nuclear reaction hardly moved from their original location. The first man-made geologic disposal facility for long-lived waste started operation in the United States in March 1999 and will provide industrial experience.

Furthermore, both the activity of long-lived radioactive waste and the time that it remains active might be considerably reduced by using partitioning and transmutation (P&T) techniques.

With this technology, the transuranic elements and long-lived radionuclides present in the waste, having been isolated, are transformed by neutron bombardment into other non-radioactive elements or into elements having shorter half-lives than the original ones. This option is being investigated by certain countries, but has not yet been developed, and it is not known when or whether it will become available on an industrial scale.

As pointed out above, one of the main objectives of sustainable development is to prevent the transfer of undesirable burdens to future generations. If the nuclear industry did not set aside adequate funds, the financial burdens associated with plant dismantling and radioactive waste disposal would be passed on. In OECD/NEA countries, the costs of dismantling nuclear power plants and of managing long-lived wastes are included in the electricity generating costs and applied to the end consumers; in other words, they are internalised. Although the cost of radioactive waste management is quite high in absolute terms, it does not represent a significant component in the cost of nuclear power generation.

The suitable management of radioactive waste implies the application of advanced technologies, the development of which requires qualified training and R&D programmes. This generates employment and provides a transfer of knowledge to future generations. Scientific and industrial development takes place under strict control, as a result

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The El Cabril site in Spain: the drums of radioactive waste are introduced into the concrete container before being disposed of into the repository vaults.

of which in practically all countries in which activities relating to nuclear energy are carried out, standards have been developed to guarantee the health of the general public, the workers involved and the environment. Likewise, institutions specifically responsible for nuclear and radioactive issues have been set up, and have been provided with human and material resources as well as the necessary legal authority to ensure high levels of safety control.

However, although radioactive waste management must first be based on rigorous science and technology, the solution must also be socially and politically accepted. In sustainable development, social equality and representation count as much as science and technology.

The dissemination of adequate information is essential, but not sufficient in itself. Communication is a two-way process, and confidence in this process often appears to be more important than the specific technical information actually provided. Overpowering information may be seen as offensive if it involves the audience having to accept it as an act of faith, and if harbouring doubt is considered to be indicative of ignorance.

In order to bring about a sufficient degree of acceptance, it is necessary to understand the mechanisms that govern the social perception of risk. There are many factors that affect the perception of risk, such as the level of control, familiarity with the technology, the degree of uncertainty, concern for the consequences, the degree of credibility of the institutions, the decision-making process and the ideas and values of the community in which people live.

Addressing the public's concerns and negotiating acceptable solutions will be an important challenge. A decision-making process should be set up step by step, and all the affected groups should be allowed to participate. The role of governments will be crucial in defining this process, and they should act as a source of objective information. They should also dedicate adequate resources for this purpose.

Finally, it should be borne in mind that international collaboration, accomplished mainly through the co-ordination and directives of organisations such as the OECD/NEA and the IAEA, is allowing for the promotion and globalisation of activities relating to nuclear safety, the development of standards, training, R&D and surveillance of compliance with non-proliferation treaties.

Conclusions

Radioactive waste management, as currently carried out in OECD/NEA countries, is fully consistent with the principles of sustainable development. It allows present generations to progress without leaving burdens for those of the future, while transferring to the latter a corpus of knowledge, standards and structures of international relations that will facilitate their own development.

Nevertheless, achieving public acceptance is essential if we are to attain the objectives of sustainable development. With this in mind, and in view of public opinion regarding the nuclear risk, it is necessary to provide impulse and include public participation in decision making. ■