SNETP
Sustainable Nuclear Energy Technology Platform

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The main areas of public concern regarding nuclear energy relate to safety, waste and proliferation. Despite massive attention being paid to these issues by designers, suppliers, operators, regulators and governments, a significant proportion of the general public remains unconvinced. However, opinions vary widely from country to country and depend on factors such as social status, education and gender. In general, people who are well informed about nuclear energy or who live close to nuclear facilities tend to be more supportive than those who are less informed or who live further away. This observation sends a strong message about the importance of openness and transparency and also about the value of information and site visits. This factsheet has been produced by SNETP to demonstrate to stakeholders that the nuclear research community takes the public's views seriously and is ready to address their concerns openly.

Nuclear Energy Factsheets

Nuclear Power: Issues of Public Concern

The 2011 tsunami in Japan and its consequences for the Fukushima Daiichi nuclear power plant confirmed that nuclear safety requires continuous attention. In hindsight, the nuclear accident could have been avoided with appropriate technical measures. The key lesson to retain is that complacency in dealing with risks and nuclear safety, in particular the nuclear safety culture and associated continuous improvement, the lack of critical assessment of plant safety by all stakeholders and insufficient emergency preparedness are among the critical root causes of the consequences of the accident.

It is a major reminder of the importance of nuclear safety for responsible nuclear energy generation and has led to great efforts worldwide in the nuclear sector and regulatory bodies alike to learn and improve when possible. Although the events in Fukushima have not led to radiation-induced casualties, a large area of land has been contaminated and over 100 000 people were evacuated from this area.

It is therefore a key responsibility for the nuclear sector worldwide to ensure and strengthen safety as much as possible and to make sure that adequate mitigation measures are in place to minimise the consequences of potential severe accidents.

Fukushima Daiichi NPP

• Nuclear safety

Nuclear safety generally refers to the ability of a nuclear facility and its personnel to prevent the uncontrolled release of radioactive material into the environment, and if this should occur, to limit the consequences of the release. Many factors contribute to nuclear safety starting with a suitable site, robustness of the design, its deep safety analyses, high quality construction and operation of the plant, a strong, independent regulator, and appropriate training of all personnel involved. In addition, sound operation and emergency procedures, preventive maintenance programmes, periodic safety reviews at regular intervals, and measures to incorporate lessons learned from operational experience, accidents and incidents are crucial. Last but not least, the consistent promotion of excellent nuclear safety culture based on critical assessment, transparency, openness and continuous learning are all key elements to ensure the highest level of safety. In fact, experience shows that safety culture is one of the most, if not the most important factor. It has been revealed to be decisive in avoiding potential accidents in the future and is being implemented in all nuclear countries.

Nuclear facilities, in particular nuclear power plants (NPPs), are complex systems with a large inventory of radioactive materials contained in nuclear fuel which can be potentially released. In order to minimise the risk and consequences of nuclear incidents and accidents, the design and operation of nuclear facilities are based on a defence-in-depth concept representing a set of successive protection levels and barriers against the uncontrolled release of these materials into the environment. During the 16 000 reactor-years of civil nuclear reactor operation, three major nuclear accidents have occurred: Three Mile Island, Chernobyl and Fukushima Daiichi, of which the last two have led to the uncontrolled release of radioactive materials. Technically these accidents could have been avoided, and the international nuclear community is responsible for learning from all of the aspects relating to them: why and how they could occur, what happened during the accidents and how the aftermath was managed.

• Severe accidents

NPPs and fuel cycle facilities have, in normal operation under effective regulation, very low health and environmental impacts. Radiation protection regimes based on the 'as low as reasonably achievable' (ALARA) principle have been generally effective in limiting the impacts of radiation on workers in nuclear facilities and the public. The levels are well below regulatory limits, which have been set conservatively. The events in Harrisburg, Chernobyl, and Fukushima have shown that severe accidents need constant attention from nuclear safety regulations and measures, as well as from nuclear designers. For example, continuous improvement through technological modifications, new materials, manpower qualification and training, accident management and enhanced regulatory effectiveness represent such measures. As a result, all reactors that are under construction today (i.e. Gen III reactors) incorporate by design additional safety features dedicated to the prevention and mitigation of severe accidents.

• Emergency preparedness

The concept of defence-in-depth in nuclear safety provides multiple protection levels against the occurrence of failures and their deleterious development in a serious accident. In very unlikely cases of failure of the engineered safety features, the protection of the population is ensured by implementing protective measures, such as sheltering, iodine prophylaxis, evacuation, control to prevent the distribution of contaminated food, etc. For these purposes, each NPP is required to have internal and external emergency plans prior to plant commissioning. Combined with the emergency plans established from the local to the national level, including governmental bodies and their institutions for crisis management, this allows coordinated actions with all organisations involved. The effectiveness and overall preparedness of these emergency plans are tested regularly.

• Radioactive waste

Radioactive waste from the nuclear energy sector represents small volumes that can be isolated safely from the biosphere at acceptable costs. Repositories for the disposal of short-lived, low-level radioactive waste are in operation in many countries. Long-lived and high-level radioactive waste has to be isolated over very long periods of time from the environment.

There is a high level of confidence among the scientific and technical community engaged in the field that the geological disposal of radioactive waste is technically safe, and that the technology for building and operating repositories is mature. Plans for implementing such facilities are already well advanced, as in Sweden, Finland and France.

Complementary approaches, such as partitioning and transmutation (P&T) of minor actinides, are being investigated as potential components in an overall radioactive waste management strategy. P&T of long-lived nuclides could reduce the radiotoxicity of waste sent to repositories, thereby effectively reducing both the amount and the lifetime of radioactive waste.

Each country is taking the time and responsibility to choose the best and most appropriate solution for storing nuclear waste. This responsibility is taken very seriously to ensure that the selected solution is robust and aligned with policies and social expectations.

The Implementing Geological Disposal of Radioactive Waste EU Technology Platform (IGD-TP) and other initiatives such as SITEX, carry out collaborative actions in Europe to facilitate the stepwise implementation of safe, deep geological disposal of spent fuel, high-level wastes, and other long-lived radioactive wastes by solving the remaining scientific, technological and social challenges, thereby supporting the waste management programmes in Member States.

• Nuclear proliferation

Proliferation risks of nuclear weapons and the associated public concerns induce constraints on nuclear power deployment throughout the world. While it is a political challenge for which no easy solutions exist, political and technical measures have been implemented to restrict unwanted developments. The Non-Proliferation Treaty and the IAEA safeguards regime implemented worldwide have generally proven to be effective in detecting and deterring non-peaceful applications. However, constant vigilance backed by strong high level political support, including ultimately of the UN Security Council, is needed to ensure the effectiveness of these actions.

The GEN III reactors under deployment together with the development of a new (4th) generation of reactors offer opportunities for enhancing proliferation resistance and facilitating safeguards. Past experience and ongoing R&D provide confidence that proliferation risks can be effectively reduced in the context of a stringent and powerful international safeguards regime.

REFERENCES

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