

A full understanding of the benefits and risks of current and emerging nuclear technologies and applications of radioactivity requires a thorough reflection on their context of application and the related technical, political, economic, social and ethical aspects.

This requires a transdisciplinary approach, where natural and social sciences meet, and multiple disciplines (nuclear physics, radiation protection, radioecology, ethics, sociology, psychology, communication, political science, law, decision sciences, economy) are brought together and combined. Such an approach aims at performing a genuine justification exercise and favours the pursuit of robust and transparent policies that account for societal concerns.

The broader framework for the activity of our unit is Science and Technology Studies, which create an integrative understanding of the origins, dynamics and consequences of science and technology. We address a number of thematic areas whereby focus is laid on:

- **Safeguards**, providing technical support to the verification of the peaceful use of nuclear materials and non-proliferation of nuclear weapons.
- **Societal aspects** connected to the use of radioactivity and nuclear technologies along the entire fuel cycle.

## SAFEGUARDS

### Context

One of the concerns of the general public related to the peaceful use of nuclear energy is the possible misuse of nuclear materials for the manufacture of nuclear weapons. In order to prevent proliferation of nuclear weapons, the international Treaty on the Non-proliferation of nuclear weapons was established in 1970. The signatories to this treaty accept Safeguards (verifications) on the nuclear materials in all nuclear installations by the International Atomic Energy Agency (IAEA).

In the last 15 years the focus of safeguards has been adjusted to include, alongside with verification of declared nuclear materials, also the search for possible non-declared nuclear activities in a country. This complementary monitoring requirement is laid down in the Additional Protocol of 1998.

### Objectives

Through this research programme SCK•CEN seeks to maintain its knowledge and expertise in safeguards, being able to provide advice for the authorities and other potentially interested parties in all safeguards matters related to current and future installations. The resulting tasks are connected to both the Non-proliferation Treaty and the Additional Protocol.



### Activities

The thematic issues dealt with in the context of safeguards include both technical aspects and socio-political analyses:

- R&D on safeguards approaches for present and future (Belgian) nuclear installations, through safeguards-by-design studies and vulnerability analyses, in particular for Gen IV type reactors, geological repositories and gas centrifuge enrichment plants.
- Nuclear metrology, specifically spent fuel measurement techniques for the industry and in support of the IAEA inspections at nuclear installations.
- Socio-political indicators of (non-)proliferation explaining the motivations of Member States to pursue or abandon nuclear weapons.
- Analysis and integration of open source information, environmental samples and decision-support system tools for the IAEA.
- Education and training in safeguards for the IAEA inspectors and other target audience.



Left: Fork detector for spent fuel characterisation developed by SCK•CEN. Right: Measurements of spent fuel using the fork detector.

## SOCIETAL ASPECTS OF NUCLEAR SCIENCE AND TECHNOLOGY

### Context

SCK•CEN started in 1999 its research Programme on Integration of Social Aspects into nuclear research (PISA). In 2010, the PISA research was taken up in the Nuclear Science & Technology Studies unit of the Society & Policy Support expert group.

Within this research we focus on social, ethical and political aspects related to the development, use and implications of nuclear technologies.

### Objectives

Through the use of specific methods such as reflection groups, public opinion surveys, stakeholder processes and decision-support tools, we seek to involve various parties (researchers from the nuclear and non-nuclear field, policy-makers and other stakeholders) in transdisciplinary and inclusive research activities.

We study the way knowledge is developed and decisions are taken, e.g. with regard to the (organisation of) involvement of civil society in nuclear technology assessment, both at research and policy level.

### Activities

Our current research in this area is carried out along three thematic lines:

**Risk governance**, with a focus on how society perceives and deals with risks related to nuclear activities and radioactivity. This is a cross-cutting theme, touching upon:

- Structures and processes for collective decision-making in matters of nuclear risk, where science, politics, industry and civil society are all invited to play a role.
- Risk perception and public opinion research on topics related to the use of nuclear technologies - the "SCK•CEN Barometer".
- Risk communication in radiological emergencies, in support of a more effective emergency management, with a special focus on the preparedness phase.



Experiments with media for risk communication research.

- International legislation on responsibility and liabilities in the case of transboundary environmental damage arising from the peaceful uses of nuclear energy.
- Ethical aspects of radiological protection, e.g. a comparison of the guidance frameworks used for the protection of human versus non-human biota.
- Multi-criteria analysis as a theoretical framework promoting a transparent decision-making process that can directly include stakeholders' preferences; we develop and use methods that account for inherent uncertainties and stakeholders' conflicts.
- Safety culture in nuclear installations, using perception based judgments.



Stakeholder engagement.

**Governance of radioactive waste**, centred around the siting of radioactive waste disposal and the process of engaging local communities and other stakeholders in complex decision-making.

**Energy governance**, including assessment of energy scenarios and aspects of justification of nuclear technology in the framework of sustainable development.



National and international trainings.

In order to share our knowledge and expertise and make it available to a broader public, including researchers, policy-makers and various nuclear and non-nuclear actors, we are actively involved in education and training programmes, covering topics such as ethics; technology assessment; social, economic and psychological impact of radiological emergencies; communication.

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