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Education and Training in Radiation, Transport and Waste Safety Newsletter

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Building competence through education and training in radiation protection, radioactive waste safety, and safety in transport of radioactive material is fundamental to the establishment of a comprehensive and sustainable national infrastructure for radiation safety, which in turn is essential for the beneficial uses of radiation while ensuring appropriate protection of workers, patients, the public and the environment. IAEA's Division of Radiation, Transport and Waste Safety provides direct assistance to Member States via a range of **tools and mechanisms**, such as by organizing educational and training events, developing standardized syllabi with supporting material and documents, and by fostering methodologies to build sustainable competence and enhance effectiveness in the provision of training. The main objective is to support Member States in the application of the IAEA Safety Standards. Seminars and additional activities are also promoted to **broaden knowledge** on relevant areas for an effective application of the standards.

Tools and Mechanisms to Build Competence through Education and Training

Background

The IAEA's Division of Radiation, Transport and Waste Safety has developed a large portfolio of tools and mechanisms to build competence through education and training aimed at enhancing and strengthening radiation safety infrastructures in IAEA Member States (Figure 1). The IAEA Strategic Approach to Education and Training in Radiation, Transport and Waste Safety (2011–2020)[1] assigned the IAEA Regional Training Centres (in Africa, Asia and the Pacific, Europe, and Latin America) a key role in the development of competence in the region, for example by hosting the Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources (PGEC), providing expertise for education and training in the area, and by collaborating with IAEA to disseminate the methodology for establishing a national strategy for building competence through education and training.

Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources (PGEC)

IAEA's PGEC is a comprehensive and multidisciplinary programme based on a standard syllabus which has recently been updated to take account of new IAEA Safety Standards such as the revised IAEA Basic Safety Standards and to ensure it is consistent with ICRP's latest terminology. It covers: Review of Fundamentals; Quantities and Measurements; Biological Effects of Ionizing Radiation; The International System of Radiation Protection; General Requirements for Protection and Safety; Assessment of Doses due to External and Internal Exposures; Planned Exposure Situations (generic requirements, specific requirements for occupational, public, and medical exposure); Emergency and Existing Exposure Situations. The PGEC also includes a module on 'Train the Trainers' as well as project work in which students are encouraged to do research or practical work that will be of direct benefit in their home country.

The PGEC is aimed at young professionals who may in later years become senior managers/decision makers with responsibilities related to radiation protection. Typically, around 80 to 100 participants per year benefit from this 6-month course that is hosted by IAEA Regional Training Centres in Africa (English and French), Europe (English and Russian), Latin America (Spanish), and Asia (Arabic and English).

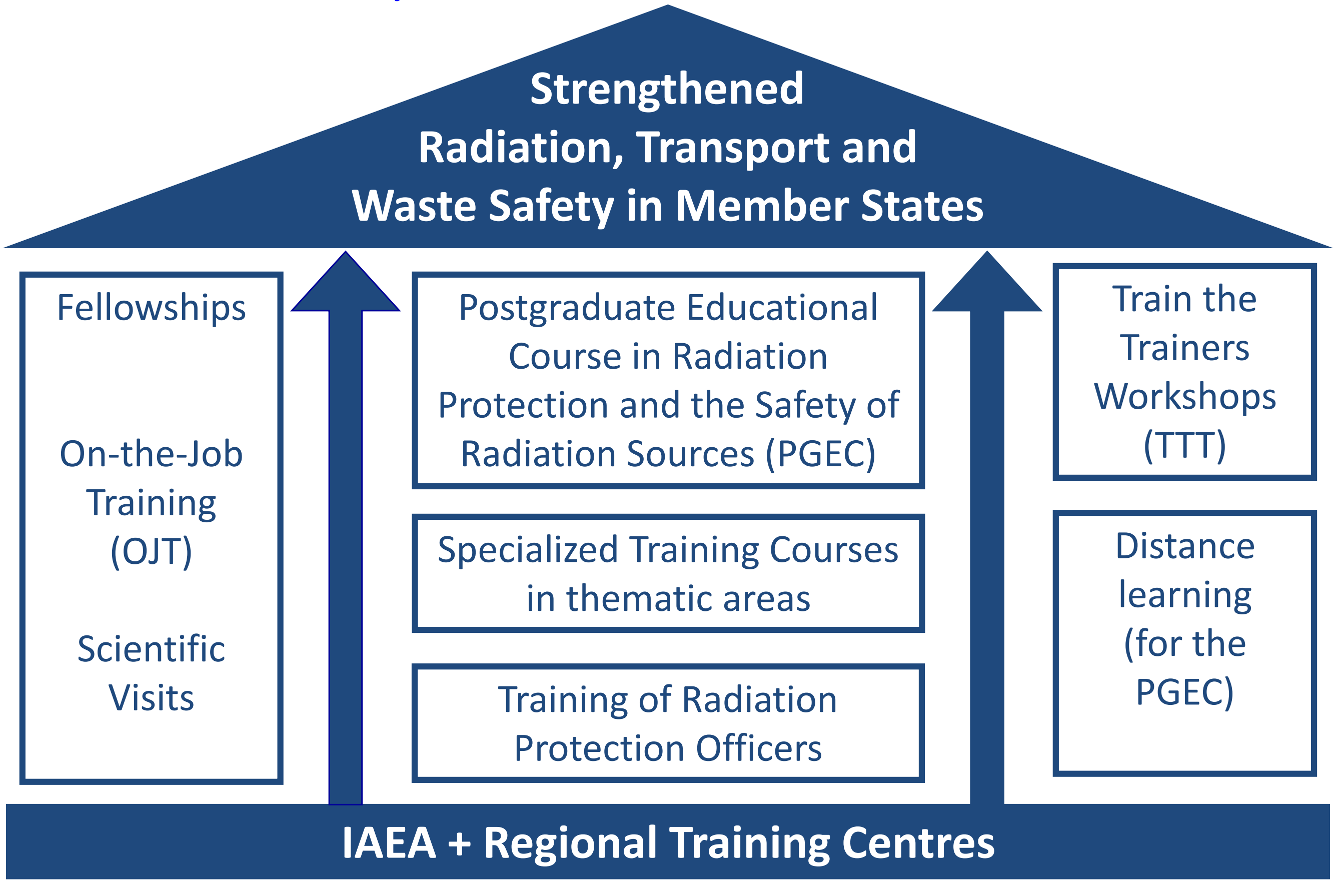

Fig.1: Tools and mechanisms to build competence in radiation, transport and waste safety.

[1] Note to the IAEA Board of Governors and General Conference '2010/Note 44'.

Fig.2: Group photo for the closing of the the Postgraduate Educational Course (PGEC) held in Ghana (2012-2013)

Presenter's material in the form of PowerPoint slides and lecture notes have been made available to the training centres to ensure that the information provided to the students is consistent across all regions and that it is based on IAEA Safety Standards. Data from the training centres shows an increasing trend in the use of national lecturers and less reliance on lecturers provided by IAEA. This is taken to be a good indicator that the competence and self-sustainability of these centres are improving, while noting that the use of external international experts is still valuable.

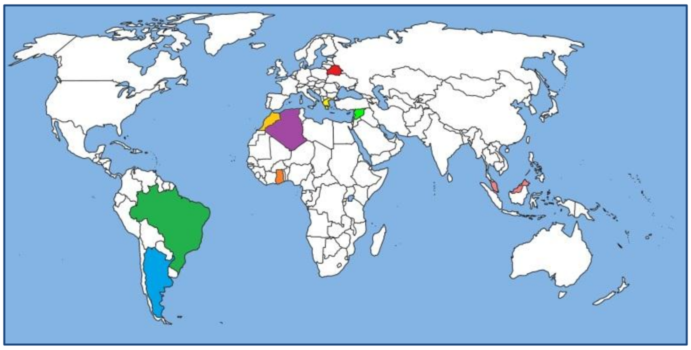

Fig.3: Member States hosting an IAEA Regional Training Centre for radiation protection: Algeria, Argentina, Belarus, Brazil, Ghana, Greece, Malaysia, Morocco, and Syria.

Specialized Training Courses in Thematic Areas

IAEA's Division of Radiation, Transport and Waste Safety has developed a large portfolio of specialized training courses of short duration (between 3 days to 6 weeks) on a range of subjects. Topics covered include, for example: regulatory framework; occupational protection; patient protection; radioactive waste management; transport of radioactive materials; and safety of radioactive sources. The courses are organized at both the national and regional level for various target audiences, such as: regulators; workers in industry, medicine and research; and medical staff.

Each year around 25 such training events are organized in various IAEA Member States around the world in Arabic, English, French and Russian, Spanish.

Fig.4: Example of training material for specialized training courses in some specific areas.

Training for Radiation Protection Officers

The Radiation Protection Officer (RPO), according to the IAEA Basic Safety Standards, is a person technically competent in radiation protection matters relevant for a given type of practice who is designated by the registrant, licensee or employer to oversee the application of relevant requirements. Noting the key role played by the RPO, IAEA is developing a syllabus for training RPOs, based on foundation and practice-specific modules. Foundation module is aimed at providing a basic understanding of: radiation protection principles and source safety; the general requirements of the IAEA Basic Safety Standards; and the duties of the radiation protection officer. The syllabus includes suggestions for practical sessions, demonstrations, laboratory exercises, case studies, and technical visits to re-enforce the theory. Practice-specific modules describe the additional topics to be covered by RPOs at a range of medical and industrial facilities. Suggestions are also made for topics that could be covered during 'on-the-job' training.

According to the IAEA Safety Standards, the Radiation Protection Officer is designated by the employers, registrants and licensees, in consultation with workers or through their representatives, in accordance with criteria established by the regulatory body.

Training the Trainers

The Train-the-Trainers (TTT) modality is aimed at developing communication skills as well as familiarizing participants with IAEA training material with a view to building a core of national trainers in radiation protection. The training material includes presentational and communication skills, organization of training events and practical exercises. The TTT course is designed to be interactive with an emphasis on presentations being by the participants. TTT workshops for radiation protection officers in medical and industrial applications have been run around the world at both national and regional levels.

Fig.5: Trainers' selection criteria: one of the subjects included in the Train-the-Trainers workshops.

Fellowships, On-the-Job-Training, Scientific Visits

Fellowships are normally awarded for periods of up to one year, and in certain cases, extensions for further periods may be considered. These fellowships are available to university graduates or their equivalent, and to individuals at technician level in the requested field, mainly through project-oriented on-the-job training. Subject to the availability of funds and/or suitable training opportunities, candidates are selected on the basis of educational and professional qualifications, the needs of the Member State concerned, the number of fellowships previously awarded to that Member State and the language proficiency of the nominee.

On-the-job training is provided to individuals by means of IAEA fellowships that are typically one to three months in duration. Such fellowships enable individuals to work alongside experienced professionals in well-established organizations with the purpose to get a practical experience and gaining specific skills for a certain methodology or process.

Scientific visits are awarded to senior staff for the purpose of studying the development of radiation protection and safety, organizational aspects and function of training providers, training programmes and schools in radiation safety, and observing research activities. These awards are intended to broaden the scientific or managerial qualifications of specialists in developing countries. The duration does not exceed two weeks.

Distance Learning

Distance Learning is a learning process undertaken under conditions where the learner and instructor are separated by distance and/or time. Distance Learning may involve the use of computer systems, the Internet, radio or television broadcasts, video presentations and correspondence courses. Such approach has become an important mechanism to reach out a wider audience while at the same time optimizing the resources necessary for the conduct of training events. The IAEA Division of Radiation, Transport and Waste Safety have adopted the Distance Learning approach to deliver the pre-training course for the PGEC. The pre-training material, originally developed in slides by the United States Nuclear Regulatory Commission, has been adapted to be delivered through the IAEA's Cyber Learning Platform for Nuclear Education and Training (CLP4NET). The aims of the pre-training course are:

- To refresh the knowledge of the participants with basic and relevant subjects to facilitate their attendance at the PGEC;
- To identify the areas where the participants might need further support.

The pre-training course has four modules on fundamentals, namely; biology and radiation effects, chemistry, mathematics, and health physics. Each module includes basic topics that are key and relevant to radiation protection and the safety of radiation sources. At the end of each module, a test is available to verify the level of knowledge of the attendee.

A first pilot edition of the pre-training course on Distance Learning modality has been conducted in occasion of the PGEC held by the Ghana Atomic Energy Commission with the support of the IAEA from November 2013 to April 2014. The 20 participants selected for the course were invited to take the Distance Learning course one month before the beginning of the PGEC. Their attendance was monitored thoroughly and the results of the tests on the various modules of the pre-training course were analyzed. A report on this pilot course was prepared and sent to the PGEC Director in Ghana to plan any further action needed to individually support the participants.

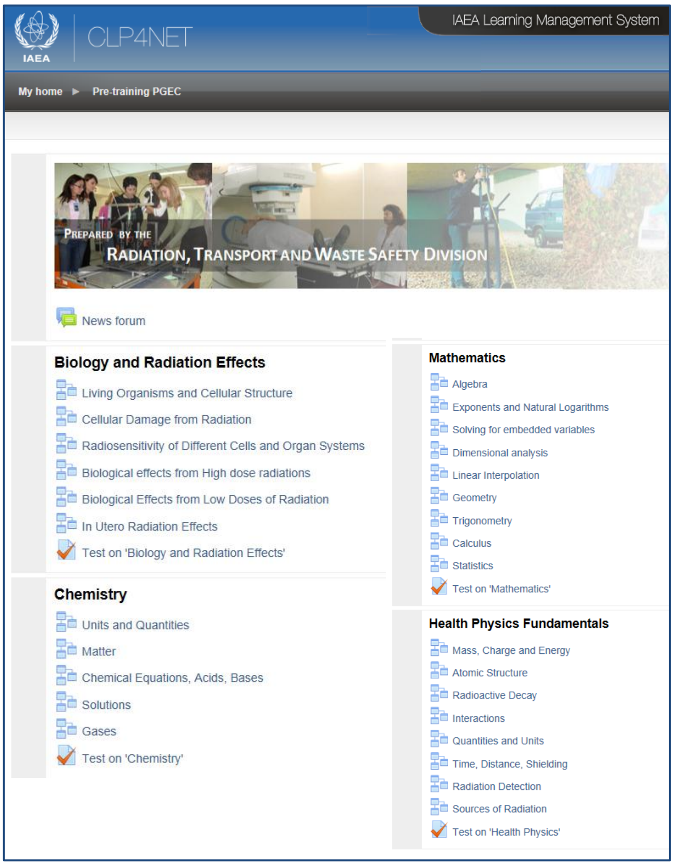

Fig.6: The pre-training course for the Postgraduate Educational Course (PGEC) on distance learning modality.

Broadening Knowledge in Radiation Safety

The Directors of the PGECs hosted in IAEA Regional Training Centres meet once per year to identify ways of harmonizing and improving the course by sharing good practices and lessons learned. In the meeting held in July 2013, Mr Gaston Meskens was invited to present his views on ethics in relation to radiological risk governance, and to share with the PGEC Directors his experience in lecturing on this topic, particularly in relation to a full day interactive seminar he conducted during a PGEC held in Malaysia in 2011. After his presentation and a very fruitful discussion, the PGEC Directors invited Mr Gaston Meskens to prepare a text to elaborate on an understanding of ethics in relation to radiological risk governance. That text follows hereafter.

The views expressed remain the responsibility of the named author. The information contained does not necessarily reflect the views of the IAEA.

The Ethics of Radiological Risk Governance

– a discussion text –

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1. Radioactivity and justification

What are we speaking about when we speak of ethics in relation to the radiological risk? Dealing with radioactivity in society is a complex challenge in any respect, but one can distinct four fundamental contexts that require different visions on that complexity, and on what it would mean to responsibly deal with it. The first context is the context of 'naturally enhanced' natural radiation. The second context concerns industrial practices that involve technically enhanced natural radiation. The third context is the context of peaceful applications of nuclear technology. These include applications of nuclear physics processes, such as the fission or fusion of nuclei for energy production or the use of decay radiation in medical treatment and diagnose or in industrial purposes. The fourth context is the use of nuclear technology or material as a weapon, either as a mean for political deterrence, in organised military operation or in terrorist actions.

The reason to distinct these different contexts is motivated by the scope of this short essay: to propose an understanding of the ethics of radiological risk governance and its relation to the social and political aspects of governance, and this as well in theory as in practice. To put it simple: if we consider average natural background radiation as an element of our natural habitat, then any significantly enhanced level of radioactivity in the vicinity of living species represents a risk – in the sense of a potential harm – to the health of those living species. In these cases, pragmatic reasoning thus requires us to consider the possibility of protection, mitigation or avoidance, but essentially to first evaluate why the radioactivity occurs in the first place, and whether we can possibly justify it. But whether that justification exercise can be done meaningfully or not depends on how we perceive the context of the occurrence of radiation.

For what the first context is concerned, whether we want it or not, natural radiation is there and any naturally enhanced occurrence (e.g. in the case of high concentrations of Radon) has a potential impact on health. Thinking in terms of justification of the presence of that radiation is meaningless, which leaves us with evaluating the justification of exposure, and thus of the possibility of protection, mitigation or avoidance of its impact. In the second context of technically enhanced natural radiation (for instance in the oil refinery industry or in aviation), radiation exposure manifests as a 'side effect'. Practices as such may be contested (as is the case with the oil or phosphate industry), but very rarely, the issue of radiation exposure will become a decisive factor in the evaluation of the justification of these practices. Similar to the case of naturally enhanced natural radiation, the radiation justification exercise thus reduces to the evaluation of exposure, and thus to the evaluation of the possibility of protection, mitigation or avoidance of its impact. In the third context, evaluation of the justification of the use of nuclear technology obviously takes the reason of that proposed use (the projected 'benefits') as a first criterion, with the aim to 'balance' it with the projected risks. Despite the fact that opinions on these projected benefits and risks differ among people, in this context, an evaluation of the justification of the use of a risk-inherent technology, or thus of the presence or 'creation' of radiation, remains meaningful, and this because the application context is 'neutral': while opinions may differ on how to produce energy or to do a medical treatment, nobody is 'against energy' or 'against medical care' as such. The neutral context thus makes a meaningful joint evaluation of the justification of the nuclear technology application possible, and it will not affect possible outcomes (a rejection or acceptance of the technology) as such. Finally, in the fourth context, a meaningful joint evaluation of the justification of (the risk of) the nuclear technology application is not possible, and this for the reason that the context of application itself is not neutral. A pacifist perspective does not support a principle justification of nuclear deterrence and armed conflict strategies, while, in a perspective that sees politics always as a politics of power and conflict, these strategies may be perceived as justified.

2. The ethics of justification

The ethics of radiological risk governance under consideration in this essay concern the third context: the use of nuclear technology in a ‘neutral’ application context, being it the context of the production of energy, the context of medical diagnose or therapy or the context of industrial use. So why this long introduction on contexts and then this narrowing of focus? The main argument of this essay is that the ethics of how we deal with the radiological risk primarily concern the ethics of the method of justification of the risk, and that the ethical consequences of its anticipated or manifested ‘adverse effects’ should therefore be assessed in that perspective. In simple terms, ethical consequences of an adverse impact of radiation (whether in the form of chronic exposure or an incident or accident) will be perceived differently by those affected if they sense that the nuclear technology application was justified in a fair way in the first place. But speaking in terms of a ‘fair justification’ is only meaningful for the third context described above. For the cases of naturally or technically enhanced natural radiation, thinking in terms of a fair justification of the risk as a side effect is meaningless. For the fourth context, being the context of military use or terrorism, a fair justification is by definition not possible, as there will never be a consensus on whether the context of application itself is ‘fair’ or not.

This doesn’t mean that one cannot think in ethical terms about enhanced natural radiation or military use, on the contrary. But one has to take into account that our ethical considerations cannot be ‘enclosed’ within a neutral context connected to the practice under investigation. Although ‘comparing’ these fields of ethics is meaningful for philosophical considerations related to radiological risk governance, a further elaboration on this falls outside of the practical limits of this text.

3. Ethics, knowledge and values

Ethics are about being concerned with questions of right and wrong, but there are different ‘levels’ of thinking about these questions. Philosophy identifies ‘meta-ethics’ as that discipline or perspective that deals with concepts of right and wrong (what is rightness? what is goodness?). Next to that, philosophers speak of ‘normative ethics’ as the discipline or perspective that considers the references that can be used to evaluate a specific practice or conduct. In that sense, normative ethics thus refer to ‘what ought to be’ in absence of ‘evidence’ that would facilitate straightforward judgement, consensus and consequent action. That absence of evidence can as well relate to the knowledge as to the values we may want to use to evaluate that specific practice or conduct.

In the case of evaluating a practice or conduct that involves a specific risk, we obviously need knowledge about the nature of cause and effect and about the probability that an adverse effect will occur. In this perspective, one may understand that the justification of a radiological risk is always complicated, and this by the fact that one has to deal with uncertainty due to incomplete and speculative knowledge about the natural, technical and social phenomena in play. There is the stochastic nature of low dose impact, but also the fact that we need to deal with human error (as in the case of radiotherapy or the operation of nuclear power plants) and with long term evolutions (as in the case of mammography campaigns or radioactive waste disposal). In addition to the need to deal with knowledge-related uncertainty, there is the need to deal with value pluralism. That is: even if we would all agree on the available knowledge to evaluate a specific risk, then opinions can still differ on its acceptability. In these cases, science may thus inform us about the technical and societal aspects of options; it cannot always instruct or clarify the choice to make. If we thus consider that an evaluation of the acceptability of a risk-inherent practice depends on knowledge-based opinions and values-based opinions, we can then construct a simple picture of four distinct cases as presented in Figure 7.

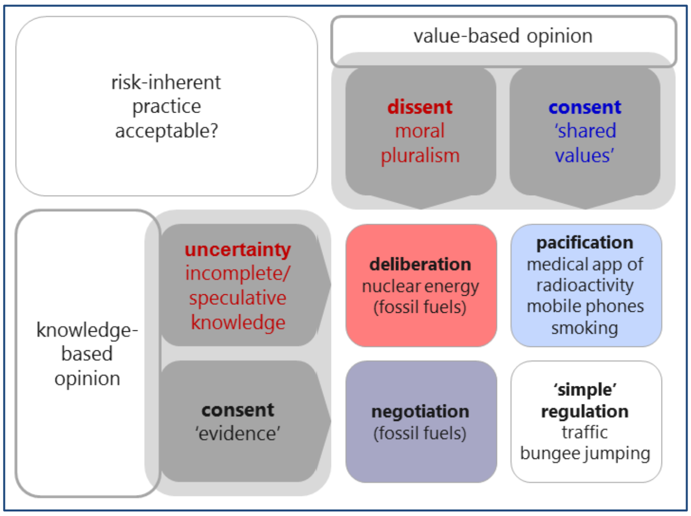

Fig.7: Justifying risk – Mapping the playing field (adapted from Hisschemöller & Hoppe 1996[2])

The context of this text does not allow broad elaboration on the figure, but it shows that justifying the risk of radiation in medical context, but also, as a comparison, that of mobile phones and smoking, is what social scientists call a ‘semi-structured problem’ that can be handled on the basis of ‘pacification’. The reason is that, despite of the fact that we lack evidential knowledge to assess those specific risks[3], people agree to take it on the basis of shared values. Shared values are thus about those

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[2] M. Hisschemöller, R. Hoppe, Coping with intractable controversies: the case for problem structuring in policy design and analysis, Knowledge and Policy: The International Journal of Knowledge Transfer and Utilization 8 (4) (1996) 40e60.

[3] Of course there is the known relation between smoking and lung cancer, but the lack of evidence is in the delayed effect and especially in the fact that there is contingency into play (there is no predictable evidence (yet) for why apparently some individuals are more susceptible than others).

situations wherein we have the feeling that we all accept a specific 'risky' practice in light of a shared benefit (mobile phones), or wherein we are of the opinion that there are specific risky practices whereof people should be able to decide for themselves whether they want to engage in them or not (smoking, bungee jumping). The only condition that should be fulfilled in any case is the condition of being informed about the risk and thus of being capable to judge for oneself to take it or not. Protection measures are thereby inspired by the precautionary principle and completed with additional measures to support those who want to 'quit' and to protect those 'passively involved' (for instance. the active versus passive smoker). In these cases, the fairness of justification thus relates to responsible dealing with incomplete and speculative knowledge, and the key criteria for fair justification are precaution and 'intellectual solidarity', taking into account that intellectual solidarity in this case translates as caring for the possibility of informed consent ('intellectual emancipation') and respecting freedom of choice.

In contrast to complex problems that can be handled on the basis of 'pacification', justifying or rejecting nuclear energy seems to be an unstructured problem that needs deliberation. Not only do we need to deliberate the knowledge one can use, deliberation will also need to take into account the various values people find relevant to judge this case, and the arguments they construct on the basis of these values. Therefore, the fairness of justification relates to responsible dealing with incomplete and speculative knowledge and with moral pluralism. The key criteria for a fair justification exercise are then again precaution and intellectual solidarity, taking into account that intellectual solidarity translates this time as caring for the possibility of informed consent ('intellectual emancipation') and intellectual confrontation (of the rationales we use to make our case).

In a way, we can say that connecting risk and fairness is about finding ground between ensuring people the right to be protected on the one hand and the right to be responsible themselves on the other hand. The right to be responsible leans thereby on the prime criterion of the right to information about the risk, but from there on, in a democratic society of capable citizens, it splits into two opposing meanings: it can translate as the right to co-decide (medical treatment, nuclear energy), but also as the freedom to hurt yourself (smoking, mobile phone use, bungee jumping).

Figure 7 shows us what we knew already: that risk is not a mathematical formula. It is a potential harm that one cannot completely know and one cannot fully control. With this perspective, the question of what is an acceptable risk has a simple answer (which doesn't mean that it is simple to put it in practice): people will accept a risk they cannot completely know and fully control simply when they trust that it is marked by fairness. And the figure tells us that fairness in this context simply denotes the fairness of the method of justification of the risk. This finding has important consequences with respect to responsibilities. It means that judging whether a risk is acceptable is judging whether it is *morally* acceptable. It also means that no scientific, managerial or political authority can determine alone what would be an acceptable risk. Scientific explanation, fair (open, transparent) communication and the 'promises' of protection (in the form of a responsible radiological protection and nuclear safety culture) are necessary conditions, but they can never generate societal trust related to acceptability themselves.

This last reflection brings along the need to raise awareness for the possibilities and limits of radiological protection and nuclear safety culture in this sense. In light of the previous, we can state that fostering a responsible radiological protection and nuclear safety culture is a *necessary but insufficient condition* for the societal justification of (the risk of) nuclear technology applications. Still many scientists and policy makers claim that a nuclear risk is justified when there is a responsible regime of protection put in place. Based on the ethical considerations above, we can conclude that it is actually the other way round: responsible protection needs to be put in place once all involved actors would have jointly justified the use of nuclear technology.

4. Elements of a fair method of justification

As a way to bring together the ideas presented in the last paragraph, I present here what I identify as the three basic elements of a fair method of justification in the case of risk-inherent practices of which the evaluation is complicated by knowledge-related uncertainty and value pluralism.

1	**The preparedness to see justification as a mutual agreement.**
	In the complex cases of nuclear technology applications, a risk cannot be justified through one-directional 'convincing explanation', but only through mutual agreement among concerned actors. Obviously, that mutual agreement, as outcome of a justification exercise, can either be to reject or to accept the use of a nuclear technology.
2	**Caring for formal possibilities of deliberation.**
	An acceptable risk is a risk that is justified relying on the formal possibility of deliberation among informed concerned actors (responsible and affected).
3	**Caring for intellectual solidarity by way of caring for intellectual confrontation 'supported' by intellectual emancipation.**
	In more detail, this implies > recognising that the practical limitations to participation in deliberation cannot be used to question the principle of participation as such; > enabling deliberation on values and principles as much as on practices; > enabling reflexivity: enforcing transparency with

> respect to the rationales we use to motivate our stake is only meaningful and effective if the setting also enables actors to be reflexive about their motivations;
>
> > caring for critical-intellectual capacities: the preparedness of someone to be reflexive about his/her stakes (and about the related beliefs, hopes and fears) can be called a moral responsibility, but it essentially leans on the capability to do so.

5. Intellectual solidarity concerns us all

As scientist, manager, politician, entrepreneur, medical doctor, RP officer, consultant, activist or citizen, we are all moral agents when we reason about complex issues such as the peaceful applications of nuclear technology. Moral reasoning belongs to our capacities as human beings, but it requires specific 'competences' that can be generally formulated as 'awareness', 'insight' and 'curiosity', as suggested in the table below.

awareness	- of context (social, political, historical); - of the societal implications of risk justification for specific applications;
insight	analysing and understanding - complexity, uncertainty, value reference; - consent, dissent; - the possibilities and limitations of science;
curiosity	- crossing borders between 'disciplines'; - leaving the comfort zone: developing a critical sense & an open mind.

In other words: in order to stimulate our ethical sense, we all benefit from the capability to analyse complexity and to become more reflexive with respect to our own stakes. Important to note is that these competences are not 'additional' to the so-called core competences of researchers, mandatories and policy makers, but that they are needed to support these traditional core competences.

6. The importance of education with respect to ethics of radiological risk governance

I could end this essay with the dry conclusion that the complexity of justifying the use of peaceful nuclear technology applications and of the consequent dealing with their potential adverse effects simply implies that education programmes for professionals (researchers, radiological protection and safety mandatories, doctors, managers, etc.) need to adapt to meet these advanced requirements and thus need to care for the development of the competences suggested above. However, in my multiple experiences with lecturing about ethics in academic and professional courses devoted to radiological protection and nuclear engineering, I have not only sensed with course participants the broad recognition of that need, but above all a general interest in and enthusiasm for contextual reflections about social, political and ethical aspects of nuclear technology applications. And even so participants have been consistently eager to reflect on what these ethical considerations imply for the responsibilities connected to their own role as researcher, radiological protection and safety mandatory, doctor or manager.

I thus dare to conclude that the big majority of students and professionals involved with nuclear technology in whatever context apparently consider courses on ethics as very relevant in general sense, even if there is no 'direct' connection to their own job. My experience tells me that students and young professionals have a hunger to engage in discussions on the big questions that surround their research and profession, but also that they feel that their traditional education and working environment is unable to satisfy this hunger or not interested in doing so. As a result, they not only lack coherent contextual knowledge related to 'the politics of nuclear technology', but are also in need of a language to speak of the complexity of risk justification and of the related scientific, social, political and ethical aspects. Therefore, recalling the principle of 'the right to be responsible', I dare to state that developing and employing the capacity for students and professionals to 'think out of the box' is not their duty but their right. And that right can be fulfilled by giving these students and professionals the possibility to engage in critical considerations about the ethics of radiological risk governance in general and about the consequent implications for their own research and policy field and professional mandate in particular.

Readers interested in joining a reflection group on the integration of courses on ethics in radiological protection education and training programmes are invited to contact the author at gaston.meskens@sckcen.be.

Impressum

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