The OECD/NEA perspectives on the maintenance of competence: future challenges for nuclear infrastructures

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Ladies and Gentlemen,
On behalf of the OECD Nuclear Energy Agency [NEA], I would like to express my thanks to the organisers of this Conference for creating this opportunity to meet here in Brussels and to address infrastructure issues, a very important area of increasing concerns for many of the NEA member countries. It's also a great honour and a pleasure for me to present, during this opening session, the perspectives of my Agency on this topic and to share with you the results of our studies. And on a personal basis, I would like to welcome this opportunity I was offered to represent my Agency, to introduce myself as the new NEA Deputy Director for Safety and Regulation. I would like to mention the participation of one of my NEA colleagues, Ted Lazo from our radiation protection division, who will chair the first session.
For many years, radiation protection has been a strategic arena of NEA activities. Through various programmes of work of its standing technical committees, and particularly of the Committee for Radiation Protection and Public Health [CRPPH] through expert groups, the NEA has continuously developed its knowledge in this field.
I will share with you some of the findings resulting from the NEA work relevant to this topic.
Before going into the details of this talk, however, I think that a few facts about the OECD Nuclear Energy Agency are important to be given to you as background to our work in this area.
The Organisation for Economic Co-operation and Development (OECD) is an international, intergovernmental organisation. Its member countries can be characterised as a group of developed countries sharing common values regarding democracy and market economy. The Nuclear Energy Agency is part of this broader organisation. One of the NEA strengths is the consolidation of the best expertise among developed countries which have sufficient experience in nuclear field. Broadly, the mission of the NEA is to provide assistance to its members to better address existing and emerging issues in the area of nuclear power. Emphasis is placed on developing scientific and technological bases for public, worker and environmental health and safety.
The NEA has for some time been concerned with the maintaining competence in all areas that are of relevance for nuclear energy. As you can see, a key NEA report relevant to this area dates from 1994, but we have worked rather continuously on this subject, both before and after 1994. The NEA concern has focused on maintaining competence in support of governmental actions to assure public health and safety.
In this regard, two of our committees, the Committee on Nuclear Regulatory Activities (CNRA) and the Committee on the Safety of Nuclear Installations (CSNI), recently developed a collective statement, and based on this, a joint strategic plan. This report analyses the current status of the nuclear power industry and, in particular, the main challenges that regulators and safety researchers will face in the next five years. These challenges will determine the focus of future CNRA and CSNI activities.
The first of these challenges that was identified is the shrinking nuclear infrastructure.
Several specific aspects were highlighted as being particularly relevant. It is clear that the number of suppliers of nuclear facilities and nuclear equipment is declining. For example, fewer countries than in past years are capable of manufacturing large steal tanks, such as reactor pressure vessels, steam generators, pressurizers, etc., that are essential components of nuclear power plants. This loss of institutional capability has been accompanied with the general "greying" of a generation of soon to retire, highly experienced experts. It will be difficult to replace this expertise as opportunities for careers that could help to build such expertise have been decreasing. Education in nuclear related fields has declined, probably in response to a market for new reactors that has been stagnant for almost three decades. The financial resources to conduct high-level nuclear safety and other nuclear-related research have also suffered greatly.
Although the political and economic climate for nuclear energy has changed recently and new nuclear power plants are ordered, the decline of the past years can not be erased overnight.
In 2000, the NEA published a study of nuclear education and training trends, and found several negative signs. Many university-level nuclear engineering programmes were being forced to merge with other departments for lack of enrolment. From 1990 to 1998, the period of the study, the number

of undergraduate degrees in nuclear-related fields dropped by 10%. Of these graduates, it was seen that between 20% and 40% respectively choose not to enter the nuclear field upon graduation, thus somewhat compounding the decline in the available workforce.
The study also revealed that the number of young faculty members joining nuclear departments is relatively small, and that most faculty members were in their late 40s or early 50s. The problem of aging is not limited to faculty, but also extends to facilities. The study found that the number of research reactors available as teaching institutions have declined, and that those that remain are generally over 25 years old.
To address this rather gloomy picture, it was recommended that action should be taken rather swiftly by NEA member governments. Several specific actions were suggested.

- Governments should encourage strategic, integrated planning, including education and manpower, should support and encourage young students, and should support the development of education networks.
- Universities should provide programmes that are more attractive, and should interact early and often with potential students.
- Industry should continue its rigorous in-house training.
- Research institutes should develop more exciting and attractive initiatives to attract quality students.

The value of co-ordinated efforts among governments, universities, industry, and research institutes was highlighted and sharing best practices was strongly encouraged.
Although it is difficult to pinpoint any single event, the focus on these issues over the past years has clearly had some effect because some possibly encouraging statistics seem to be emerging. As with many aspects of life, however, the playing field seems to still be shifting, so while some challenges are being met, others are emerging.
Beginning in the mid 1990s, the CRPPH began to survey university programmes offering degrees in radiological protection around the world. The focus of these surveys was on programmes and degrees in radiation protection, or what is called Health Physics in the United States. Programmes in what is called Medical Physics were not included in these surveys.
Now, after three rounds of surveys, it is starting to become possible to see some trends. Although not all universities have completed their reporting to the latest survey, many of them have, and so I am able to site some results from these programmes. I caution that these results are based on voluntary responses to a survey questionnaire, and thus may not be fully representative of all programmes. But these numbers can provide input to the assessment of general trends.
So, in terms of universities in the United States offering some type of radiation protection degree programme, numbers seem to be broadly stable. This being said, several of the more prominent programmes have, in the past few years, closed their doors.
In terms of enrolment, while not putting too much stock in the absolute value of these numbers, the trend seems to be a long-term decline, although this is less clear for Bachelors of Science, or BS, degrees.
Relative Trends from the US

Slight decline in the number
of universities offering RP degrees

Year / Degree	1996	2001	2003
BS	12	12	11
MS	26	21	18
PhD	18	16	16

Decline in enrolment

Year / Degree	1996	2001	2003
BS	173	111	294
MS	361	148	156
PhD	156	103	59

Decline in diplomas awarded but a change is taking place…

Year / Degree	1994	1995	1999	2000	2001	2002
BS	56	62	28	22	33	39
MS	151	172	60	53	39	47
PhD	32	22	15	19	23	20

Perhaps the most important statistic from these surveys relates to the number of degrees granted, that is, the number of students becoming available for the workforce. It seems that since the mid-1990s, the number of degrees declined rather significantly, even though if, in the recent years, signs of increasing slightly may have shown up. Nevertheless, what is clear, is that the total number of graduates is far fewer now than it has been in the past.

There are also examples of encouraging changes: this year, the University of Tokyo has established a nuclear professional post-graduate school supported by the Government and industry, to turn out high-level experts for nuclear regulators and nuclear industry.

Thus, while infrastructure remains a major issue within the nuclear power sector, there has been a significant focus on identifying these issues, and approaches to improvement. Recent development in terms of new plant orders, very concretely in Finland and Japan, encouragingly in France, and within the last few weeks in the United States, along with aggressive building plans in China, will hopefully contribute a positive impetus to the re-invigoration of the educational and research infrastructure.

Now, let's look back to the past. Society and its approaches to protection against ionising radiation have significantly changed over the past decades.

The RP professional has always been, and continues to be focused on the radiological protection science aspects of a particular situation being considered, in order to select the "best" radiation protection options. This can be characterised schematically as evaluating the identified radiological risks, and optimising protection to reduce risks. The roles and responsibilities of radiation protection specialists, as socially trusted partners, were clear and secure.

In the meantime, during the last decades, many groups and individuals have been interested in being involved in discussions and decisions, particularly those affecting public health and environmental protection issues. Individual members of the public subject to particular risks, local and national groups and associations, and even federal, state and local government offices not directly responsible for decisions often feel that their views should be taken into account during any decision-making process, and that their concerns need to be addressed. These individuals and groups, as well as the responsible regulatory authorities and, if applicable, the risk-causing facility/process operator, have come to be known collectively as Stakeholders. Stakeholder involvement in decision-framing and decision-making processes is increasingly common in today's world. Stakeholders question not only the role of science and but also the function of the authorities in risk decision making, and demand accountability in decisions regarding the management of risks. Stakeholders have succeeded in bringing social values in addition to scientific judgement, to decision-making processes.

A challenge that this evolution poses to the RP specialist impacts on education and training. Traditional engineering and RP science training has focused on technical aspects. However, RP specialists are increasingly being called upon to interact and communicate with diverse stakeholder groups, and to be able to appropriately provide technical information to these groups in forms and formats that address stakeholder needs and concerns. Although it will clearly not be necessary to train RP specialists to be "public relations experts", it is important that they be trained to communicate in both technical and non-technical fashions such that their essential messages can be correctly assimilated into decision-making processes.

Universities have to develop relevant curricula, but the training and education needed for this role may be difficult to fit in the busy schedules of university students. Government, industries and research institutes will need to consider these new realities in developing their future training programmes.

At the same time, some scientific challenges from radiation biology research need more efforts by RP professionals. Three broad areas pose particular challenges: the concept of dose as a measure for health detriment, the foundation of the LNT (linear non-threshold) hypothesis and an eventual genetic-susceptibility of individuals to radiation induced cancer.

We have to recognise that many RP experts are still needed for significant research activities.

The Nuclear Energy Agency will continue its work in all these areas, to hopefully contribute effectively to improving our approaches, thus better assuring a safe and environmentally friendly use of nuclear energy.

Thank you very much, Ladies and Gentlemen, for your attention.

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