

MANAGING NUCLEAR SAFETY KNOWLEDGE IN SMALL, NON-NUCLEAR COUNTRIES: CHALLENGES AND PITFALLS – *EXPERIENCE OF MONTENEGRO*

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Abstract

Addressing safe utilization of radiation sources in small countries is quite a specific issue in many ways – given modest (but only seemingly not demanding!) scope of activities/facilities, from one side, and limited resources/capabilities of the state, from the other. Starting from the premise that safety must be paramount, thus not compromised by any means at any moment, country's limited resources (institutional, human, financial, technical) should be used in the most meaningful (focused, efficient and effective) way towards achieving that aim. This is a reasonable and responsible attitude towards both the well-being of country's own citizens and to complying with international norms and obligations in the field. Two categories/principles emerge crucial in this respect: commensurateness and competence. Montenegro is a small, developing and “non-nuclear” country, the use of radiation sources being modest and limited to ordinary medical and industrial applications. Even though, there is (or will be in the foreseeable future) a considerable need for nuclear knowledge in many fields, safety-related one way or another. The multi-facet role of a state university in providing the required nuclear knowledge, competence, expertise and technical services is discussed in light of the above. Education, training and scientific/technical excellence are emphasized. The support of IAEA and European Union in generating adequate capabilities and creating a sustainable system in the country (through networking, e-learning, equipment and expertise provision, project frameworks, HRD schemes, etc.) is essential. While education basically stands for knowledge, training contributes to its practical applicability – both being fundamental constituents of competence. Importantly, training cannot replace education – attempting so, one falls into a typical competence pitfall. Training is thus meaningful only when superposed onto an adequate education. Messing up these terms will lead to a false perception of knowledge and competence (quasi-knowledge and quasi-competence); eventually, safety will inevitably be compromised. Some particular experience of Montenegro is outlined, concerning the establishment, goals and *modus operandi* of the University Centre for Nuclear Competence and Knowledge Management (UCNC).

1. INTRODUCTION

Nuclear safety knowledge and based-on-it nuclear safety competence represent a broad range of both theoretical and practical achievements of research and experience accumulated in more than hundred years of extensive developments in nuclear field. It goes from fundamental physical laws of the universe to widespread medical applications for diagnostic and therapy purposes, from nuclear power plants or nuclear weapons to common analytical techniques, from huge internationally operated accelerators to plain household smoke detectors...

However, the need for nuclear knowledge (safety-related in particular) in a society/country may vary substantially, depending primarily on two factors: its level of general development and whether the society/country utilizes (or intends to utilize) nuclear energy for power production or not.

Finding itself in a triangle between

- narrow scope of radiation activities/facilities (seemingly/deceptively not demanding);
- limited resources available in the country and
- domestic responsibility and international norms/obligations in the domain of nuclear/radiation safety,

a small country will likely recognize two principles to be followed in order to meet its goals in a realistic (focused, effective and efficient) way: *commensurateness* and *competence*. Being competent and finding the right measure (“not less, not more”) is thus imperative for all: users and facilities, regulators and legislators, technical support organizations and educational institutions, and others.

2. SITUATION IN MONTENEGRO

Montenegro is a small, developing and “non-nuclear” country (population 625.000, no nuclear installations or fuel cycle elements whatsoever). The use of radiation sources is modest and limited to a few ordinary applications – primarily in health care and sporadically in some other fields.

Even though and strange enough, there is (or will be in the near and mid-term future) a significant need in nuclear knowledge, competence and expertise – directly or indirectly related to proper (safe and effective) utilization of radiation sources. It goes about the following, the list being far from exhaustive [1,2]:

- medical applications (diagnostics, radiotherapy, palliation, sterilization of equipment, consumables, blood products, etc.);
- radiation protection, incl. various dosimetry services and QC/QA of radiation sources;
- environmental protection (radioecology, analytical and monitoring services, etc.);
- low and medium activity radioactive waste management;
- industrial, geological, hydrological, agricultural, biochemical and archaeological applications (non-destructive testing, various gauges, radioisotope labelling, harmful insects sterilization, etc.);
- scientific research, higher education and training;
- legislative and regulatory aspects, including both the development of domestic legal/regulatory infrastructure for the safe and secure utilization of radiation sources and complying to international safety norms and joining international conventions in the field;
- preparedness and response to radiological and nuclear emergency situations;
- combating nuclear terrorism and illicit trafficking of nuclear and other radioactive materials;
- nuclear forensics;
- security systems based on X-rays and other nuclear methods;
- introduction of some future topics (e.g. nuclear power for electricity generation and sea water desalination);
- public information and communication with media, etc.

Given that, it should be taken into account that Montenegro, even a non-nuclear country, used to be part of ex-Yugoslavia, which was a pretty advanced nuclear country. There is hence a certain germ/tradition in nuclear knowledge – especially in the system of higher education – which permeates favourably the local professional nuclear/radiation society.

Finally, one should note the above list is pertinent/applicable to many countries with similar nuclear/radiation profile. As a matter of fact, these countries make the vast majority (by number, at least) and the world and the IAEA system.

It goes without saying that the topics listed are relevant for all countries, thus nuclear ones as well. However, it is understandable that the approach to, and the treatment of nuclear safety knowledge are basically different in nuclear and non-nuclear countries – hence the point of the present paper.

3. KNOWLEDGE AND COMPETENCE – FUNDAMENTAL PREREQUISITES FOR THE PURPOSEFUL AND SAFE UTILIZATION OF RADIATION SOURCES

Successful implementation of international norms on the utilization of radiation sources – largely and in much detail addressing safety issues – requires a number of prerequisites at the State level. This primarily means the provision of adequate resources: legal, institutional, material (financial, technical, logistical) and, of course, human. Among the latter, it is often taken for granted that necessary knowledge and competence do exist *per se*. However, this is not always the case, just the contrary – time, efforts and material resources (both from the country itself and from international cooperation) are frequently wasted because these fundamentals are not built solid at first.

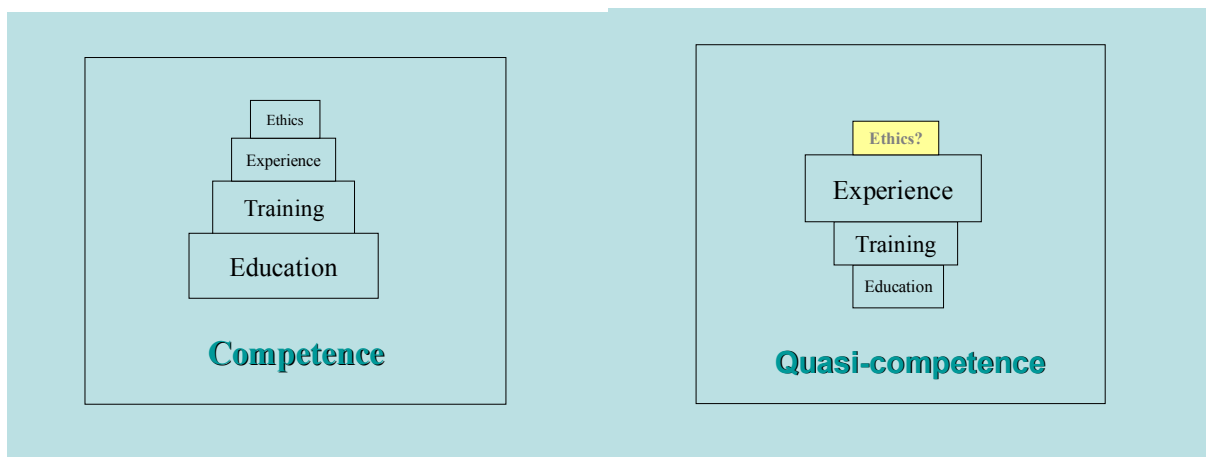


Figure 1. Education as the fundament of competence and competence vs. quasi-competence

Provision of adequate knowledge, competence and expertise represents consequently a major concern in small countries – if inadequate (e.g. like in Fig. 1, right), safety will eventually be jeopardized. The above are thus the fundamental prerequisites not only for the meaningful and purposeful utilization of radiation sources, but also for their safe and secure employment at all

Universities, state ones in particular, are the logical and regular points of creation, dissemination and preservation of nuclear (including safety) knowledge, competence and expertise in small countries. Let us mention hereby the fundamental difference between state and private universities: the former are meant for meeting the country needs in various aspects of fundamental and applied knowledge, while the latter are meant for profit.

Furthermore, while education basically stands for knowledge, training contributes to its practical applicability – both being fundamental constituents of competence. Importantly, training cannot replace education – attempting so, one falls into a typical competence pitfall. Training is thus meaningful only when superposed onto an adequate education. The same holds for experience. All of them (education, training, experience) are necessary constituents of competence, but messing them up will lead to a false perception of knowledge and competence (quasi-knowledge and quasi-competence); eventually, safety inevitably will be compromised (Fig. 1).

A similar dangerous pitfall is the misperception (unfortunately, not so uncommon in small non-nuclear countries) that competence stems from the position the person holds. It should be *vice versa*, of course.

Quasi-knowledge and quasi-competence are more perilous for nuclear safety than plain ignorance and incompetence (i.e. clear lack of knowledge and competence), as the latter are more explicit and easier to recognize/prevent/rectify.

It is important to note that quasi-knowledge and quasi-competence can be traced behind most of nuclear mishaps – from minor/benign incidents (like just poor, clumsy communication with public/media), to major accidents with grave consequences.



Figure 2. University of Montenegro campus (left); IAEA NKM Mission in 2009 (right)

In this context, the importance of formal education at universities is crucial and should be particularly pointed out. In its complexity, it includes the ensemble of i.a. educational programmes accreditation and regulatory overview, teaching staff qualification and permanent development, selection and enrolment of students, international inter-university cooperation with student exchange/ mobility schemes, etc.

4. UNIVERSITY OF MONTENEGRO

University of Montenegro (UM) is the only state university in the country (Fig. 2) and the only one providing higher education, scientific research and expertise in natural and technical sciences, including nuclear/radiation-related ones – it is the statutory duty of UM to do so, and to do it in a manner commensurate to the country needs [3]. By far the most relevant expertise in the country is either concentrated at UM or is deriving out of it. Therefore, it goes without saying that UM has fundamental role in meeting nuclear knowledge management (NKM) goals in Montenegro, including the safe and purposeful utilization sources [4].

5. IAEA AND EU ASSISTANCE

Small issues in big countries are often big issues in small countries. IAEA offers the unique and equal opportunity for all Member States (MS) to come up with their problems and seek for cooperation/assistance in order to cope with them; given the impetus/interest from MS, there are numerous modalities IAEA offers in pursuing these goals.

Montenegro became an independent country and IAEA member state in 2006. It has since successfully participated in various IAEA activities, including several cycles of technical cooperation (TC) projects. In the beginning the focus was on developing regulatory infrastructure (legal and institutional) and upgrading capabilities in medical application of radiation sources (diagnostics and therapy). Given the country is an “ecological state” – as defined by the first article of its constitution – emphasis was put on environmental protection as well (radioecology and application of nuclear techniques in environmental monitoring). Safety and security were addressed through participation in dedicated activities organized by the IAEA – e.g. projects on drafting national radiation regulations on radiation safety, or combating illicit trafficking of nuclear and other radioactive materials (whereby border police capabilities were upgraded towards meeting international norms).

Being in the negotiations/accession process with the European Union (EU), Montenegro is also in position to benefit from various mechanisms existing in the EU to strengthen capacities in non-power applications of nuclear energy, including safety of radiation sources. In this sense, our positive experience with IAEA cooperation was affirmatively reflected/accepted during negotiations on Chapter 25 – Science (the chapter being much about cooperation with EURATOM). This chapter which was the first chapter to be opened in the negotiations and was successfully closed (preliminarily, awaiting finalization of negotiations/accession).

It is the policy of the country (institution in charge is Ministry of Science) to approach cooperation with the two (IAEA and EU) in the way that the activities complement and resonance with each other, rather than overlap or excess – fortunately/helpfully, it is already in the mechanisms of IAEA and EU for the most part. This is reflected *inter alia* in the latest Country Program Framework (CPF), specifying priorities in technical cooperation for the period 2014-2020, with human resource development (HRD) among the first priorities [5]. Note that the CPF period coincides with the supposedly final stage of Montenegro accession to the EU.

6. NETWORKING

Networking is becoming increasingly important for managing (building, preserving, sustaining, disseminating) a national body of knowledge, competence and expertise (NKM). This is particularly valid for those countries whose domestic resources are limited and/or where no critical mass of the above three constituents exists, which could sustain the system on its own. For instance, IAEA-based international networks for nuclear security education (INSEN) [6] and training/support (NSSC) [7], even relatively recent, proved pivotal/fundamental in this respect. There are also very useful dedicated networking schemes hosted by the European Union.

Networking is highly permeable and successful within university communities. It is easy to join/participate for all interested in a topic, regardless of academic titles, positions, etc.

At UM (Department of Physics) we have launched several targeted educational courses at post-graduate level, following the IAEA-INSEN guidelines [8]; the pioneering educational materials developed within the network represent the basic literature for both students' and lecturers' use [9]. We also participate in nuclear knowledge management (NKM) activities and use their information system (INIS) when sourcing relevant data. UM is also national contact point for INES (International Nuclear and Radiological Event Scale) and has trained staff for properly reporting in case of incident/accident. UM participates in IAEA-supported Nuclear Instrumentation Laboratory Network (NILNET).

Selected laboratory services are offered as well, primarily for educational/training purposes, but also for routine measurements, monitoring of radioactivity and radiation parameters in the living, working or outdoor environment. Laboratory for nuclear spectrometry has classic NaI and HPGe detector systems, very high sensitivity anti-coincident spectrometer, etc., while environmental laboratory offers atomic absorption spectrometer, medical QC/QA control devices, radon equipment, etc. [10]. These are all at students' permanent disposal for educational purposes at various levels (B.Sc., M.Sc., Ph.D.) and within various educational programmes (radiation protection, safety and security of radiation sources, radioecology and environmental protection, etc.).

7. CONCLUSION: WAY FORWARD

In concluding, let it be emphasized that Montenegro is determined to continue with its efforts in improving nuclear safety knowledge and the way it is managed. In particular, the pivotal institution, State University of Montenegro, through its Centre for Nuclear Competence and Knowledge Management (UCNC), is on the way towards [11]:

- becoming national centre of competence and expertise in nuclear/radiation related issues;
- assessing, creating, preserving and transferring nuclear knowledge (NK), commensurate to Montenegro needs (nuclear knowledge management – NKM);
- offering consultancies and technical support services to all relevant stakeholders;
- being advisory body to the government for nuclear/radiation related issues and
- focal point for dissemination and exchange of NK, in particular with IAEA and EU;
- promoting nuclear/radiation applications for peaceful purposes, in particular medicine and environmental protection;
- being national radiation protection centre;
- developing curricula for nuclear/radiation related studies at all levels;
- supporting young students and scientists in nuclear/radiation related field and facilitate their exchange with reputed institutions abroad and
- giving proper and timely information and comments to the public and media on relevant topics/subjects.

An IAEA NKM expert mission to UCNC in 2009, including representatives from NKM centres in the region, affirmatively reviewed the above goals and encouraged both IAEA and Government of Montenegro to continue supporting its realization [1]. Ever since, UCNC stays on the above course. Our new visions – following Montenegro EU accession process – extend to EU perspectives, Horizon 2020 Framework Programme in particular [12].

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