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NUCLEAR- AND ENERGY-RELATED ISSUES IN MONTENEGRO

Montenegro is a small Mediterranean and West Balkan country, with an area of only 13 812 km², and population of 633 000 [1]. In 2010, its GDP was 3.2 billion EUR [2] (GDP per capita 5.050 EUR). In spite of its small space, Montenegro has very diverse and beautiful nature, lot of natural monuments, six national parks, and two regions protected by UNESCO as the world natural and cultural heritage. Therefore, and with a generally accepted intention within its population to preserve these natural riches, by the first article of its constitution, Montenegro has been declared as 'ecological state', which means that all major development programs and steps to be undertaken in the country should be regarded from environmental sustainability standpoint firstly. Besides an undisputed great importance of this fact in securing legal framework for a sustainable development of the country, it makes that realization of some important programs for economic and infrastructural development, especially those which are being opposed by the environmental NGOs, goes sometimes too slowly. This is specially the case with projects related to the new power plants builds, of which no one has been realized in the last 35 years.

On the other hand, the development of the energy sector is a precondition for economic development and a higher standard of living, and it has great influence on political stability, security and national sovereignty.

To satisfy its energy needs, Montenegro produces brown coal, lignite and firewood, uses hydro energy and industrial wood waste. It is energetically independent 54%. The production of electric energy in 2010 was 4.02 TWh (32% from thermal and 68% from hydropower plants), while the consumption was 4.9 TWh [3].

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In 2007, Montenegro adopted the Strategy for the Development of Energy up to 2025. In this forthcoming period Montenegro is planning to increase significantly production of lignite and hydro energy, and increase the usage of solar energy, wind energy, municipal waste and industrial wood waste. By 2025 the total production of primary energy is expected to increase up to 1.03 Mtoe¹, while consumption will be 1.77 Mtoe, which means an energy independence of 58%. The most important resources will be coal (participating with 64%), hydro energy (27%) and new renewable sources of energy (9%, which is far below the EU 20% target for 2020) [4].

After 2025, because of its own competitiveness and level of social development, the energy sector of Montenegro will definitely have to follow the market oriented European and world trends.

Montenegro is among those countries in the world that are the richest in respect of water. Therefore, in the long-term, the water resources are one of its key resources, not only for energy production, but also for drinking water export, tourism, food production, maritime transport and other uses. Indeed, water could become the pillar for the development of the country, with the possibility of its full evaluation on the wider region of the Mediterranean and South-East Europe. On the subject of energy production, Montenegro's hydro potential (approximately 9.8 TWh/year on major sources) is among the best in the world with respect to its economic efficiency, of which only about 20% is used by now [4].

Nuclear power is not included in energy planning of Montenegro. After the Chernobyl disaster, the Yugoslav Parliament adopted in 1989 a moratorium on building nuclear plants. Although some newly formed countries lifted the moratorium after the 1991 breakup of Yugoslavia, Montenegro keeps steadfast to it – the Law on Protection of Ionizing Radiation and Radiation Security, proclaimed in August 2009, confirmed the ban on building nuclear plants, production of nuclear fuel, deposition and reprocessing of spent nuclear fuel in the country. As a matter of fact this was a mere copying of the Yugoslav 1989 moratorium, since no particular political decision was subsequently made in Montenegro

In Montenegro, there is no nuclear science or nuclear research centre in its proper sense, and the use of radiation sources is modest and limited to ordinary medical and industrial applications. Despite this limited scope of nuclear/radiation activities, there is a non-negligible nuclear knowledge and expertise in the country.

Teaching staff of the Department of Physics at the University of Montenegro was regularly sent for specializing in prominent institutes worldwide, which resulted in having nowadays experts in nuclear and particle physics, positronium physics, nuclear analytical techniques, radioecology, radiation protection, nuclear instrumentation software, nuclear law, etc. Besides, there are another two institutions in Montenegro that should be also mentioned in this context: Clinical Centre of Montenegro runs a decent radiation medicine practice, both in diagnostics

¹ The *tonne of oil equivalent (toe)* is the amount of energy released by burning one tonne of crude oil, approximately 42 GJ. The IEA/OECD define one toe to be equal to 41.868 GJ.

(NMR imaging, gamma-camera, angiography, mammography, PET is on the way) and radiotherapy (linear accelerators, brachytherapy is about to start), while Centre for Ecotoxicological Investigations is well equipped with instruments for nuclear spectrometry and dosimetry of ionizing radiation.

It is obvious today that a relatively significant nuclear knowledge is (or will be) needed in Montenegro, much more in applications than in pure science. It goes about the following areas [5]:

- medical applications (diagnostics, radiotherapy, palliation, sterilization of equipment/consumables/blood products, ...),
- environmental protection (radioecology, low and medium activity radioactive waste management, analytical and monitoring services, ...),
- industrial, geological, hydrological, agricultural and biochemical applications (non-destructive testing, various gauges, radioisotope labeling, ...),
- scientific and educational applications,
- radiation protection, emphasizing safety and security of radiation sources,
- legislative and regulatory aspects, including complying to international safety/security norms and joining international conventions in the field,
- preparedness and response to radiological and nuclear emergency situations,
- combating illicit trafficking of nuclear and radioactive materials,
- forensic applications,
- security systems based on nuclear methods,
- public information and communication with media, etc.

From the above mentioned, we may conclude that, at present, there is a clear shortage in nuclear knowledge in the country, in medical, environmental, industrial and regulatory sector. We see two main reasons for that:

- general decline of students' interest for natural and technical subjects,
- absence of an adequate organization of the existing nuclear expertise.

Poor students' interest for studying natural sciences and technics is mainly due to socio-economic changes in the past two decades, which led to absence of challenging jobs in these fields in Montenegro. The University of Montenegro is the only university in the country effectuating practically complete high education in natural and technical sciences. Basic education in nuclear physics is provided only at the Department of Physics within the Academic study programme Physics, which, at the post graduate level, offers some curricula with topics in radioecology, medical physics and radiation protection. The number of physics students constantly declines, so that the Department can hardly justify its existence, and is threatened with closure. Physicists are employed mainly in schools as teachers, some in the environmental protection institutions (monitoring and regulatory), and in the largest hospitals. The best students stay to work with the Department of Physics, or go abroad, because there is no physics research institute or other employers to offer them attractive jobs in the country.

Centre for Nuclear Competence and Knowledge Management (UCNC) has been established in 2009 at the University of Montenegro, as a place where hu-

man resources, expertise, education, and research in nuclear related fields should be concentrated. The UCNC has the intention of [5]:

- being national center of competence and expertise in nuclear related issues,
- acting towards assessing, creating, preserving and transferring nuclear knowledge, according to Montenegro needs and priorities,
- promoting nuclear sciences and applications,
- offering consultancies and technical support services to regulatory authorities and stakeholders,
- being advisory body to the government for nuclear related issues,
- focal point for dissemination and exchange of nuclear knowledge,
- developing curricula for nuclear related studies at all levels (from elementary to higher education),
- supporting young students and scientists in nuclear related field and facilitate their exchange with reputed institutions abroad,
- giving proper and timely information and comments to the public and media on relevant nuclear related subjects.

A dedicated IAEA Nuclear Knowledge Management Expert Mission, which was conducted to the UCNC by the end of 2009, supported the concept and initial steps taken by the UCNC.

In general, literacy of the Montenegrin population in nuclear sciences and applications is very low, and a fear of radiation is widespread. The reasons for some sort of radiofobia and repulsive attitude of general public to everything which is named as 'nuclear' we can find, as somewhere else, in some general roots (atomic bomb, nuclear weapon race, Chernobyl, Gulf war and disease, Fukushima), as well as in some bad local experience (NATO's strikes on Montenegrin territory with depleted uranium ammunition in 1999), but above all in a fear of everything what is unknown. Therefore, before any meaningful debate between experts and public at large on nuclear energy related issues, it is necessary to raise nuclear education of the general public and, what is very important, of the media.

As a conclusion we can say that producing nuclear energy in Montenegro is not a realistic prospect, but since nuclear power generation is included in the energy planning of our neighbors, it is rational to face the facts, to discuss professionally the issue of nuclear power, to keep our citizens informed on what is going on in the region, and, perhaps, one day in the future, to participate one way or another in regional nuclear power projects. In order to maintain regional cooperation and protect national interests in energy sector – at least through monitoring the construction of future nuclear builds in the region, pursuant to the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991) and other conventions on cross-border impact – we consider necessary that Montenegro lifts the meaningless ban on nuclear builds power plants as soon as possible. This would help not only talking openly to our more nuclear-oriented neighbors, but also changing popular perception of the ban as the prohibition of even understanding global needs for nuclear energy, and opening and discussing relevant issues.

REFERENCES

- [1] “Montenegro in numbers 2010”, MONSTAT Statistical office of Montenegro, Podgorica 2010 (in Montenegrin).
- [2] “Macroeconomic indicators in 2011”, www.mif.gov.me/organizacija/sektor-za-ekonomsku-politiku-i-razvoj/103921/Makroekonomski-indikatori-u-2011-godini.html (in Montenegrin),
- [3] “Financial report for 2010 adopted by the Board of directors”, public statement of the Montenegrin Electric Enterprise, 22 March 2011, www.epcg.co.me/03_01_0084.html (in Montenegrin)
- [4] “Montenegro in the XXI century – in the era of competitiveness” (chapters Energy and Environment and sustainable development), Montenegrin Academy of Sciences and Arts, Podgorica 2010.
- [5] “Centre for Nuclear Competence and Knowledge Management”, Establishment Elaborate, University of Montenegro, Podgorica, 2008.

