The role of the international integration of nuclear education, nuclear knowledge management and education in providing the basis for the future renaissance of nuclear energy

V.M. Murogov*, M.N. Strikhanov and B.M. Tulinov

National Research Nuclear University (MEPhI) Moscow–Obninsk, Russia E-mail: victor_murogov@mail.ru E-mail: BMTulinov@MEPhI.ru E-mail: MNStrikhanov@MEPHI.ru *Corresponding author

Abstract: For Russia, nuclear technologies serve as the basis for economic, energy and political security. However, there are some challenges that significantly inhibit nuclear growth and development. One of these challenges is the shortage of qualified personnel. In the Russian nuclear sector there has been no systematic approach to workforce training and re-education until now. One of the most effective ways of solving the problems of nuclear education is to strengthen the cooperation between the universities at the national and international levels. The establishment of the most important element of the Russian nuclear educational cluster – the National Research Nuclear University (MEPhI) – is one of the initiatives that are in trend with global nuclear progress in Russia.

Keywords: knowledge preservation; nuclear education; international networks.

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Biographical notes: Victor M. Murogov obtained a degree in Engineering and Physics of Power Plants at National Research Nuclear University (MEPhI) in 1961. He joined the Institute for Physics and Power Engendering (IPPE) in Obninsk and made a career from Junior Research Associate to Director of IPPE. He obtained his PhD in Nuclear Physics in 1967 and Doctor of Science in 1989. From 1996 until 2003 he was a Deputy Director General of the International Atomic Energy Agency (IAEA). Since 2001 he was the Manager of the INPRO International Project. From 2004 to date he is a Professor in Obninsk at the State Technical University Nuclear Power Engineering (IATE) and Chief Scientist of the Russian National Research Centre 'Kurchatov Institute'. Since 2005 has been the Director of the Russian Association of Nuclear Science and Education. In 2008 he became a Director of the International Centre for Nuclear Education, MEPhI, Moscow. He is author or co-author of 376 scientific papers (including 170 scientific publications, 29 inventor's certificates, 62 international patents, and 9 books).

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Mikhail N. Strikhanov graduated from the National Research Nuclear University (MEPhI, a state university) in 1974, specialising in Theoretical Nuclear Physics, and graduated from Saratov Law Academy in 2007. After completing his PhD in Theoretical and Mathematical Physics in 1978, he continued working in the academic field and became DSc in Physics and Mathematics (Nuclear Physics) in 1992. He is the author or co-author of 3 books and 157 articles on relativistic nuclear physics and 87 articles on research and educational issues. He received a Russian Federation Government Award for success in the sphere of education. Since May 2007 he has worked as a Rector of the MEPhI. He has been the MEPhI representative for the STAR experiment (quark-gluon plasma identification) at Brookhaven National Lab (USA) since 1993 and an ALICE experiment participant at CERN (Switzerland) since 1997.

Boris M. Tulinov obtained his PhD in Theoretical Nuclear Physics at Moscow Engineering Physics Institute in 1977. Since 1996 he has been a Senior Researcher at the Academy of the National Economy under the Government of the Russian Federation in the field of technological business. From 1971 to 1999 he was a leading Researcher and Associate Professor at MEPhI, Deputy Dean of the Faculty of Experimental and Theoretical Physics, and Deputy Chief of the Department of Physics of High Density Energy. From 1999 he took over the post of Director of the Institute of International Relations at MEPhI and Dean of the Humanitarian Faculty at MEPhI, which he is successfully guiding until now. He is author or co-author of 240 scientific papers on the mathematical simulation of physical processes and on international scientific cooperation.

"The main point of a new paradigm is that not capital, not natural resources, not labour force becomes the primary resource for the development of the economy. It is, and will be, knowledge."

Peter Drucker (economist, politician, philosopher)

1 Introduction

The current problems of power engineering, the unpredictability of the organic raw materials market (primarily oil) and the current financial crisis have put an emphasis on the role of nuclear energy. For Russia, nuclear technologies are not just an element of the energy market, they serve as the basis for our economic, energy and political security. They also provide the grounds for our social development: Russia is 'doomed' to use and develop nuclear technologies.

It was the President of the Russian Federation who appealed to participants of the UN Millennium Summit (2000) with the initiative to ensure *energy stability for development based on nuclear technologies*. The initiative turned out to be extremely opportune and was supported by the global community. Nuclear energy itself, as well as nuclear technologies, will have to pass the way of internal fundamental development. Nowadays, in times of discussions on the coming renaissance of nuclear energy, new 'innovative'

structures and management methods have been developed, while the nuclear technologies (Pressure Water Power Reactor (PWR), Liquid Metal Cooled Fast Reactor (LMFR) and Nuclear Fuel Cycle (NFC)) have remained practically at the level they were 20 years ago. This is one of the main reasons for stagnation. All of the above can be illustrated in a diagram on the energy resources in use (Figure 1).





Currently, nuclear energy is based on uranium-235 resources, of which there are significantly lower reserves than those of oil and gas. There is no long-term future for such nuclear energy. In this case, what stabilising role of nuclear energy can be talked about?

But there is a solution: fast neutron reactors in a closed fuel cycle. Using this technology, all uranium reserves (U-235, U-238) would become available, as well as the reserves of thorium. The sources for nuclear energy would be practically unlimited.

This is the challenge that the state corporation Rosatom is facing at the moment, so it took a decision to switch over to a new level of nuclear technology within the framework of the Targeted Programme Atomic Energy Technologies for Future Generation, which has the time framework 2010–2020, and the subprogramme 'A closed fuel cycle development and commercialisation of fast neutron reactor'.

2 The problem of knowledge preservation is the problem of personnel retention

Having a qualified workforce in the nuclear industry is one of the most complicated problems at the current stage of nuclear power development. The predicted rates and scope of nuclear power development require a rapid growth of personnel support for all units and structures of the nuclear energy industry. The existing educational system and the manner of personnel placement within the nuclear industry are obviously inadequate for its large-scale development.

In the Russian nuclear sector there has been no systematic approach to solving the problem of workforce training. The situation is critical. Apart from an overall decrease in the number of research engineers (who have been a driving force for innovative

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development), a significant portion of them have reached the age of 60. The average age of key nuclear specialists (doctors of sciences) and academic staff with 'nuclear' specialisation is far beyond the mean length of life in the country. This situation becomes even more dramatic in the context of an overall demographic crisis and a downturn of the quality of formal education.

Economic conditions, technical capabilities and the teaching staff of 'nuclear' universities do not allow the necessary large-scale production of a qualified workforce for the nuclear industry. However, this is not merely a Russian internal problem: *this is a common problem for all developed and leading nuclear countries*.

3 International integration of nuclear education

Developed countries recognise the need for providing advance support to nuclear power engineering and educating qualified specialists. This is necessary mainly due to the need for a large-scale development of nuclear energy. It should ensure the country's energy safety and provide an understanding of the specific set of requirements to nuclear personnel. A number of leading countries have decided to develop nuclear energy. Their governments, in particular the USA, Europe and China, are going to start preparation of required specialists at an accelerated pace. In some countries (the USA, the European Union, China, Korea, Japan and others) corresponding national programmes have been adjusted and focused on attracting the younger generation. They have initiated development of national systems for nuclear education and positive 'rebranding' of the nuclear field for young people.

The most important development of nuclear education should be presented in the integration of universities into international networks such as European Nuclear Education Network Association (ENEN) and Asian Network for Education in Nuclear Technology (ANENT). The aim is to coordinate and join the efforts of various countries in a certain region (European for ENEN and Asian for ANENT) for the unification of educational programmes. This will result in a mutual acceptance of degree certificates and exchange of students, teachers and researchers, providing a wide access to information in the field of nuclear science and education, and strengthening of all forms of interuniversity cooperation.

The establishment of the most important element of the Russian nuclear educational cluster – the National Research Nuclear University (MEPhI) – is fully in line with the world trends in nuclear education and is enabling Russia to demonstrate internationally competitive performance in this knowledge-intensive field.

One of the most effective ways of solving the problems of nuclear education is to strengthen the cooperation between the universities at the national and international levels. Such cooperation can serve the purpose of effective management, the transfer and preservation of nuclear knowledge, *etc*.

4 The National Research Nuclear University (MEPhI)

This is the first time that a regional-industrial principle has been proposed for organising educational entities in five federal districts. The FNU will unite 6 specialised universities, 13 colleges and 5 primary professional educational institutions (Figure 2).





In total, there are:

- 24 educational institutions
- 40 000 students
- 7250 personnel
- 2750 faculty members, including more than 1600 members with advanced academic degrees
- an education area of more than 500 000 m².

The mission of the Federal Nuclear University is as follows:

- training of specialists and scientific innovation for supporting nuclear industry and other technology-intensive sectors of the economy in the Russian Federation
- system upgrading of higher and secondary-level professional education
- a comprehensive approach to regional development based on the integration of science, education and industry and an effective strategic partnership with the business society.

Personnel training challenges will be solved by local educational institutions placed in the Central, Volga, Ural, Siberian and Southern federal districts within the area of Rosatom, forming company towns (Nuclear Power Plants (NPPs), scientific research institutes and a manufacturing complex).

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5 International Center of Nuclear Education (ICNE-MEPhI)

The President of the Russian Federation announced the integration of science and education as a solution to the problems of education and of scientific organisations that have lost their workforce potential and, as a consequence, are not in high demand.

This process should not be purely 'domestic' – it should involve international cooperation. Assistance can be provided by such structures as the International Center of Nuclear Education (ICNE)–MEPhI (Moscow) with its affiliate at the State Technical University Nuclear Power Engineering (IATE) in the Obninsk.

The centre will cooperate – in fact, some necessary steps have been taken already – both with international organisations (the International Atomic Energy Agency (IAEA), World Nuclear University (WNU), ENEN, ANENT, *etc.*) and with public and government organisations (first of all the industrial sector).

One of the first steps of the centre was the development of the Education and Research Center Concept. Its foundation comes from the educational and research institutions of the First Russian Science City (Obninsk) and the model of nuclear education within the frame of the International Nuclear Innovation Consortium (INIC). It benefits Commonwealth counties (CIS and EurAsEC). The centre belong to the National Research Nuclear University (MEPhI).

6 Conclusion

The unpredictable development of the 'organic' energy market (as an example, the current financial crisis) has put an emphasis on the role of nuclear energy.

The future renaissance of nuclear energy is being discussed, but the nuclear technologies used remain practically at the level they were at 20 years ago. Nuclear industry, technology, research and scientific centres have to develop a new innovative NPP and NFC, *e.g.*, the commercial Fast Reactors (FRs) and the closed NFC, and also on this basis to use all uranium and thorium reserves in the future.

However, the existing system of personnel assignment and education in the nuclear energy industry is obviously insufficient for following its estimated large-scale growth. This is a common problem for all developed and leading nuclear countries. The most important tendency of human resources development for nuclear energy consists of the integration of universities and research centres into an international network (such as ENEN and ANENT) and international cooperation for Nuclear Knowledge Preservation and Management (NKM) – first of all in the area of so-called critical nuclear knowledge (such as FR, closed NFC, High Temperature Gas-cooled Reactor (HTGR), small innovative NPP and others). A significant role in it belongs to the IAEA.

This 'critical' knowledge and experience is going to present very important key elements for the future development of nuclear energy, but it does not have much commercial application today. Establishment of the most important element in the Russian nuclear education cluster – the National Research Nuclear University (NRNU), which integrates 24 educational institutions – presents a successful local example of global trends.

This national university should be involved in the international cooperation in education and NKM development. This activity will be assisted by ICNE.

Bibliography

Fast Reactor Database: 2006 Update (2006) IAEA.TEC/DOC/1531, Vienna.

- International Conference on Knowledge Management in Nuclear Facilities (2007) IAEA, 18–21 June.
- 'Managing nuclear knowledge' (2005) Proceedings of a Workshop, Trieste, Italy, 22–26 August, STI/PUB/1266.2006.
- Murogov, V.M. (2006) 'Nuclear personnel training and the future of nuclear industry', *Nuclear Energy Bulletin*, Moscow, October, pp.46–48.
- Murogov, V.M., Ponomarev-Stepnoy, N.N., et al. (2007) 'International initiatives of IAEA: from innovation nuclear technologies to the improvement of "nuclear" education', Nuclear Energy Bulletin, M., June, pp.37–45.
- NATO-Russia Advanced Research Workshop (2008) 'Proliferation-resistant nuclear technologies', Carnegie Moscow Center, Moscow, 27–28 March.
- Strikhanov, M.N. (2008) 'The development concept of the Federal Nuclear University for the years 2009–2015 and for the period up to the year 2020', *Interdepartmental Work Group Under the President of the RF on the Implementation of Priority National Projects*, Moscow, 28 May.