

Needs of National Infrastructure for Nuclear Energy Program in Macedonia

A. Chaushevski¹, S.N. Poceva¹, H. Spasevska¹, N. Popov²

¹Faculty of Electrical Engineering & IT – Skopje, Macedonia

²JSC ELEM – Skopje, Macedonia

Abstract. The introduction of a nuclear energy program is a major undertaking with significant implications for many aspects of national infrastructure, ranging from capacity of the power grid, access roads and production facilities, to the involvement of stakeholders and the development of human resources. For new comers countries without nuclear power, even for those who wish to realize substantial expansion of existing nuclear capacity, it can take up to 10-15 years to develop the necessary infrastructure.

One of the crucial problems in nuclear energy implementation are human resources needs and educational infrastructure development in this field. No matter what will be the future energy scenario in the Republic of Macedonia, the nuclear educational program is the first step to have HR in the field of nuclear energy.

This paper presents the proposed direction for having HR for establishing national infrastructure in nuclear energy program in Macedonia. This includes establishing and developing of MONEP (Macedonian NEPIO), and the enhancing the capabilities of the national regulatory body in the Republic of Macedonia.

Keywords: NEP (Nuclear Energy Program), HR (Human Resources), NEPIO (Nuclear Energy Program Implementation Organization), MONEP Macedonian Organization for Nuclear Energy Program (Macedonian NEPIO), NRB (Nuclear Regulatory Body).

1 Introduction

Based on the required workforce and staff for the nuclear energy program that is recommended by international organizations, [1-3], and taking into account the existing educational and institutional infrastructure in Macedonia [4], some proposal and recommendations for the development of human resources for NEP in Macedonia are made. According the Study [5], it is some directions for establishing of the necessary national institutional bodies for NEP, such as MONEP (Macedonian NEPIO) and nuclear national regulatory authority. To achieve the above goal, a systematic assessment of the existing educational and HR infrastructure has been undertaken, while keeping in mind international guidance on the number and type of resources required in each phase of the nuclear power program implementation. Some of the existing governmental regulatory bodies, such as Energy Regulatory Commission (ERC) (<http://www.erc.org.mk>), or directories dealing in some fields connected with energy or safety matters, such as Directory for Radiation Safety (DRS) (<http://drs.gov.mk>) and Crisis Management Centre (CMC) (www.cuk.gov.mk), can be used to establish appropriate departments for a nuclear power program. The existing staff in these organizations, complemented with new staff, can reach the appropriate knowledge level to support the new nuclear energy program in the upgraded national bodies, such as the National Nuclear Regulatory Body, the National Nuclear Commission, and others.

According to the IAEA recommendations and standards for implementation of nuclear infrastructure, approximately the 15 years period is needed. This period is variable depending on the economic development and the economic situation of the country. In Figure 1, in more detail, the timetable for each of the three phases to put into operation the NPP is explained. The study elaborates only the first two phases for NEP in Macedonia from the human resources point of view. Numbers of HR needs are:

- NEPIO (MONEP) 10–50 people
- Regulatory body 30–100 people
- NPP operator – 600 people for the single unit

2 Options for Development the NEP in Macedonia

The first phase of building nuclear HR infrastructure consists of implementation of several activities and training of personnel in the field of nuclear technology, nuclear engineering, protection and management of radioactive materials, funding models for the NEP and nuclear power plant legislation. This activity can continue for more than five years in parallel to gathering information and performing other necessary activities in preparation for making a decision on embarking on a nuclear power program in Macedonia. Several alternatives can be envisioned. Assessment of the HR Infrastructure for Nuclear Energy Program in Macedonia

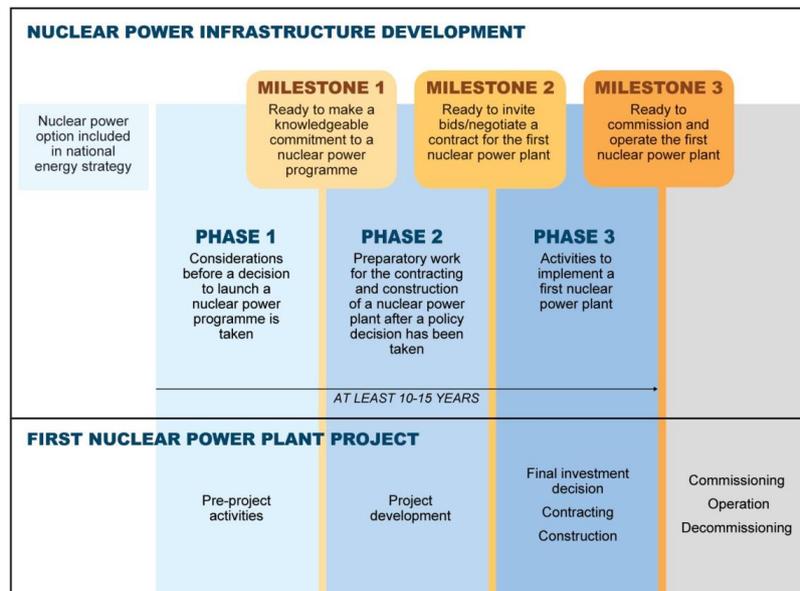


Figure 1. Phases and milestones to enter the nuclear energy program according to IAEA.

- Strategy 1 : Use of national staff trained exclusively in the national education system in institutions in Macedonia
- Strategy 2: Staff educated partly in the national education system, and partly in educational institutions outside Macedonia (regional or other neighboring countries).
- Strategy 3: Staffing strategy based on consulting and contracting services from foreign institutions which have experience in NEP implementation and NPP construction and operation.

All of these strategies have advantages and disadvantages, which are considered and elaborated in the study currently being performed in Macedonia. The first phase of NEP includes the implementation of several activities such as:

- Training of the personnel in the field of nuclear engineering, protection and management of radioactive materials and other relevant fields of NEP
- Trying to find models for financing the NEP
- Implementation the law and legislation in the field of nuclear power.

During this period, which can last more than five years, would have prepared documents and received information about the steps that Macedonia needs to make the entry in NEP. The most acceptable options for establishing the NEP in Macedonia are:

- Option 1 – Creating national human resources and educational infrastructure for supporting a national NEP
- Option 2 – Participation in regional programs with other countries in a new regional NEP
- Option 3 – Joining in the already established NEP program of the country that have NPP

There are two other options that are not considered due to their nature:

- Option 4 – Implementation of NEP in Macedonia by a country that assumes the role of the investor, owner and operator of a NPP in Macedonia, in which the resulting needs for a NEP implementation in Macedonia have very specific elements and time frames
- Option 5 – Do not enter the NEP (cancellation or freezing of the program), in which case there is no need for a NEP driven activity to enhance Macedonian educational and HR infrastructure.

Which option is most appropriate for Macedonia depends on two factors:

- The situation in Macedonia: necessary personnel and implementation of institutional infrastructure, energy policy as well as the public opinion.
- The situation in the region and elsewhere: economic conditions for investments and support from international financial institutions, interest of countries of region for NEP, interest of certain countries and vendors that have the technology of NPP for investment and others.

Option 1 is entering the NEP with national human resources and national institutions. This option is viable if it meets the requirements for implementation of NEP and financial, human and institutional aspects.

Option 2 is entering in the NEP with regional cooperation from one or more countries in the region that are comparable to Macedonia in terms of energy needs, economic and financial strength, and have an interest in the nuclear power utilization.

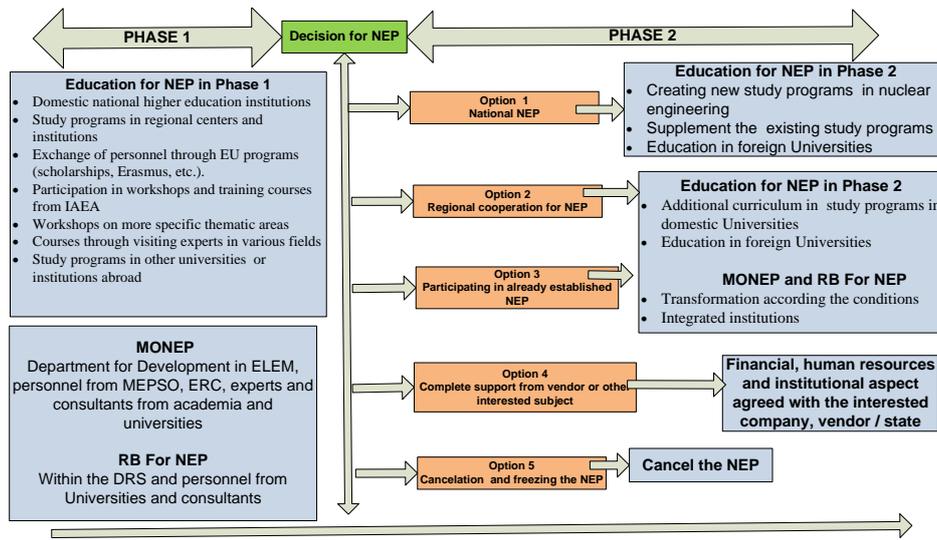


Figure 2. Program scheme for NEP in Macedonia in the first two phases.

Option 3 assumes cooperation with a country that has an ongoing nuclear power program and operating nuclear power plants, and is interested in expanding its NEP to other countries. As an example, the possibility of participation in the Bulgarian NEP (NPP Kozloduj 7 and 8) or Romanian NEP (NPP Cernavoda 3 and 4) can be considered.

Option 4 is entering the NEP by cooperation with a country or a company that uses nuclear power technology and has an interest in investing and building NPPs in foreign countries, such as Macedonia. In this case, financial, human resources and institutional aspects of such a nuclear power and HR program would be driven by bilateral negotiations and agreements with such interested company or country.

Option 5 is cancel the NEP in Macedonia.

The program scheme for development of NEP in Macedonia in both phase 1 and phase 2 according IAEA is represented in Figure 2.

3 Proposal for Establishing the National Regulatory Body for NEP

In the first phase period can last about 5 years of education staff based on domestic study programs, the participation of our students and experts of international forms of education such as workshops, training programs and others types of schools. This can be accomplished through various ways of funding and technical support to the IAEA and the EU through programs as Erasmus, Marie Curie and others.

This phase may conclude bilateral agreements with countries in the region (Bulgaria, Romania, Serbia, Croatia and Slovenia) to study ahead for our students and experts in regional centers in certain thematic fields of nuclear energy. There are interesting areas that are not the curricula of our universities as nuclear reactor engineering, reactor physics, radiation protection, nuclear fuel cycles, waste management and more.

At this stage, the Government should establish and MONEP (Macedonian NEPIO) as a formal legal entity and the beginning it can be start with around 10 people within the Department of development in ELEM. This agency can participate with personnel from various companies like MEPSO, ministries and academics. Financial part would be covered by existing companies where staffs participate with an additional fee for the engagement.

Also in this phase should be established the national regulatory body for NEP. This can be formed as a department within the existing institutions and agencies such as the Directory for Radiation Safety (DRS). Decision as a legal entity should be created by the Government.

In the second phase following the decision should come from the government for further activity on the NEP. The decision would be based on fundamental analyses, public opinion and consultants on the basis of studies that will be undertaken during the first phase. Depending on the decision, which could include one of five proposed options, would be continued with further activities in the area of HR for NEP and in terms of institutional infrastructure for NEP.

No matter which way would be created HR for NEP, domestic universities and education system, training and education in foreign institutions, participation in international training programs, schools, etc., it is necessary to create a strategy for retention the staff for NEP, especially in the field of nuclear engineering which is deficient in Macedonia. In this context, the government needs to find a mechanism for retaining and attracting vocations especially for NEP, as a time binding or otherwise which is applied in various sectors (health, industry, etc.).

In order to realize the structure according MONEP, which is shown on Figure 3, it requires organization of minimum 10-20 people with appropriate educational qualifications for each of the positions in MONEP. These personnel could be considered appropriate or hire the existing staff of domestic companies (public or private).

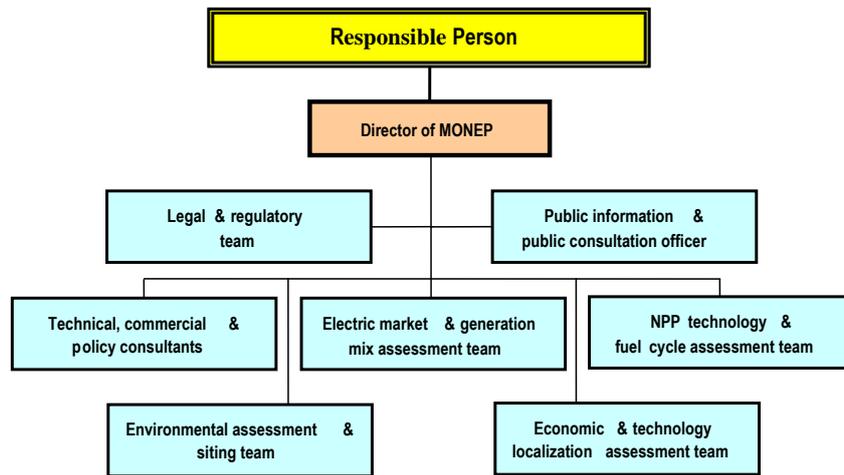


Figure 3. Proposal for structure of MONEP (Macedonian National NEPIO).

During Phase 2, the regulatory body and the NPP operator are gradually assumed responsibilities and necessary resources will be transferred to these organizations. MONEP transformation between the two stages in the implementation of the NEP depends on the decision of keeping the NEP after the first phase. If it is adopted one of the options 1 to 4, can make a transformation of MONEP. Figure 4 presents the transformation of MONEP between the two phases of decision.

Macedonia is at the beginning of this part of establishing the national institutions and bodies for nuclear energy program. Therefore, the proposed way for establishing the MONEP is from the existing enterprises and organizations. As the simplest and most acceptable way from financial point of view, is to form MONEP within ELEM departments of development. It can be formed as a legal entity which may accept personnel from ELEM and MEPSO, or staff from other agencies, companies and ministries. Staff from other companies would be within the parent organizations and can be supported with some part-time financial compensation for obligations in MONEP, which in financial terms would be most acceptable option.

For the establishment of the national NEPIO as MONEP and national safety regulatory body, the government has a crucial role to support the HR development in this area. The organizational and management structure of these institutions needs to be decided by the Government based on assessments and studies of the existing staff in Macedonia and the required resources for NEPIO and NRB. As mentioned above, it is recommended by the IAEA that NEPIO can best perform its role and function if it is part of a government institution, or of government-owned institution. Considering the current level of effort of the NEPIO in Macedonia, and its work plan and schedule, this is achieved by placing the NEPIO within the development sector in the Macedonian Power Plants (ELEM), with the staff of about 10 experts. These experts can be hired from existing public companies, ministries, universities and consultants from abroad. Macedonia already has a regulatory body for radiological protection in the medical industry. This regulatory body needs to be upgraded and to extend with human staff and resources that are knowledgeable in nuclear power regulation. This can be achieved by using one of the above mentioned strategies.

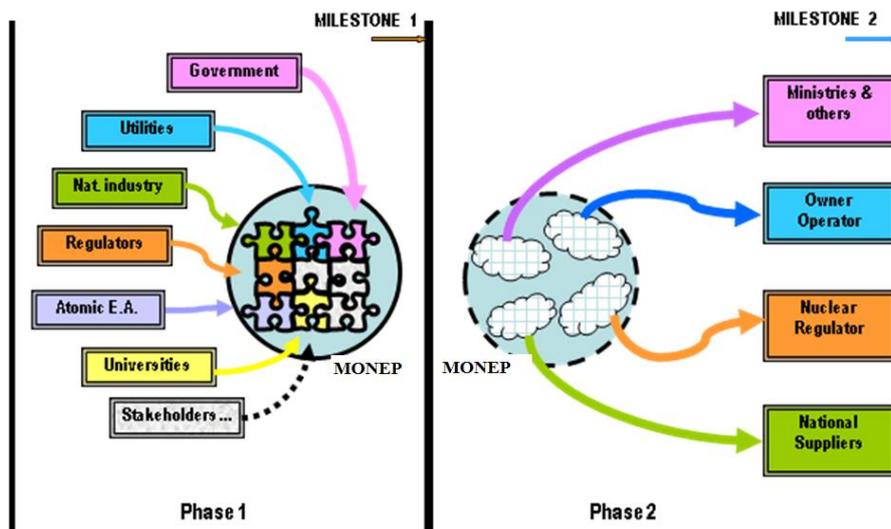


Figure 4. Transformation of MONEP between the two phases of decision.

The main objective of national regulatory bodies for nuclear safety is to ensure that, within their countries, activities related to the peaceful use of nuclear energy is performed in a safe manner in accordance with international safety principles and with full respect for environmental protection environment.

It is important to emphasize that although the mission of the regulatory body to provide oversight of nuclear safety, the primary responsibility for the safety of nuclear installations must remain with the licensee or operator of NPP.

For the realization of the national regulatory body for the NEP in Macedonia according to the requirements and needs, the situation is more complex. For this purpose it is reviewed the existing national commissions, departments and agencies such as (RCE - Regulatory Commission for Energy) and (DRS- Directory for Radiation Safety), that can be completion and can establish the departments for the NEP to develop in national bodies.

4 Future Activities for Implementation of NEP in Macedonia

As future activities in phase 1 for obtaining relevant indicators of the situation in Macedonia for entry into the complex nuclear program, it is necessary to realize more studies and analysis of relevant structures and sectors related for the implementation of NEP. In the forthcoming period it is necessary to have studies in several segments and specific sectors such as:

- Study on the possibilities of the national infrastructure industry, the economy and the transport sector to include the implementation of NEP
- Study for opportunities and ways of financing the high investment energy projects in developing countries
- Communication and cooperation with the public sector on strategic programs in the field of nuclear energy
- Study completion of curriculum at all levels of study (first, second, third cycle) of individual faculties in the areas needed for nuclear engineering in Macedonia

5 Conclusion

Realization of a nuclear energy program of any country requires significant preparations and engaging all the relevant factors and through the inclusion and upgrade the infrastructure of a country. Education is the basis to create the necessary staff for the NEP in the first phase as preparatory activities, and most certainly in the next stages of construction and operation of a nuclear power plant.

Workforce planning is an essential, ongoing human resources management process. Each organization involved in the nuclear energy program should develop and maintain its own workforce plan; at least for the Phases 1 and 2. The NEPIO should maintain an overall plan to enable an

integrated national approach to resource utilization and development.

To develop a realistic and adequate HR plan, in the first step it is very important to perform an assessment of weaknesses in the HR area, and to identify the gap to the HR level required for launching a nuclear power program.

From preliminary studies in Macedonia, the main gap is in the following fields: nuclear regulatory expertise in review, licensing and enforcement process, nuclear engineering, reactor engineering, fuel cycle, waste treatment, etc.

In terms of additional HR supportive activities, Macedonia is already engaged, and needs to continue to be, in international programs offered in the field of nuclear energy via the International Atomic Energy Agency (IAEA). In addition, HR development help can be achieved via cooperative projects with other countries, participation in regional or international workshops or training courses on certain areas, visiting research institutes and nuclear laboratories and others. Macedonia is already involved in such activities.

Based on the investigation can draw the conclusions and the steps that need to be made to improve the educational infrastructure and strengthen capacity to create the necessary HR in education for the NEP.

- The existing educational infrastructure in universities in all three levels (first, second and third cycle of study) covers part of the necessary study curriculums for NEP, mainly nonnuclear occupations and activities, engineering studies (civil engineering, electrical professionals, information and communication technologies, electronic and automation, mechanical engineering, materials technology and metallurgy), natural sciences (physics, mathematics and statistics, chemistry) and from other branches (economics, management, law sciences).
- The lack of nuclear engineering for establishing the NEP, in the first phase may be covered by educating our personnel in foreign institutions in the region and beyond, participation in regional and international training courses and workshops on specific areas of nuclear engineering organization seminars, schools and courses with foreign visiting professors to the universities in Macedonia and others.
- In the first phase to deciding of entering the NEP which may be for a period of five to ten years should be opportunities for training of our personnel through international institutions in the field of nuclear science as, fellowships from IAEA in Vienna, using scholarships through various EU programs, and of course a bilateral collaborations with institutions in the region (Bulgaria, Romania, Slovenia, Serbia, Croatia).
- In the first phase to the decision for the NEP, that requires other research and studies in various areas of the NEP can be accessed at complementing individual study programs at some of the faculties in Mace-

donia and introducing new courses in the areas that are needed the NEP.

- Faculty of Electrical Engineering and Information Technology (FEIT) can be a holder of educational activities for NEP in Macedonia, who has extensive experience with cases of nuclear energy and nuclear power plants. This institution as a part of the Sts Cyril and Methodius University of Skopje has experience in educational and research activities in the power plants operation in the power system, which has already held more than 30 years of study programs and curriculum in the first and second cycle.
- The development of personnel in the second phase after deciding NEP, depends on the option that the Government will accept after the period of the first phase which would have made all the necessary analyzes and studies on specific areas necessary for a decision on NEP.
- The creation of MONEP which is actually a Macedonian national agency for conducting NEP (after recommendations of IAEA as NEPIO), should be within the ELEM in the Department for development. The functioning of this unit in the development sector should be expanded with new staff (a total of 10 people) in areas such as power systems and grid, tendering and financing of big-budget projects in energy as NPP, legal regulation of NEP, nuclear physics etc. Personnel needed for this body can be engaged and part of domestic institutions (ELEM, MEPSO, ministries, agencies, etc.), from academia as universities, and of course taking the experts from the international foreign consulting firms and institutions for NEP.
- This MONEP body should be formed as a legal entity by the Government or by the appropriate public state institution such ELEM.
- The functioning and activities of the MONEP in the first phase would be in ELEM, and in the second phase, the body would continue to function dependence on the decision to NEP in the first phase.

- The establishing of a regulatory body for NEP in Macedonia (RB for NEP), the first stage may be within the existing DRS. This state institution is formed as legal entity with competencies in nuclear techniques in areas that are used (nuclear medicine, public health, control and applications for agricultural products and food needs and customs control of goods, transport of radioactive materials, etc.).
- The responsibilities of this body within the DRS should be expanded with the necessary areas in nuclear energy referred to the proposals.
- In terms of the functioning of this body (RB for NEP) which would be within the DRS can be equipped with staff and other national agencies and commissions such as the ERC, the Energy Agency and others.

The investigations in the last few years in HR sector are only the initial stage of identifying the existing infrastructure in the education and institutions with proposed activities that are necessary for establishing the NEP in Macedonia.

References

- [1] INTERNATIONAL ATOMIC ENERGY AGENCY, Milestones in the Development of a National Infrastructure for Nuclear Power, NG-G-3.1, IAEA, Vienna (2007).
- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, Evaluation of the Status of National Nuclear Infrastructure Development, NG-T-3.2, IAEA, Vienna (2008).
- [3] INTERNATIONAL ATOMIC ENERGY AGENCY, Workforce planning for new nuclear power programmes, NG-T-3.1, ISSN 1995-7807, 0., IAEA, Vienna (2011).
- [4] Documents for curriculum of study programs in the Universities in Macedonia.
- [5] Chaushevski A., Spasevska H., Nikolova-Poceva S., *Study of Human Resource Development for Nuclear Energy Program in Macedonia*, Faculty of Electrical Engineering and IT, UKIM, Skopje 2014.