

Position paper

Priorities in education and training activities in nuclear fields to preserve the availability of excellent nuclear experts

Rationale and summary

The following priority activities are proposed based on the experience of ENEN and its members in very successful nuclear education and training (E&T) actions within Framework programmes of European Commission and activities within the member states:

1. **The mobility** with facilitated access to the research infrastructures is an important part of **guided career development** of highly specialized students and young professionals for their future careers in multidisciplinary and multicultural environments. It is also one of the most important preconditions to further develop the cooperation between different nuclear stakeholders. Experience with ENEN+ mobility scheme -**funding the cross border mobility to improve careers of nuclear learners and young professionals** -indicates that about 0,5MEUR/year enables enhancement of nuclear careers of approximately 300 people. The ENEN+ mobility fund is already at the end and may need an alternative in 2020 and 2021 (0,5MEUR or more per year).
2. **The 5% rule** in the H2020 EURATOM projects is an excellent tool to stimulate the E&T within the **narrowly specialized** research and expert communities involved in particular projects. This needs to be sustained and complemented by E&T actions beyond particular communities (e.g., multidisciplinary communication), involving also educators (universities), who are rarely involved in the H2020 EURATOM projects. Targeted dissemination events to get students and university teachers in touch with the research progress in narrowly specialized EURATOM projects and related research infrastructures, again with support for mobility of students, are seen as appropriate tool. NESTet 2020 and FISA conferences are immediate candidates to host such dissemination events.
3. **Attract new talents.** Activities such as competitions, career events, summer camps, etc., targeting high school pupils, B.Sc. students and teachers, should be supported with mobility funds. These activities also need very strong involvement of nuclear stakeholders that do not actively participate in E&T (end users).
4. Develop **strategic agenda of European nuclear E&T** to better enable and further develop existing best practices in career guidance, coordination, cooperation and existing and innovative education approaches. It is our assessment that, at least at the moment, the most important or critical activities for the sustainability and further development of nuclear E&T in EU should be directed towards the influx and development of new talents, supported by coordinated actions of all stakeholders. Development of specialized solutions, such as for example new courses, advanced methods and initiatives (which have been stimulated in the H2020 calls in 2018 and 2019) are of limited value without sufficient number of students and should be replaced or at least complemented with more general solutions involving multiple expert communities and multiple stakeholders. A diverse situation is nevertheless noted in different member states: France for example does not report shortage of candidates, but most of the remaining nuclear member states do. **Protection of the weakest link might apply here!**

Some explanatory remarks are given below and are closed with an example of possible future action.

Background

Sustainable and safe use of zero-carbon nuclear power relies heavily on the availability of outstandingly educated, trained and motivated people. Yet the number of students, nuclear professors and departments at the universities seem to be in decline since the 1990s. In many European countries, the lifetime extension of nuclear power plants has been or will be licenced in the near future. Unfortunately, the lifetime extension of a highly qualified workforce is not possible. In the next years, a need of several hundredths of educated people per year is expected, and the number of graduates are currently not meeting this demand. In addition, continuous research and innovation in technology and safety of nuclear power plants and internationalisation of the (nuclear) power markets require excellent and ever more specialized technical experts, who will understand the installations of increasing complexity and will be equipped to work in multidisciplinary, multicultural and highly competitive environments. Therefore, continuous actions are required to fill this gap by attracting, educating, and retaining new young talents in the nuclear sector. Actions to close this gap have a clear European dimension, because it is likely not to be filled in time by graduates from home countries alone. Needless to say, adequate career guidance supported by mobility and access to infrastructures of students during the formal education and early professional life is of crucial importance for the development of the technical experts with experience in multidisciplinary and multicultural environments.

Challenge

The continuous actions are carried out at the B.Sc. level, are continued at the M.Sc. level and optionally also on the level of a Ph.D. Such bottom-up approaches to receive the nuclear education and training practiced during the last two decades were on the whole satisfactory to maintain the education systems and generate warnings to the decision makers. They were unfortunately **not satisfactory to attract many new talents** and **did not lead to substantial innovations to nuclear (power) technologies**. The proclaimed closures of operating plants in many countries may contribute to further dwindling of nuclear education. Top-down (strategic) approaches are needed to maintain and further develop the nuclear education and training. They include the collaboration of stakeholders on a high strategic level in order to organize a structured approach. Beside this, the approaches may include policy studies to review current and planned future activities and development and implementation of nuclear education, training and knowledge management strategies consistent with the long term visions/plans for development and implementation of nuclear technologies. Both bottom-up and top-down approaches in combination are promising and results can be maximised by a strengthened collaboration between different stakeholders in nuclear.

Proposed measures

Increased collaboration of strategic nuclear stakeholders could form a good basis for increased collaboration, which could raise the attractiveness of nuclear topics and retain young scientists in the nuclear field. A promising measure is the structured collaboration between universities and operators of large-scale infrastructures. These infrastructures are located at national research centres or even at industry, some others at universities, in EU and abroad (e.g., Russian Federation. Unfortunately, the excellent collaboration in the ENE-RU series of projects is not funded any more). Collaboration between universities and research organizations exists, predominantly on the local and much less on the wider European scale. Therefore, it is beneficial for a future European highly qualified workforce, if research infrastructure would be available for students, student projects, training courses, practical exercises, internships or any other measure, which attracts students to start the academic career with a topic related to nuclear applications. Facilities could be used in research fields of neutronics, thermal-



hydraulics, materials, etc. in nuclear sectors like nuclear engineering, radiation protection, and research for interim or final storages, nuclear waste (not limited to those specific areas).

A program should be developed to close the gap between academia (universities) and operators of large-scale infrastructures. The program will have to indicate the availability of research infrastructure for collaboration, and universities working in different research areas forming groups of interest (i.e. radiation protection, radiochemistry, etc.). Inside of these groups, the student level will be identified at which the practical research will be carried out. Pilot actions demonstrate successful approaches.

Successful proposals include international collaboration (beyond Euratom member countries, e.g. IAEA, IOECD/NEA, Russian Federation, China...).

Career guidance, mobility and accommodation of students and teachers will have to be established.

Expected impact

The impact of such measures is given by attracting more qualified people into nuclear professions and finally into industry. Students will be provided with better skills or know-how (e.g., through access to research infrastructure) and knowledge or know-why (lectures given at universities), which will make them better prepared for jobs in industry, regulatory bodies and academia.

Another impact is the integration of already nuclear qualified workforce (senior scientists) into the research and E&T activities. These people carry enormous know-how and know-why, which could be given to a next generation of graduating students and graduates.

Through this measure, the collaboration between Universities and research centres and research Infrastructures will be strengthened, open access to research infrastructures will be supported.

The impact could be increased by involving national programs in EU and beyond.

The role of ENEN

The preservation and further development of expertise in the nuclear fields by higher Education & Training is the core mission of ENEN AISBL and we would definitely need help in securing the success of this mission. ENEN AISBL (European Nuclear Education Network) Association is an international non-profit organisation, located in Brussels, Belgium, established 16 years ago, which acts towards preservation and further development the expertise in nuclear Education and Training. ENEN currently comprises more than 75 members from the EU and beyond, among which are leading European universities, research organisations, regulatory bodies and industry actors. The broad membership base has proven highly successful at bringing all stakeholders together on projects around training and education in nuclear energy.

ENEN has already **established infrastructure to develop and disseminate the new knowledge, best practices, career guidance, strategic agenda and coordination for the European nuclear education and training, including management of the mobility funds and calls. Stable funding supporting some or all of the above activities would significantly improve its efficiency through better focus and efficiency of the available human resources.**

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