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EDUCATION, TRAINING AND MOBILITY: TOWARDS A COMMON EFFORT TO ASSURE A FUTURE WORKFORCE IN EUROPE AND ABROAD

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Summary

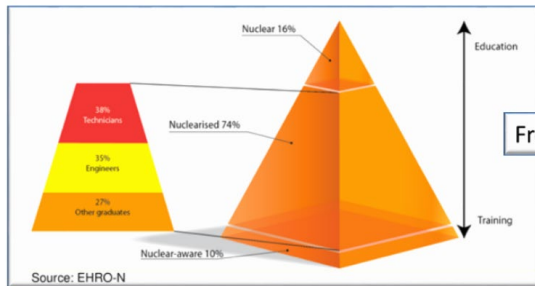
- Introduction
- Needs of New Member States and Specific Regional Initiatives
- Exchanges with Education Systems beyond Europe
- Continuing Education Efforts for Nuclear Technologies
- Projects by ENEN: keeping high Nuclear Safety levels in Europe
- Conclusions

Introduction (1/4)

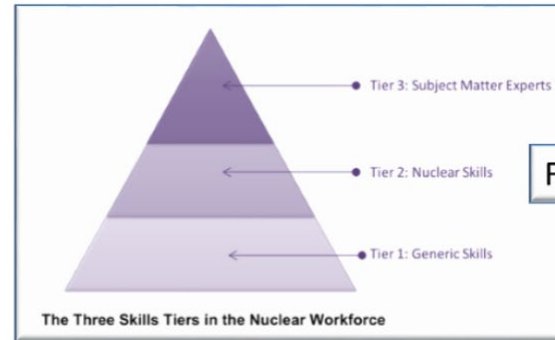
- Both **enthusiasm and aversion** characterized the attitude towards nuclear energy since its first deployment
 - its mass-intensive characteristics are perceived as an **opportunity or a deterrent**
 - these biased feelings are **cyclically weakening efforts to keep a nuclear workforce**
 - this occurs mostly in the periods after accidents, **without any real rationale**
- The effects of this phenomenon result in the presence of **fluctuations in workforce** and/or of **shortage in replacements** for retiring experts
 - “**nuclear experts**” are very important, since they are the core of nuclear K & S
 - **non-nuclear experts (“nuclearised”)** may be a **bottleneck** for sector competition
- **Nuclear and nuclearised experts are both relevant** (in different shares) for the nuclear workforce

Introduction (2/4)

- In general, the optimal composition of the nuclear workforce in case of new builds is depicted as having a **pyramidal (or triangular) structure**, at whose tip specifically educated nuclear experts are located, in relatively limited number, while the lower levels are more widely populated with personnel having generic skills, to be “nuclearized” or made “nuclear-aware” at different levels



From the EHRO-N reports



From the UK national report

Introduction (3/4)

- A common feature of all the personnel working in a nuclear environment should be at least a sound basis of education and training in relation to **nuclear safety culture**, as an overriding priority at all the technical and managerial levels, while the depth of competences in the rest of nuclear disciplines may vary depending on the function.
- In the current descriptions of nuclear workforce, the need for personnel who has received a specific and in-depth nuclear education and training (the “experts”) must be considered also **in view of the role it has in providing nuclear knowledge and skills to the other personnel**; so, their smaller number should not lead to overlook their relevance as **nuclear knowledge and skill “multipliers”**.
- The objectives of the projects summarized herein are variously addressing nuclear E&T **to keep it lively at any time, in order to provide an adequate nuclear workforce in Europe without dangerous oscillations or scarcity**

Introduction (4/4)

- These projects share the **common intent to contribute, at different extents and in different contests, to nuclear E&T and to facilitate cross-border mobility and life-long learning of students and professionals.**
- **A number of these projects are led by or include the participation of the European Nuclear Education Network (ENEN).** The ENEN AISBL, now an international association under the Belgian law, was constituted in 2003 in France, starting its actions with only 22 members. It celebrated its 10th anniversary in 2013 at the previous FISA/EURAWASTE Meeting held in Vilnius Lithuania and in 2018 it also celebrated its 15th anniversary, during a ceremony held in Brussels before its annual General Assembly.
- The Association, whose *“mission is the preservation and further development of expertise in the nuclear fields by higher Education and Training”*, has today 77 members who are actively involved in promoting its actions.
- **Let’s now list the addressed projects and summarise their main outcomes.**

Needs of New Member States and Specific Regional Initiatives

- In recent years, the need was felt to make sure that **New Members States would be effectively included into the process of networking** and inclusion in the research and education community previously established for Old Members States (OMS).
- In particular, **a good level of participation of NMS in Euratom Projects was identified as an important aspect to be assured in welcoming these states into the European nuclear research and education community.**
- In addition, **the specific situation and key initiatives going on in specific areas of Europe attracted the attention, suggesting to check for the presence of adequate capacitance for carrying on the intended projects or in order to stimulate better cooperation.**

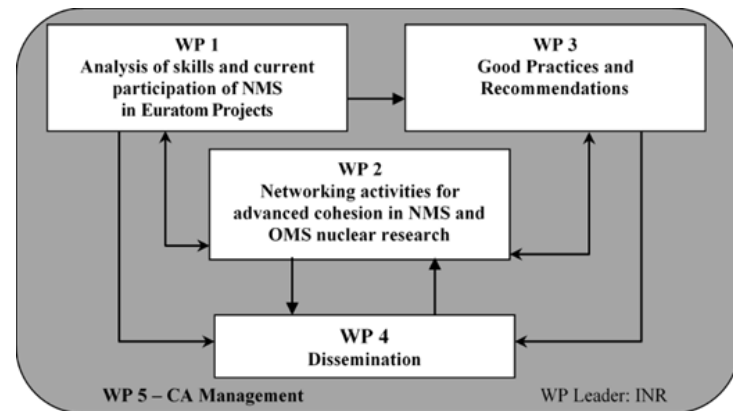
Needs of New Member States and Specific Regional Initiatives

- This was the case of the **Lead cooled Fast Reactor demonstrator (called ALFRED)**, proposed to be built in Romania which, involving the known challenges of Generation IV reactors, requires specific expertise in the related sector.
- Likewise, the **Baltic Region hosts a number of research centres and institutions with a considerable potential in nuclear science and technology**, whose level of cooperation was deserving improvements for fully developing their potential.
- **Projects addressing these issues were conceived and run in order to promote cooperation and developments in nuclear science and education**, aiming to respond to the needs described above.

Needs of New Member States and Specific Regional Initiatives

FP7 NEWLANCER Project (Nov. 2011-Oct. 2013) paved the way for a sustainable participation of NMS in European nuclear energy research
NMS needed to be “welcomed” in the Euratom community to establish a good level of networking with OMS

- **Six NMS in the Consortium** (BG, HU, LT, PL, RO, SLO)
- **Linking regional experts with OMS research centres and platforms** (SNETP, IGDTP, MELODI)
- **160 specialists** in 19 National and 5 Regional Expert Groups
- **For E&T**, a good international participation was found: common issue the declining interest for nuclear careers
- **Need to improve** strategic planning, cooperation between activity holders and Universities, info on Euratom actions in study programmes, ensuring NMS visibility in European nuclear initiatives



**4 EU Projects rooted in NEWLANCER network:
MACXIMA, EAGLE, ASAMPSA_E and ARCADIA**

Needs of New Member States and Specific Regional Initiatives

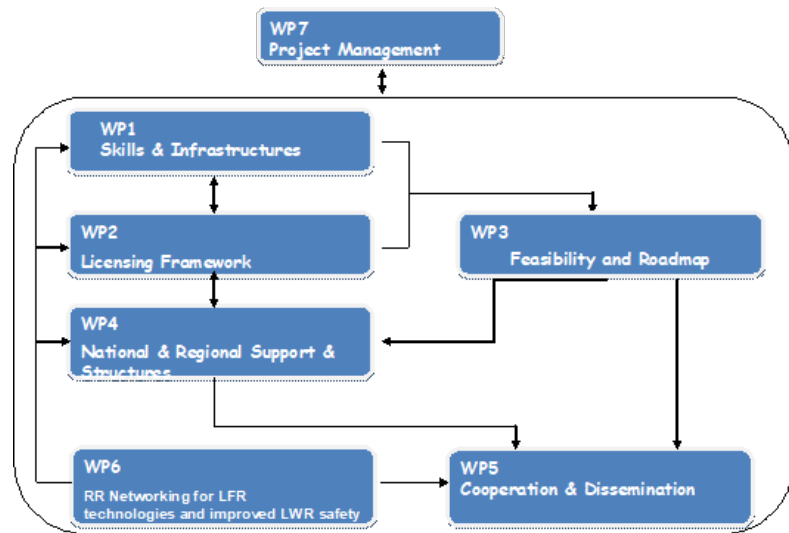
FP7 ARCADIA Project (Nov. 2013-Oct. 2016) - Assessment of Regional Capabilities for new reactors Development through an Integrated Approach

OBJECTIVES

- **ALFRED as a demonstrator of LFR in Romania:** the project assessed its **feasibility**
- WP1 coped specifically with **E&T needs**

OUTCOMES

- **Good perspectives** for ALFRED construction
- **Good competences** at regional and EU levels
- **New competences needed:** nuclear data, Pb TH, thermo-mechanics and Pb chemistry, I&C, management of an international project
- Based on ECVET principles, **E&T is proposed:**
 - Conceive Design Implement Operate approach
 - Application specific courses at Excellence Centres
 - New programme in Energetic and Nuclear (Univ. Pitesti)



Academic Knowledge among the critical prerequisites: NEED to TIMELY FILL THE GAPS

Needs of New Member States and Specific Regional Initiatives

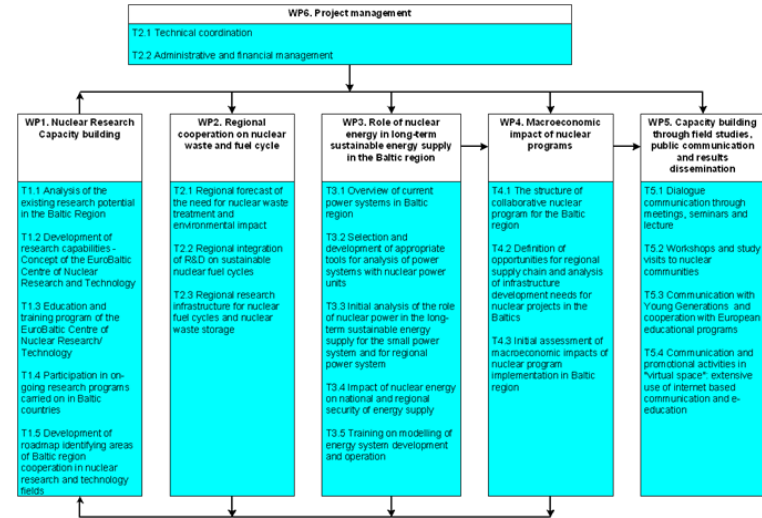
H2020 BRILLIANT (July 2015-June 2018) - Baltic Region Initiative for Long Lasting InnovActive Nuclear Technologies

OBJECTIVES

- To establish and promote cooperation in Baltic Region
- Increased cooperation for better nuclear energy development
- Roadmap to EUROBaltic Centre of Nuclear Research and Technology

OUTCOMES

- EE, LV, LT and PL organised meetings on nuclear with students, industry, politicians, stakeholders
- Sweden offered access to Äspö Hard Rock Lab., Bentonite Lab., Canister Lab., site Investigation Oskarshamn
- Developments of the energy sectors in EE, LV, LT and PL were modelled with the MESSAGE tool
- Energy security of EE, LV, LT and PL was assessed using methodology developed at Lithuanian Energy Institute



2BETINA Project (Baltic Education and Training Infrastructure in Nuclear Application) proposed in 2018

Needs of New Member States and Specific Regional Initiatives



Baltic Center for Nuclear Fuel Cycle Studies - Oskarshamn

Baltic Center of Nuclear Education - Tartu

Baltic Center of (Nuclear) Coolant Technology Development - Riga

Baltic Center of Nuclear Security and Safety – Vilnius/Kaunas

Baltic Institute of Nuclear (Power) Research - Swierk

Exchanges with Education Systems beyond Europe

- The creation of the European Nuclear Education Network (ENEN) in 2003 represented an important step in promoting harmonisation by mutual recognition in nuclear disciplines in Europe, starting with nuclear engineering, but not limiting to it.
- While the introduction of the European Credit Transfer System (ECTS) and the implementation of the Bologna Convention in Europe were creating a common basis for exchanges and student mobility, the need was felt to approach two different countries whose education environments in the nuclear field were going to play an increasingly important role, being Russia and China.
- Promoting and easing exchanges of students and teachers between Europe and these Countries was then considered an action worth of a specific efforts. As explained hereafter this operation was more successful in the case of Russia than of China.

Exchanges with Education Systems beyond Europe

FP7 ECNET (March 2011-Feb. 2013): Exchanges with China

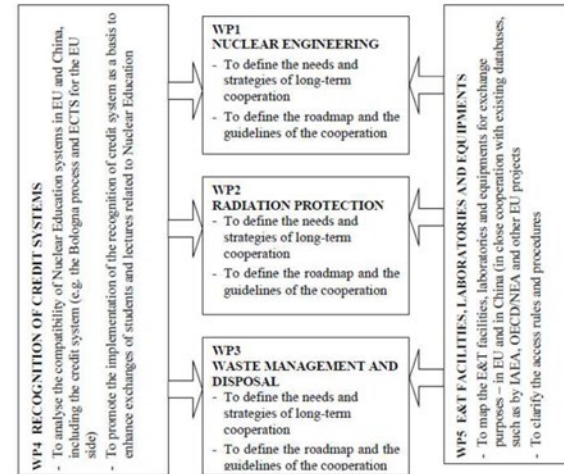
The Bologna Convention and ECTS represented a step within Europe: **easing the exchanges with other E&T environments was immediately felt as a need**

OBJECTIVES

- **Cooperation in the nuclear fields:**
 - Promoting mutual recognition
 - Expanding exchanges of students and lecturers
 - Secure knowledge management

OUTCOMES, DIFFICULTIES, RESULTS

- Two mirror projects and consortia on either side
- Language difficulties at the time
- Insufficient exchange of information for E&T system comparisons
- Useful link established: PoliTo (IT) and SJTU



STILL GREAT INTEREST IN REPROPOSING THE COOPERATION, WITH POSSIBLY LESS DIFFICULTIES NOWADAYS

Exchanges with Education Systems beyond Europe

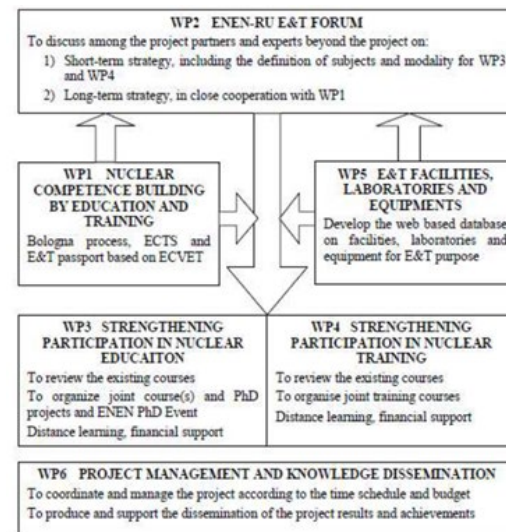
FP7 ENEN-RU II (July 2014-June 2016): Exchanges with Russia

OBJECTIVES

- to define a common basis for cooperation between the European and Russian networks for E&T
- to define an implementation plan for cooperation
- to solve the language difficulties found during ENEN-RU
- to implement a collaboration plan in a sustainable manner
- to operate the knowledge management framework
- to promote further use of E&T facilities

OUTCOMES

- two mirror projects and consortia on either side
- comparison of curricula in Nuclear Engineering
- bilateral agreements
- participation in joint courses
- web database for E&T facilities
- participation in key events on either side



The project put the basis for continuing the cooperation of ENEN with MEPHI-NRNU and Rosatom-CICET

Continuing Education Efforts for Nuclear Technologies

- The need for **educational opportunities stimulating students to undertake nuclear careers in a period of low attractiveness** has been a continuous worry for ENEN and other players involved in the effort to maintain a sufficient level of nuclear workforce and expertise in Europe.
- Offering to students **experiences in high level laboratories, intersemester courses and the access to that kind of general information that can be provided by Massive Open Online Courses (MOOCs)** represented the target of one of the projects described below, aiming to make more lively the panorama of the nuclear educational offer in Europe.
- A further project moved from consideration of the ongoing introduction in European countries of the **VVER technology, requesting specific training capabilities to be provided by a dedicated Academy**, whose establishment was conceived in cooperation with ENEN.
- Both the initiatives, though not directly led by ENEN, represent efforts contributing to that process of maintaining and developing knowledge in the nuclear fields within Europe, which is continuously stimulated by the Association.

Continuing Education Efforts for Nuclear Technologies

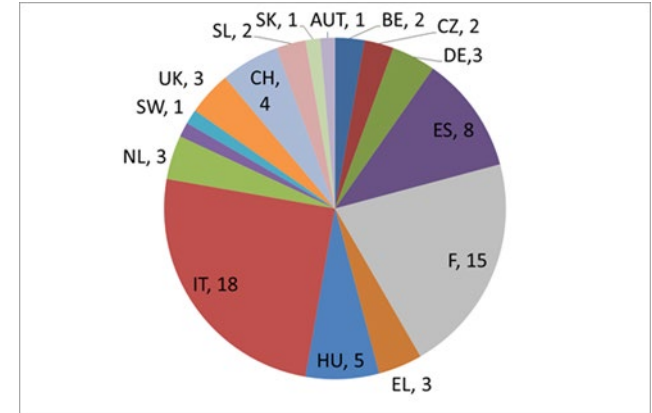
FP7 GENTLE (Jan. 2013-Dec. 2016): Graduate and Executive Nuclear Training and Lifelong Education

OBJECTIVES

- offering training to students via Student Research Experiences
- offering Inter-Semester Courses for BSc and MSc students
- Setting up a MOOC on Nuclear Energy

OUTCOMES

- SRE: internships at the GENTLE Project Partners' labs (up to 24 months)
- ISC: for graduate students and professionals on topics which were not part of the academic curricula, as nuclear fuels, nuclear safeguards and security, nuclear waste management, nuclear decommissioning, nuclear data, reactor techniques, TH phenomena: more than 100 students attended
- MOOC: large success in three editions, with a number of attendees greater than 4500, 5800 and 2200 (the last as a provisional figure)



SRE ATTENDANTS PER COUNTRY

The MOOC was a very inspiring and rewarding action, eventually leading to a very efficient way of teaching nuclear science and engineering

Continuing Education Efforts for Nuclear Technologies

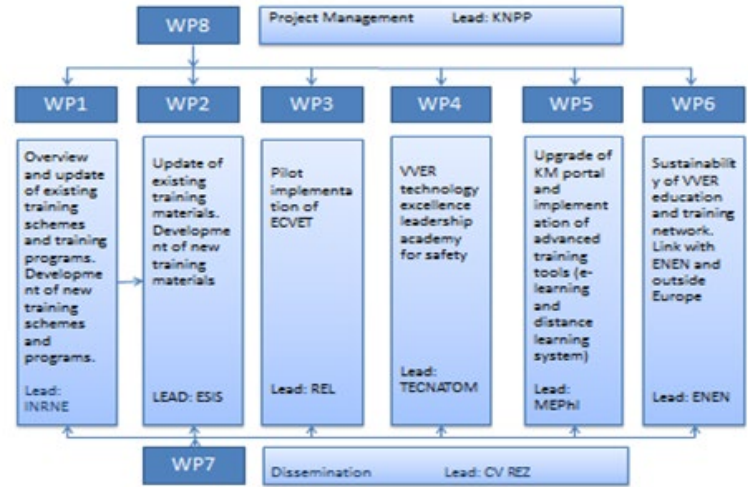
H2020 CORONA-II (Sept. 2015-Aug. 2018)

OBJECTIVES

- enhance the safety of nuclear installations through better training in VVER area
- continue the state-of-the-art regional training network for VVER
- make available a comprehensive set of training programs

OUTCOMES

- pilot training for different groups: A) nuclear professionals and researchers; B) non-nuclear professionals; C) students; D) professional and personnel of contractors
- distant training and e-learning (8 courses, with IAEA's CLP4NET)
- establishment of the CORONA Academy
- pilot training to ensure a strong Safety Culture



Need for a permanent structure that assures E&T follow-up and its survey

IN THIS FRAME, THE INTEGRATION INTO THE ENEN ASSOCIATION WAS FOUND TO BE INSTRUMENTAL

ENEN PROJECTS: KEEPING HIGH NUCLEAR SAFETY LEVELS IN EU

- The following three described projects **represent major efforts coordinated by ENEN** to cover specific needs that emerged in past years, trying to provide a remedy to the decreased interest in nuclear careers.
- **The first project was directly stimulated by the EC after Fukushima**, in the aftermath of the concerns raised in relation to the proper implementation of a nuclear safety culture, whose partial lack is often identified at the basis of occurred reactor accidents.
- The ANNETTE project represents instead **the attempt to establish a major long-lasting coordination among course providers in Europe aiming to propose sharp and focused courses for Continuous Professional Development** to people having already a job in the nuclear fields or wishing to enter them. Though it includes a number of other actions providing further value to the action, ANNETTE is therefore focused on the quite difficult task of proposing courses in a period of low interest for them.
- Finally, ENEN+ represents the latest project of the series, based on **the awareness that a major effort should be established to attract and retain students in the nuclear fields, starting since the Secondary School, through the BSc, the MSc and PhD levels**. It is finally recognised that student mobility, to be favoured, requires the allocation of adequate financial resources to make it feasible at any level, providing adequate grants.

ENEN PROJECTS: KEEPING HIGH NUCLEAR SAFETY LEVELS IN EU

FP7 NUSHARE (Jan. 2013-Aug. 2017):

NUSHARE was a project implementing a European Education, Training and Information (ETI) initiative proposed by the Commissioner for Research and Innovation and the Commissioner for Energy after the Great East Japan Earthquake and Tsunami on 11 March 2011 (Fukushima).

OBJECTIVE

Develop training programmes on Nuclear Safety Culture for three target groups:

- TG1: represented by journalists and civil society representatives
- TG2: represented by staff members of Nuclear Regulatory Authorities (NRAs) and Technical Safety Organisations (TSOs)
- TG3: represented by electric utilities, systems suppliers, and providers of nuclear services at the level of responsible personnel, in particular managers.

OUTCOMES

- pilot training for French journalist and a Media Educational package developed in cooperation with the World Federation of Science Journalists (<http://wfsj.org/v2/2017/06/15/new-toolkit-on-nuclear-safety-for-journalists/>)
- several training modules developed by ENSTTI for NRAs and TSOs personnel and implementation of pilot courses by INBEx with the “Fermi” training tool
- several sessions by TECNATOM for managers in TG3 using different conventional and non-conventional means, including micro-learning techniques

NUSHARE LEAVES BEHIND IT A WAKE OF USEFUL MATERIAL AND REFLECTIONS, INSPIRING FURTHER PROJECTS

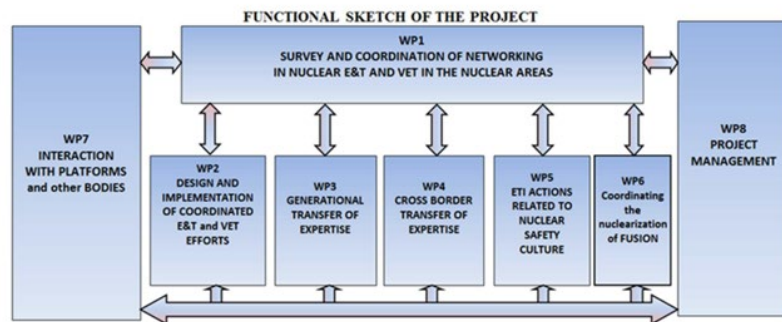
ANNETTE (Jan. 2016-Dec. 2019): Advanced Networking for Nuclear Education and Training and Transfer of Expertise

OBJECTIVES

- coordinating networking in the nuclear fields
- Master and Summer School for CPD
- reviving the production of educational material
- implementing a cross-border personnel exchange in industry
- reinforcing actions for promoting Nuclear Safety Culture
- supporting the process of nuclearisation of Fusion

OUTCOMES

- several actions already completed for coordination
- summer School and Master pilot courses run or being run: by-laws for a new ENEN certification prepared
- production of new educational material underway
- cross-border, cross-company exchange under ECVET rules
- actions for NSC and fusion: MOOCs being prepared



ANNETTE CATALYSES EFFORTS FROM DIFFERENT SECTORS INCLUDING NUCLEAR ENGINEERING / SAFETY, RADIATION PROTECTION, GEOLOGICAL DISPOSAL, NUCLEAR FUSION

ENEN PROJECTS: KEEPING HIGH NUCLEAR SAFETY LEVELS IN EU

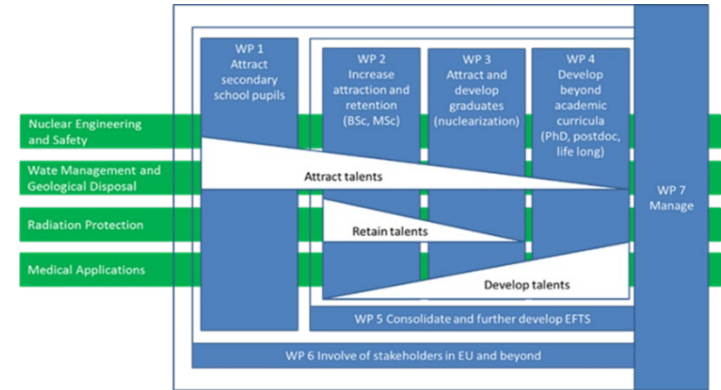
ENEN+ (Oct. 2017-Sept. 2020): Attract, Retain and Develop New Nuclear Talents Beyond Academic Curricula

OBJECTIVES

- to preserve, maintain and further develop the valuable nuclear knowledge for today's and future generations
- attraction, development and retention of learners in different stages within the education systems (1: high school pupils, 2: B.Sc. and M.Sc., 3: nuclearization and 4: Ph.D., postdoc and lifelong learning)
- explore voluntary accreditation functionality within ENEN

OUTCOMES

- actions being developed according to the objectives
- mobility funding exceeding 1 MEuros being distributed
- individual career guidance
- communication strategy with stakeholders
- advocacy effort to increase commitment towards nuclear E&T



ENEN+ INVOLVES A PARTNERSHIP OF NUCLEAR STAKEHOLDERS, INCLUDING ACADEMIA, INDUSTRY, INTERNATIONAL ORGANISATIONS

CONCLUSIONS (1/3)

- The projects described in this paper addressed, inter alia, different relevant aspects of nuclear E&T in Europe
- A **deep worry** for preservation and further development of competences in relation to nuclear reactors of different types and generations has motivated each specific action
- It is clear that in different European member states the acquisition of nuclear competences is not favoured at the levels required to maintain competitiveness
- A problem to be tackled in this context is the one of the sustainability of the above described efforts, e.g. as tried by ENEN in its latest projects
- It is important that **all stakeholders be aware of and agree on the need to provide sustainable resources** for attraction, development and retention of new nuclear talents

CONCLUSIONS (2/3)

- The recent Communication of the European Commission entitled “A Clean Planet for all” stating that renewable energies *“together with a nuclear power share of ca. 15%, (...) will be the backbone of a carbon-free European power system”* in 2050, confirms that the efforts for preserving nuclear competences are directed towards the right target and need renewed commitment from all the stakeholders
- Preserving education and training in the nuclear fields even in adverse policy conditions, as achieved through the projects described in this paper, will certainly turn out as a valuable common investment, which will maintain the competences in a technology having a vital role for the sustainable development of Europe

CONCLUSIONS (3/3)

From the Euratom Work Programme 2019-2020 :

NFRP-11: Advancing nuclear education

*“(...) The aim is to bring innovation to nuclear education by employing and/or developing new methods and tools based on most recent pedagogical knowledge, including hands-on exercises in order to make the field more attractive for a younger generation. Whenever appropriate, possible career paths should be put into the perspective, by anticipating professions of tomorrow. **Rather than developing new programmes and/or courses, the existing ones should be adapted.** The action could target students as well as teachers for secondary, higher and vocational education. It should bring together specialists in technical teaching from both the field of nuclear technology and ionising radiation (including radiation protection) and it should implement the most advanced educational techniques. Involvement of end-users of nuclear technology (industry, operators, research centres, medical applications, remote handling technologies etc.) is also required.”*

The interest for preserving and enhancing E&T is still high: let's take the chance to make the several efforts deployed up to now converge into a global EU effort

Thank you for your kind attention !