Title: Database of regionally available educational resources
Type: Report to be made into webpage
Goal : To collect data about Partners' educational infrastructure; Deliverable D5.1 of WP5

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PART I. Introduction and summary

The VINCO Project requires thorough study of the educational possibilities of all four participating countries. This stems from the fact that the construction and use of the Gen IV reactors will require best understanding of the design, safety systems in particular, and the use of these novel constructions. It is well-known that although commercial use of Gen IV reactors cannot happen before next 15-20 years, the efforts to provide qualified personnel have to be undertaken pretty soon. Those who promote the Gen IV and those who will deploy it have to be very well educated and understand that they must take into account permanent , continuous development of science and technology which will guarantee not only non-stop delivery of the electric and heat energies but also will solve the problem of spent fuel storage in the socially acceptable manner. In this race it is not trivial task to take the lead as early as possible.
Every country has its own education system and there are no common approaches to the teaching of science and technology. In spite of that there are good examples, as ENEN, of the organization that works out a system of teaching and training for many participating countries. VINCO Project has no such ambitions, however it must work out educational platform that will support the technical aims of this project led by organizations from four countries: Czech Republic, Hungary, Poland and Slovakia. Not all of them are intimately collaborating with universities, and focus their attention to engineering problems. Nevertheless, their success heavily relies on talents, expertise and the best preparation of the employees already in initial phase, i.e. when they are university students. There is one point which is usually overlooked when one talks about education. This concerns the stage of pre-university time, when young secondary school's students are supposed to shape their interest in given subjects. Those with the best motivation will learn quickly and then become the best students at the university. At the very end one gets the most talented and well prepared young specialists.

Having all these in mind we decided to inspect also how does pre-university education looks like in countries participating in VINCO Project. From the enquiry, see the detail in Appendix 1,one could learn that the university students in Slovakia only can smoothly start the courses on nuclear technology. In the remaining three countries the students' knowledge of nuclear matter is insufficient and the universities have to teach basis of nuclear science from the scratch. Such courses usually appear at the 2nd and even 3rd grade. In our opinion, this is quite late as in the meantime one can loose many students who would decide earlier on their future specializations. Somewhat better situation is found when one looks at the problems of thermodynamics taught on elementary level in secondary schools. In most of countries (we have no direct confirmation of this information from Hungary) the basis of thermodynamics is taught, incl. such problems like e.g. Carnot cycle. Therefore one should try to convince, if necessary, teachers to explain basic problems with preparation of the steam and the work and efficiencies of a steam turbines. Perhaps such things are already in the curricula of many schools, because they need not to be taught in the context of nuclear energy but just in the context of generating current.

The university education oriented toward nuclear power and nuclear techniques is quite well organized in all four countries. The theoretical subjects are baked by the students' laboratories. However, there is not always clear to what extent the students can make use of various internships. It seems that in Czech Republic and in Slovakia the students have access to nuclear facilities. In Poland some of the short courses of this type are organized in foreign countries. Situation in Hungary is unclear. In every country there are at least 10 students per year who leave the university with MSc in this specialization. In the Czech Republic and in Poland one can even quote a number of "tens of students", in Slovakia 25/year. One can thus be concerned about the capacity of the labor market for these students, especially in Poland whose nuclear power program develops with unsatisfactorily smaller pace than one should expect. Besides, the labor market in Poland seems rather small for the students with nuclear specialization. In the remaining countries the industry exhibits a need of such specialists. To end the review of education in nuclear technology, there are about 1-3 PhDs granted every year in all participating countries. It is not clear, however, what is further career of these nominees.
It seems that in none of the participating countries money are allocated specifically to students specializing in nuclear power. Slovakia is involved in students' exchange program. Probably this is true also in the remaining countries. No financial support is neither provided for participation of students in international schools or conferences.

It is interesting to note that the courses in nuclear matters are usually not required on "non-nuclear" specializations (probably Slovakia is an exception). It is obvious that such courses must be rather elementary, however, they should be taught because of the need for shaping the public awareness in nuclear matters. In Czech Republic one can voluntarily attend such courses because they are offered to students from many towns. In this context one can be surprised that such possibilities do not exist in Hungary, the country with well-developed nuclear power. Industry and other sectors outside of the universities are usually not organizing regular academic-like, specialized courses. In Hungary and Czech Republic there is apparently no need for organization of such courses. Slovakia organizes courses in close collaboration with Slovak University of Technology, Bratislava. Poland educates experts mostly in nuclear safety and radiation protection only. The ones who are interested in being employed in nuclear sector must prove their qualifications. All 3 countries possessing nuclear power plants lead rather well organized approach to train post-university various specialists needed in nuclear sector. In Poland one encounters a number of jobs requiring specialized training, however, as long as nuclear power is not introduced, the efficiency of such training can hardly be evaluated. This can be contrasted with thye situation in Slovakia. Our partners from Slovakia are the only ones having (declaring to have) well-organized system of training led outside of the universities. However, all courses there (I to III category) are organized on request of Slovenské elektrárne, a.s. only.
Speaking about other educational activities that could be led by organizations included in VINCO Project, one can note that no regular schools and conferences are organized so far by the participants. When hands-on type of education is concerned, in Slovakia and Poland only one can

account on undergoing training in nuclear laboratories. It is not clear whether the simulator in Jaslovske Bohunice Power Plant (Slovakia) can be used by foreign students. In Poland some of the reactor operation techniques can be trained at the experimental reactor MARIA.
Technical support required for leading the courses presents no problem in none of the participating organisations. All of them have sufficient space and facilities to organize courses. Also, there is no particular problem with finding accommodation in reasonable price and not far from the training site. Except of the partners from Czech Republic cateferias/restauirants can be found on-site.

In conclusion one can say the following:

- Organizations participating in VINCO Project have theoretical possibilities of conducting schools and conferences on Gen IV reactors: they are equipped in basic tools (lecture halls with projectors, audio systems etc.), including the accommodation possibilities.
- They have to overthink the content of such schools. Especially the problem of practical education on nuclear reactors (experimental and in NPPs) has to be considered.
- It is impressive to see how many professional courses can be organized by Slovak and Czech partners, see Appendix 3. It seems that both of them could take a lead in the courses specially designed for education about Gen IV reactors.
- In addition to regular professional training one could also think about organizing a program which would familiarize foreigners with the country hosting the school. So far such programs were not considered.
- One should consider whether is there any chance that VINCO could influence the curricula in the secondary schools. It seems that rather minor modifications are required in order to attain the perfect match between the secondary school and university-like programs.

This report was compiled by the team from NCBJ of Poland led by professor Ludwik Dobrzyński. The report uses data provided by the VINCO partners: a questionnaire was prepared and sent to partner institutions. The questionnaire was divided into three parts – and the answers were also grouped into three sets. The first one contained questions about general education in the country, the second one contained questions about educational resources of each partner institution, and the third one asked about the courses conducted by each partner (this part was based on the information provided by ENEN). First two parts of the report contained answers to the questions, arranged in tables containing questions; four answers from each partner; and sometimes our comments or remarks (last column). The first draft has been sent to VINCO partners for discussion.
The existing courses hardly cover the subject of GenIV reactors – this subject is at best touched in theoretical manner. Therefore we decided to sort out the courses reported in chapter three of the report country-by-country, not by GenIV content.

PART II. Summary of answers about general education

Pre-university level

Q1: Do the secondary school programs include information about basic nuclear physics? Do they cover the issue of ionizing radiation, its sources and use in everyday practice? If "yes" – How do you asses the level of knowledge obtained in secondary school? In particular: does this knowledge provide sufficient basis for basic nuclear technology course or your Universities must teach nuclear physics "from scratch"?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
In Poland there are two ranges of upper secondary school ("liceum", not obligatory but often required for higher education). Curricula – basic (required) and extended (for pupils seriously interested in physics). Some nuclear physics is contained even in the basic curriculum. Each secondary school pupil learns about alpha, beta and gamma radiation (basic properties and mechanisms of emission, neutrino knowledge is not required). Other topics concern the use of ionizing radiation and nuclear energy: C-14 dating method, U-235 fission process and principles of nuclear power plant as examples. In addition, the school programme contains the notions of rest mass, mass deficit, binding energy,	Electromagnetic radiation and particles of the microworld are taught in grammar schools. The curricula obey physics of atoms, fission reaction and synthesis of nuclei. Students know basics of nuclear reactor and its importance for energy. Other thematic unit concerns the radioactivity (alpha, beta and gamma radiations)., effects of ionizing particles passing through the media. - Students can explain and compare the properties of radiation and know	Nuclear physics are included in secondary school program, but the universities usually start every physics courses from the beginning, starting at mechanics. The structure of physics courses in the universities are totally different from that in the secondary school.	Yes, Yes, Basic level, The basis is not sufficient, universities must start from scratch.	Perhaps with exception of Slovakia in VINCO countries nuclear physics must be taught from the scratch at universities. The secondary schools deliver usually very limited information about nuclear energy

ways of detecting ionizing radiation and its influence on matter and living organisms. All this allows to start nuclear technology course. This, however, does not mean that all pupils truly acquired the aforementioned knowledge.	the radioactivity of the environment and sources of radioactivity. Universities do not have to teach nuclear physics "from scratch".			

Q2: How well thermodynamics is represented in the curricula? Do the students understand ways to obtain work from heat? Is Carnot's Cycle and its efficiency discussed? Do the students appreciate the efficiency of typical steam turbine? Or energy obtained per unit mass of fuel, for instance fossil or nuclear?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Basics of thermodynamics are taught in the lower secondary school ("*gimnazjum*") which is obligatory for all young people. Pupils learn there about internal energy, heat and temperature. They are told about thermal conductivity, convection and changes of the state of the matter. They also solve exercises	Thermodynamics us taught in the grammar school. Thematic unit: Structure and properties of gases – Thermal processes in gases, gas work, internal energy. Students are able to characterize isothermal, isobaric, isochoric adiabatic processes by equations and graphically. Students can use theoretical knowledge in	we don't have information on that.	The first and the second laws of thermodynamics are shortly presented but without enthalpy and entropy definitions. Heat transfer tasks are solved in stationary cases only. Equation of state for ideal gas is formulated. Carnot's Cycle and its efficiency are also taught	**Remark on Hungary:** do you know whether university students have any difficulty with thermodynamics? Perhaps in Hungary the university curricula don't care about such problem? Conclusion: It seems that Polish schools teach about basic phase

concerning specific heat, heat of evaporation and heat of fusion. On the basic level of *liceum* the thermodynamics is not discussed, so for many pupils the adventure with thermodynamics is finished once they passed the education in the gimnazjum. Thermodynamics is taught only in classes with advanced physics. There such ideas as perfect gas, isothermal, isobaric, and isochoric processes, heat capacity in those processes. I and II law of thermodynamics is also presented, as well as Clappeyron equation, plots of perfect gas processes and thermodynamic cycles. Pupils at advanced classes calculate changes	meeting the challenges of practical life. Student can use theoretical knowledge in the understanding of the thermal engines. Thematic unit: thermodynamics – internal energy. Students understand changes in internal energy by the work performed and know how thermal exchangers works. Forms of energy - kinetic, potential, internal, energy released by combustion (calorific value), binding energy in the nucleus. We are not competent to say whether we are satisfied with the level of teaching since it is statistical statement depend on grammar schools and universities. As we are engineering organisation we do		at secondary schools. (on efficiency and energy obtained from unit mass of fuel) The answers to the rest of questions are "No"	transformations in gases. Only in classes with advanced level the students become well prepared to study nuclear power at universities.

of internal energy in isobaric and isochoric processes as well as work performed in isobaric process. They calculate the efficiency of heat engines and the influence of pressure on boiling temperature. They also perform analysis of heat balance for processes that include heat transport. To sum up – those who had advanced physics should be well prepared for studying nuclear energy matters . The rest should supplement their knowledge during self-learning.	not have this kind of information.			

Q3. How many Universities (including Technical Universities) provide MSc in Nuclear Physics or Nuclear Chemistry? How many students per year obtain "nuclear" MSc (approximate numbers are sufficient)? What are the prerequisites for starting those studies?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
At least 3 universities offer MSc in nuclear physics (scientific nuclear physics: University of Warsaw, Warsaw Technical University and Jagiellonian University Kraków), at least 4 other offer MSc for nuclear physicists under another, more general names like experimental or theoretical physics): Silesian University Katowice, University of Wrocław, UMCS Lublin, UJK Kielce. Rough estimate of numbers: about 10 "nuclear" MSc per year.	There are 3 Universities providing MSc in Nuclear Physics or Nuclear Chemistry (Slovak University of Technology in Bratislava (SUT), Comenius University (CU) and Pavol Jozef Šafárik University in Košice). About 25 students per year obtain the MSc in this field of study. The prerequisite is the knowledge of physical principles which can be obtained within the basic physics course.	2 or 3 Universities provides courses. 5-6 students per year obtain MSc. You need BSc for the entrance to MSc courses.	Czech Technical University in Prague - Faculty of Nuclear Sciences and Physical Engineering Tens of students. (prerequisites) Secondary education	All countries prepare sufficient number of the university's graduates. However, it is not clear whether the labor market is able to absorb so many specialists.

Q4. Are "nuclear" courses required for non-nuclear MSc? If so:

What faculties provide the courses these studies? What faculties require them? How many lecture hours are dedicated to such a course? What are the prerequisites for taking such a course?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Faculties of Physics as a rule provide/require from their graduates some knowledge of nuclear physics, for instance participation in "Introductory Course of Nuclear and Particle Physics" (30 lecture and 30 exercise hours, Faculty of Physics Warsaw University, around year 3). As a rule earlier participation in general physics course is required. Introductory course is required for choosing later nuclear physics for MSc.	There are study programs where "nuclear" courses are required. The courses are provided mainly by the following faculties: Faculty of Electrical Engineering and Information Technology (SUT), Faculty of Chemical and Food Technology (SUT), Faculty of Natural Sciences (CU), Faculty of Mathematics, Physics and Informatics (CU). In average, 26 hours of lectures and 26 hours of exercises (numerical, laboratory) are dedicated to each course. The prerequisite is the knowledge of	No	No. Faculties providing the course: Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering (e.g. Department of Nuclear Reactors). It supports courses for students of the below listed universities in the Czech Republic: Czech Technical University in Prague -Faculty of Nuclear Sciences and Physical Engineering, - Faculty of Mechanical Engineering - Faculty of Electrical Engineering, Brno University of Technology - Faculty of Electrical Engineering and Communication, - Faculty of Mechanical Engineering, University of West Bohemia in Pilsen	The "nuclear" courses are not always required. Especially rich offer is given to students in Czech Republic. One can hope that it results in better public understanding and acceptance of nuclear power

	physical principles which can be obtained within the basic physics course.		- Faculty of Electrical Engineering, - Faculty of Mechanical Engineering, Masaryk University in Brno - Faculty of Science Technical University of Ostrava - Faculty of Mechanical Engineering, Charles University in Prague - Faculty of Mathematics and Physics.	

Q5. What are other courses that teach nuclear matters? How many hours are devoted to nuclear matters?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Nuclear Power is usually discussed in energy curricula (a one-semester lecture, 30-60 hours, technical universities) . Nuclear physics is sometimes part of the modern physics course outside physics faculties (few hours	At Slovak University of Technology in Bratislava, Faculty of Electrical Engineering and Information Technology, there are the following courses dealing with "nuclear": Materials of Nuclear Power Plants, Decommissioning of Nuclear Power	No other courses	At Czech Technical University, Faculty of Nuclear Sciences and Physical Engineering, in study programme „Nuclear Engineering" there are more than 20 courses directly touching nuclear issues.	Except of Hungary remaining countries take care of introducing nuclear matters to their curricula

devoted to nuclear matters).	Plants, Theory of Nuclear Reactors, Dosimetry and Radiation Protection, Experimental Reactor Techniques, Enginery of Nuclear Power Plants, Operation of Nuclear Power Plants, Safety and Reliability of Nuclear Power Plants.		Other courses are available in close study programmes e.g. Nuclear Chemical Engineering, Dosimetry and Application of Ionizing Radiation .	

Q6. Are students' nuclear laboratories present in University curricula? If so – how many hours are dedicated to them and what experiments can be performed ? Please provide at least one example for nuclear and at least one for non-nuclear course (specify which).

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Nuclear lab is part of the students' lab in faculties of physics. For example Faculty of Physics Warsaw University provides nuclear-connected exercises on Freshman Practicum (Measurement of	At the Faculty of Electrical Engineering and Information Technology (SUT) there are special nuclear laboratories. In general, about one half of the exercises of the subject are realized in these laboratories. In the nuclear	we don't have information.	In most universities in the Czech Republic the number of curricula subjects increased in the nineties, while the number of teaching hours remained the same. This brought about a change in our organization of experiments. The	Except of Hungary, which has no information on this subject, it seems that all other partners take sufficient care of the students'

Radon Daughters in Air, Measurement of Beta particles Range in Aluminum, Poisson Distribution), however they are not in the "required" section (can be, don't have to be chosen). Each exercise lasts ~4 hours. On the Advanced Practicum there is a range of nuclear physics exercises (Comparison of Methods for Measuring gamma rays; Study of the Decay Scheme of ^{128}I produced via neutron activation; Measuring of Mn Content in the steel via Neutron Activation Analysis; Measurement of the Energy Spectrum of ^{236}U Fission Products; Measurement of Deuterium	courses, the exercises focused on the neutron dosimetry and determination of material parameters (e.g. measurement of the diffusion length of thermal neutrons in paraffin, measurement of the diffusion reflection coefficient (albedo) for thermal neutrons) or the tasks requiring gamma spectrometry (e.g. measurement of uranium enrichment). In the non-nuclear courses, the exercises are focused on the basic measurements (measurement of the half-life of silver radioisotopes, measurement of the dose rate).		total number of experiments has remained the same, while the time of measurements has been reduced, so that related and the follow-up experiments were merged into 2.5 to 3 hour blocks. Comprehensive courses are then compiled from these blocks. For example at Faculty of Nuclear Sciences and Physical Engineering of CTU in Prague many practical courses are provided Nr. of hours of experiment depend on study programme. Practical training is provided in various courses in the fields of radiation protection, radiation measurement and dosimetry, nuclear chemistry, experimental	

Binding Energy; Measurement of Neutron Flux), at least one nuclear exercise should be chosen. Here each exercise takes about 3-5 sessions (each session lasts 4 or 5 hours). Those specializing in Nuclear Physics have to undertake Nuclear Practicum (2 topics), and here the exercises vary, since they are in part intended as a preparation for the MSc work needed for the Dissertation. It takes about 10-20 hours per topic.			neutron and reactor physics (at training reactor VR-1), reactor operation (at training reactor VR-1), nuclear fusion physics (at Golem fusion reactor), etc.	

Q7. How many universities (including Technical Universities) offer regular specialization in Nuclear Power? How many students choose specialization in Nuclear Power?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
At least 3 technical universities offer Master degree in Nuclear Energy (Warsaw TU, Poznań TU, Silesian TU in Gliwice) At least 4 technical universities offer postgraduate studies and courses in Nuclear Energy (Warsaw TU, AGH,PWrocław TU, Gdańsk TU) Energy or Electric Faculties usually include Nuclear Energy course in the Energy curriculum. AGH and Wrocław TU provide Reactor Design courses during later stages of the curriculum, required is the technical, energetics knowledge. About 30 MSc of this kind are awarded yearly all over Poland .	The regular specialization in Nuclear Power is offered by 1 university – Slovak University of Technology in Bratislava. The average number of students in this field of study is 10 per year.	One There are roughly ten-twenty students every year who chose nuclear courses specifically.	One, Usually tens of students	Poland houses many universities that offer specialization in nuclear technology. It also promotes probably about 20 students a year to the MSc degree. Slovakia promotes 10 which seems well overthought number. It is not clear whether "tens of students promoted in Czech Republic will find employment in this country.

Q8. How much can students be acquainted with the practical operations in nuclear sector (visits to nuclear centers, nuclear power plants, repositories etc.) both as part of curriculum and through universities' mobility programs? If practical knowledge is required name nuclear training centers (both in industry and in academia) used.

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Program of MSc-Eng studies (Warsaw TU) include "Obligatory, min. 2 months long internship at nuclear installation", Polish institutions named are NCBJ and IChTJ. PWar as well as AGH (Cracow) offer training abroad (Sweden, France) in reactor centers.	The part of the exercises of subjects Theory of Nuclear Reactors and Experimental Reactor Techniques is realized at the research reactors in Vienna (Technical University Vienna, Atominstitute), Budapest (Budapest University of Technology and Economics, Institute of Nuclear Techniques) and in Prague (Czech Technical University in Prague, Nuclear Science and Physical Engineering). Also the technical visits to Slovak nuclear installations (Bohunice Radioactive Waste Treatment Center, National Radioactive Waste Repository in Mochovce) are realized. Moreover, for excellent students there are possibilities to be involved in exchange	Visits to NPP is offered at almost all Universities. Paks NPP has direct contract with a secondary school in the vicinity of the Plant and they offer practical courses, visits on a more regular basis. Paks NPP has its own training program for those who they hire. People outside is only offered technical	(training center) Department of Nuclear Reactors in Faculty of Nuclear Sciences and Physical Engineering (FNSPE) of the Czech Technical University (CTU) in Prague Students of FNSPE CTU in Prague visit within their curricula (in Nuclear Engineering programme) nuclear infrastructure in the country (NPPs, nuclear research institutes, industrial companies, waste repository) and they come in touch with foreign infrastructure (NPP, research reactors, research institutes – typically in Slovakia, Hungary or Austria).	Comment Slovakia and Czech Republic offer good places for solid training in nuclear technology. The situation in Poland seems to rely on short-term courses in foreign institutes. Situation in Hungary is unclear.

	programs in many countries (e.g. Japan, Germany and Switzerland).	visits.	Various university mobility programme are used by some students as well.	

Q9. What organizations offer PhD in Nuclear Power? What is the total number of PhDs granted each year?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Each technical university that provides Nuclear Energy curriculum must be professionally prepared to offer PhD studies program related to Nuclear Energy, as is NCBJ. Official page of Ministry of Energy names 4 universities (Politechnika Warszawska, Uniwersytet Warszawski, AGH and Uniwersytet Łódzki) and 3 institutes (IFJ, IChTJ and NCBJ) as having PhD program in nuclear energy. The number of PhDs granted is difficult to estimate, since the national (OPI) database does not include Nuclear Power as separate part of knowledge. Rough guess would probably	PhD in Nuclear Power is offered by Slovak University of Technology in Bratislava, Faculty of Electrical Engineering and Information Technology. Each year, about 3 PhDs are granted.	Very few, 1-2 PhD is finished every year, and only in the Institute of Nuclear Technics of the Technical Univ. in Budapest.	Department of Nuclear Reactors in Faculty of Nuclear Sciences and Physical Engineering (FNSPE) of the Czech Technical University (CTU) in Prague, number of PhDs typically 1-3.	There are about 1-3 PhDs granted every year in all participating countries. It is not clear, however, what these nominees are doing next

be something about 1-3 per year.				

Q10. Last but not least: can you describe the ability of labor market to absorb (employ in the "nuclear" positions) the graduates of all the mentioned courses?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Since the nuclear industry in Poland is limited to scientific and regulatory institutions the chance of working in the field of the study is quite limited.	There is a demand of the labor market for the nuclear specialists (e.g. as the operator of the nuclear power plant, researcher in the field of decommissioning, material science or construction). As engineering organization we don't have the specific information about the demand for nuclear positions.	NPP can absorb the above number of students. Also, engineering companies needs 1-2 students /year, the research institutes needs 5-6 students/year. Safety Authority also needs 1-5 graduates.	Almost all graduates can easily find a job in nuclear field in the country (in nuclear industrial companies, research institutions, regulatory body, NPPs)	Except of Poland there is clear demand for specialists in nuclear power/technology. Poland did not developed yet such demand in industrial sector

Q11. Does the industry (or any sector other than state universities) organize independent education on nuclear matters? If so – please describe their role in the overall education.

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Industry and organizations like SIOR or NCBJ may organize the training courses for the "radiological job permits" (see next question) before state exam. Scientific institutes offer PhD studies in their fields of expertise. NCBJ is organizing many events (including work in specially prepared laboratory) which are dedicated to secondary schools	The education of the companies (e.g. Slovenské elektrárne, a.s.) is in close cooperation with the experts from Slovak University of Technology in Bratislava.	No. Paks NPP has its own training program for their emplyees. This training program is not open, serves only the needs of the Plant. Radioprotection courses are offered by small companies and Institutions, as people working in medical sector also needs certificate.	No	In Hungary and Czech Republic there is apparently no need for organization of such courses. Slovakia organizes courses in close collaboration with Slovak University of Technology, Bratislava. Poland educates rather experts in nuclear safety and radioprotection.

Q12. Name the jobs by law that require specific, additional training in nuclear or radiological matters. What sort of training is required? Is independent (state) examination a must for the job? Is the training provided in languages other than official state language?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Those jobs are listed in the "ROZPORZĄDZENIE RADY MINISTRÓW z dnia 10 sierpnia 2012 r. w sprawie stanowisk mających istotne znaczenie dla zapewnienia bezpieczeństwa jądrowego i ochrony radiologicznej oraz inspektorów ochrony radiologicznej" (Dz.U.2012, poz. 1022) and among them one can find all the jobs connected with operating nuclear reactor (operator, supervisor, director of the reactor, dosimetry personnel in the reactor) or storage facilities for radioactive waste; specialists responsible for: nuclear material, radioactive waste; operators of accelerators for non-medical use. Inspectors for radioprotection are required for any enterprise that operates ionizing radiation (including X-ray medical/veterinary scanners, medical accelerators etc.). A state examination is required for a person to be allowed to take the job. As a rule a training (including	These job positions are: Inspector of nuclear safety, Operator of nuclear power plant. The training is realized in the form of post-gradual courses realized at Faculty of Electrical Engineering and Information Technology (SUT). The independent (state) examination is required for these positions. The training is provided in Slovak language only.	Radiation protection courses are needed for different positions, which is controlled by the state. The courses are in three levels, basic, advanced and master. Official state language is needed for the exam. For expert work in nuclear, you have to be a member of the Chamber of Engineers. It doesn't necessitate the exam, but a certification about the experience	Radiation protection courses are needed for different positions, which is controlled by the state	All 3 countries possessing nuclear power plants lead rather well organized approach to train various specialist needed in nuclear sector. In Poland one encounters a number of jobs requiring specialized training, however, as long as nuclear power is not introduced, the efficiency of such training can hardly be evaluated

lectures and practical exercises) and an experience in similar job is required before an exam can be taken, in some cases some requirements may be waived (for instance acting radioprotection inspectors do not need to undergo course to be allowed to take a state exam for extending their status. The job permits have limited duration and exam is required to extend them. In some cases experience in the "lower job" is a prerequisite for abating permission of higher lever (for instance in order to get permission to take the job of shift supervisor in the nuclear reactor one needs minimum one (master or engineer) or three years (no higher education) experience as an operator. Exams are taken in Polish.		in the field.		

Q13. Are there any financial resources allocated specifically for Nuclear Power students' training abroad? If yes – how they are used practically? How many students (per year) participate in regular trainings abroad? What is the typical duration of such trainings?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
It seems that international collaboration in education is not centralized and depends on a given University, the agreements it is part of and people working for it.	As was mentioned, the excellent students are involved in the exchange programs which enables the covering of the costs connected with the travel and study abroad. The average number of the students participating in these regular trainings abroad is 3; their typical duration is about 5 months.	No	No	It seems that in none of the participating countries money are allocated specifically to nuclear power students. Slovakia is organizing students' exchange. Probably this is organized as well in the remaining countries.

Q14. Is there a specific, financial support provided for participation of students in international schools or conferences? If so – please provide the details (number of students, conferences, schools).

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
There is no specific support for this. However, one can apply for certain grants or subsidies from firms from nuclear energy sector (eg. AREVA, EDF etc.)	There is no special financial support for participation of students in international schools or conferences	No	No	There is no specific financial support for this sort of activity

Q1. Please, provide the contact information for educational activities: web page address and the name of the contact person with e-mail address.

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Prof. Ludwik Dobrzyński, Head Education & Training, Ludwik.Dobrzyński@ncbj.gov.pl Prof. Helena Białkowska, Head PhD studies, Helena.Białkowska@ncbj.gov.pl	Web page address: none Name of the contact person: Ing. Ruben Vidlička E-mail address of the contact person: Ruben.Vidlicka@vuje.sk	MTA EK is not educational institute, but research institute. Courses offered for IAEA are organized by Ms. Rozsa Baranyai, baranyai.rozsa@energia.mta.hu	There is no specific contact for educational activities.	

Q2. What regular courses are organized by the organization? For each course please fill a template provided in Appendix 3.

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
No regular courses are organized by NCBJ. PhD studies program is constructed mostly by the supervisor, with some common lectures. Training courses, if needed, are organized on an ad-hoc basis.. Subject choice is usually driven by number of people who require regular training	VUJE, a.s. is organizing courses for the employee of Slovenské elektrárne, a.s. specifically for the staff of nuclear power plants operating the nuclear units VVER 440/V-213 I. category - operational control room staff, verification physicist, simulator training	Basic radiation protection, nuclear security.	No courses.	Slovakia is the only country with well-organized system of training led outside of the universities. However, all courses (I to III category) are organized ONLY on request of Slovenské elektrárne, a.s.

(A and B types depending on the degree of risk when working with ionizing radiation, accelerator operators and so on).	instructors II. category – technical and managing staff III. category – service and operational staff Courses are organized only on request of Slovenské elektrárne, a.s. one or two times per year according to the agreed schedule.			

Q3. What other educational activities (like schools, conferences etc.) are organized regularly in the organization? Also in this case fill a template provided in Appendix 3.

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Szkoła Energetyki Jądrowej (Annual School on Nuclear Power)	none	none	No	With exception of Poland no regular schools and conferences are organized in participating countries

Q4. What training laboratories are operated by your organization? What types of exercises or experiments can be performed in each educational lab/practicum? What are the access rules for each lab? Can they be used in the exchange/mobility program of VINCO?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
When strictly nuclear power is concerned, no training lab exists in NCBJ. However, some experiments	Training laboratory: Full-scale simulator of Jaslovské bohunice power plant unit VVER	Only nuclear security, and nuclear forensics laboratory courses are available They	None	Only in Slovakia and Poland one can count on undergoing training in nuclear

can be carried out in scientific labs (LBM, LPD, SLN) and in the reactor MARIA. Those labs may be used in the exchange program provided a willing supervisor from NCBJ is found. There are no formalized access rules, - one should contact e.g. Lab's head or potential supervisor. However, regulations governing work with radiation in nuclear establishment (including access for foreigners to the Świerk site) must always be observed. Establishing access rules to the infrastructure are presently under consideration within a framework of BRILLIANT project.	440/V-213 Access rules: For training and visiting of simulator is required agreement of Slovenské elektrárne, a.s.	are not engineering laboratories.		laboratories. It is not clear whether the simulator of Jaslovske Bohunice Power Plant can be used by foreign students. In Poland some of the reactor operation techniques can be trained at the experimental reactor MARIA

Q5. Describe the "lecture infrastructure" of the organization. How many lecture/seminar halls are available? What are their sizes? Are they equipped with audio-video infrastructure?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
There are many lecture halls and	Lecture/seminar halls: 10	4-5 lecture halls for 50	One, 130 places with video and	All countries have sufficient

seminar rooms available. There is a seminar room in Warsaw (Hoza street) for about 30 participants. In Świerk, there are at least 2 large halls for about 200 persons each, they may be combined to form large auditorium, and they are equipped with beamers and audio systems. There are 2 additional seminar rooms with 40 chairs each, also fully equipped with audio/video systems and "joinable" to create a combined hall for 80+ persons. Finally there are at least 6 discussion/ seminar rooms (~20-40 places each). Each hall is equipped with beamer and audio system, each room is equipped with a screen with possibility of putting a beamer.	sizes of lecture/seminar halls: from 10 to 50 participants Equipment of lecture/seminar halls: audio-video infrastructure, air-condition	people, with projector.	infrastructure.	space and facilities to organize courses

Q6. Is there hostel/hotel/dormitory operated by the institution? If so – what is the number of beds, what are the bed prices (in Euro, if possible)? Provide the same data for hostels or hotels that offer modest prices for your guests. Also inform briefly about other commercial possibilities of finding accommodation.

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
No dormitory operates nowadays at NCBJ. However, in Warsaw there is a full range of accommodation places with prices starting from about 10 Eur per bed (in hostel conditions). NCBJ Id card gives the owner to free use of NCBJ buses that connect Świerk with Warsaw, Otwock and other nearby localities.	Hostel/hotel/dormitory operated by the institution: **No**, VUJE, a.s. is renting a capacity of secondary school dormitory. Apartment at hotel INKA: 60 €/night Standard room at hotel holiday inn: 95 €/night	We don't operate dormitory. The Technical University has dormitory capacity for around 30 euros/night	No dormitory. Rez can be reached by train from Praha (21 min. from Masarykovo nadrazi), where a wide range of accommodation can be found.	It seems that there is no particular problem with finding accommodation in reasonable price and not far from the training site

Q7. Is there a cafeteria in your institution? What are its opening hours?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
Yes there are two of them. One is called Bar56, open between 6:30 and 15:30, lunches serves	There is cafeteria with opening hours from 7:00 am to 3:00 pm, serving breakfasts and	Two restaurants from 11-14 hours	No. A restaurant is close to the institute, it operates between 11:15-13:45.	Except of Czech Republic cafeterias/restaurants can be found on-site

between 10:30 and 14:45. Another one operates inside the POLATOM's building.	lunches			

Q8. Is there a program for your guests to familiarize them with your country or county? Are there any other incentives for the visitors?

Poland	Slovakia	Hungary	Czech Republic	Remarks and conclusions
None at the moment	Individual approach or also there is city information center.	No, we don't organize	No	This aspect of the visit is ignored by partners in all countries

POLAND

Title:	Szkoła energetyki jądrowej / School of Nuclear Energy
Country:	Poland
Organizing institution:	NCBJ
Language:	Polish and English
Venue:	variable, last school: Hotel Novotel Warszawa Airport
Start date:	variable, last school: 26 October, 2015
End date:	variable, last school: 30 October, 2015
ECTS points (if applicable):	n/a
Course outcome:	
Course details:	vary from year to year, see also http://www.szkola-ej.pl/http://www.szkola-ej.pl/
Formal requirements to apply:	none
Tuition fee	very low or none
How to apply?	Registration via website
Course website:	http://www.szkola-ej.pl/
Available financial support possibilities:	
Any other important details:	

How much IVth generation reactors are discussed? Very little to no Gen IV mentioning, however conference program may be modified to include this subject provided lecturers are willing.

SLOVAKIA

Course No. 1

Title: I. category

Country: Slovakia

Organizing institution: VUJE a.s.

Language: Slovak

Venue: Educational and Training Center, VUJE a.s.

Start date: According to the requirement

End date: Duration of course is approximately one and a half years

ECTS points (if applicable): Not applicable

Course outcome: Participant after successful completion of ongoing exams and final exams gain certificate. By passing the state exam gain operator license.

Course details: Course is composed from 4 parts: theoretical training, onsite training, simulator training and job training.

Subjects of theoretical training:

Theory of nuclear power plant reactors, Nuclear safety, Primary part of nuclear power plant, Secondary part of nuclear power plant, Control and management system, Operating modes of nuclear power plant, Electrical part of nuclear power plant, Chemistry in power plants, Normal and abnormal operation of nuclear power plant, Reactor and operational physics … Totally 29 subjects with overall 900 hours of education.

Formal requirements to apply: Applicant must be employee of Slovenské elektrárne, a.s. or is required agreement of Slovenské elektrárne, a.s.

Tuition fee: Individual

How to apply?

Course website: No

Available financial support possibilities: No

Any other important details:

How much IVth generation reactors are discussed? They are not discussed IVth generation reactors.

SLOVAKIA

Course No. 2

Title: II. category

Country: Slovakia

Organizing institution: VUJE a.s.

Language: Slovak

Venue: Educational and Training Center, VUJE a.s.

Start date: According to the requirement

End date: Duration of course is approximately from nine to twelve months

ECTS points (if applicable): Not applicable

Course outcome: Participant after successful completion of ongoing exams and final exams gain authorization to perform working activities in nuclear power plants.

Course details: Course is composed from 3 parts: theoretical training, onsite training and job training.

Subjects of theoretical training:

Theory of nuclear power plant reactors, Nuclear safety, Primary part of nuclear power plant, Secondary part of nuclear power plant, Control and management system, Operating modes of nuclear power plant, Normal and abnormal operation of nuclear power plant, Reactor and operational physics … Totally 23 subjects with overall 480 hours of education.

Formal requirements to apply: Applicant must be employee of Slovenské elektrárne, a.s. or is required agreement of Slovenské elektrárne, a.s.

Tuition fee: Individual

How to apply?

Course website: No

Available financial support possibilities: No

Any other important details:

How much IVth generation reactors are discussed? They are not discussed IVth generation reactors.

SLOVAKIA

Course No. 3

Title: III. category

Country: Slovakia

Organizing institution: VUJE a.s.

Language: Slovak

Venue: Educational and Training Center, VUJE a.s.

Start date: According to the requirement

End date: Duration of course is approximately from three to five months

ECTS points (if applicable): Not applicable

Course outcome: Participant after successful completion of ongoing exams and final exams gain certificate.

Course details: Course is composed from 3 parts: theoretical training, onsite training and job training.

Subjects of theoretical training:

Use of nuclear processes in the energy sector, Electrical part of nuclear power plant, Nuclear safety, Primary part of nuclear power plant, Secondary part of nuclear power plant, Maintenance of equipment, Control and management system, Environment, Work safety, … Totally 14 subjects with overall 200 hours of education.

Formal requirements to apply: Applicant must be employee of Slovenské elektrárne, a.s. or required agreement of Slovenské elektrárne, a.s. is required

Tuition fee: Individual

How to apply?

Course website: No

Available financial support possibilities: No

Any other important details:

How much IVth generation reactors are discussed? They are not discussed IVth generation reactors.

HUNGARY

Title: EERRI Research Reactor Group Fellowship Programme

(EERRI: Eastern European Research Reactor Initiative)

Country: Hungary

Organizing institution: Centre for Energy Research, Hungarian Academy of Sciences with Institute of Nuclear Techniques of Budapest University of Technology and Economics

Language: English

Venue: Budapest,

Start date: 28. 09. 2015 End date: 06.11.2015.

ECTS points (if applicable):

Course outcome: Increase the knowledge of the participant who are coming from developing countries in the field of Research Reactor operation, and Reactor Physics

Course details: Theoretical lectures and hands-on training

Formal requirements to apply: These Group Fellowships are available to university graduates or their equivalent in the requested field, mainly through project-oriented on-the-job training

Tuition fee: 6000 EUR

How to apply? Through the IAEA in-touch platform

Course website: www.eeri.org

Available financial support possibilities: Applicants can apply from IAEA if they are from IAEA members sate

Any other important details:

How much IVth generation reactors are discussed? The Programmes mainly deals with the existing research reactor operation

CZECH REPUBLIC

Course No. 1

Title: Control systems of Nuclear Reactors

Country: Czech Republic

Organizing institution: CTU Prague, FNSPE

Language: English

Venue: FNSPE

Start date: September 2015

End date: May 2016

ECTS points (if applicable): 2

Course outcome: Detailed knowledge of safety systems of nuclear facilities, their philosophy, robustness against potential problems and failures

Course details: Matter of the subject is concentrated on categorization of systems in nuclear power plant according to importance to nuclear safety; next on requirements of different categories of systems and typical instrumentation of research nuclear facilities and nuclear power plants. Attention is given to definition of nuclear safety, single failure criterion and redundancy, common cause failures, independence and diversity; furthermore to qualification of safety systems. At the end, lectures deal with control and safety systems of systems research nuclear facilities. The lectures are completed with visit of the training reactor VR 1 with demonstration of its safety and control system.

Formal requirements to apply: Open for foreign students incoming to CTU Prague for study stay

Tuition fee: ?

How to apply? ?

Course website: No

Available financial support possibilities: ?

Any other important details:

How much IVth generation reactors are discussed? Not specifically. Issues common to all reactor generations

CZECH REPUBLIK

Course No. 2

Title:	Digital Safety Systems of Nuclear Reactors
Country:	Czech Republic
Organizing institution:	CTU Prague, FNSPE
Language:	English
Venue:	FNSPE
Start date:	September 2015
End date:	May 2016
ECTS points (if applicable):	2
Course outcome:	Knowledge of problems of computer based safety system of nuclear reactors, differences in comparison to hardwired systems, requirements on hardware and software, systems testing, configuration management
Course details:	Lectures deal with use of computers in safety systems of nuclear reactor, with requirements on their hardware and software. Attention is devoted to software life cycle, to software requirements, design, coding, integration of HW/SW, verification/validation, maintenance and configuration management of software. Requirements and limitation of programming languages by software coding are discussed. Problematic of programmable logical devices (CPLD, FPGA) for use in safety and control systems of nuclear devices was introduces into lectures. Subject is also completed by demonstration of validation of operational power measuring and independent power protection systems of VR 1 reactor I&C
Formal requirements to apply:	Open for foreign students incoming to CTU Prague for study stay
Tuition fee:	?
How to apply?	?
Course website:	No

Available financial support possibilities: ?

Any other important details: ?

How much IVth generation reactors are discussed? Not specifically. Issues common to all reactor generations

CZECH REPUBLIC

Course No. 3

Title:	Computer Control of Experiments
Country:	Czech Republic
Organizing institution:	CTU Prague, FNSPE
Language:	English
Venue:	FNSPE
Start date:	September 2015
End date:	May 2016
ECTS points (if applicable):	3
Course outcome:	Detailed knowledge of available instruments for control of experiments, measurement of electrical values and data acquisition; programming in graphical oriented development systems intended for control of experiments, data acquisition and their evaluation
Course details:	Lectures provide information about standard interfaces of personal computers - parallel, serial, USB, LAN and special interface cards; about standalone equipment that communicate with computers via serial lines or GPIB (IEEE488) interface, further about measuring systems with VME, VXI and LXI interfaces, discuss their advantages and disadvantages. Next, lectures deal with programming of measuring systems - special dedicated software, problems of use of high programming languages and especially use of graphical oriented development tools (Agilent VEE ane LabView); data acquisition and evaluation. Finally, students prepare individual software project for data acquisition and evaluation.
Formal requirements to apply:	Open for foreign students incoming to CTU Prague for study stay
Tuition fee:	?
How to apply?	?
Course website:	No

Available financial support possibilities: ?

Any other important details: ?

How much IVth generation reactors are discussed? Little

CZECH REPUBLIC

Course No. 4

Title:	Introduction to Nuclear Reactor Physics
Country:	Czech Republic
Organizing institution:	CTU Prague, FNSPE
Language:	English
Venue:	FNSPE
Start date:	September 2015
End date:	May 2016
ECTS points (if applicable):	3
Course outcome:	Students are aware of nucleus structure, nature and types of nuclear reactions. They learn characteristics of diffusive media and fissile and fissionable materials. They get acquainted with stationary solution of neutron flux distribution, and reactor power
Course details:	Lectures begin with description of fundamentals of microstructure of matter up to the level of electrons, protons, and neutrons. It is followed by description of nuclear reactions with special focus on interactions of neutrons with nuclei. The fission process initiated by neutrons is described in detail as it is the source of energy release in fission nuclear reactors. Students get acquainted with conditions for fission chain reaction realization, yield of fission products, and energy release in this reaction. The lectures are concluded by introduction to diffusion theory derived based on Fick's law. It is applied to calculation of distribution of neutrons in diffusive media. The neutrons can be released by neutron sources or as a result of fission reactions.
Formal requirements to apply:	?Open for foreign students incoming to CTU Prague for study stay
Tuition fee:	?
How to apply?	?
Course website:	http://en.katedra-reaktoru.cz/?page_id=47

Available financial support possibilities: ?

Any other important details: ?

How much IVth generation reactors are discussed? Little

CZECH REPUBLIC

Course No. 5

Title:	New Nuclear Sources
Country:	Czech Republic
Organizing institution:	CTU Prague, FNSPE
Language:	English
Venue:	FNSPE
Start date:	February 2016
End date:	May 2016
ECTS points (if applicable):	3
Course outcome:	Overview of new nuclear power systems. Orientation in various new and proposed reactor types - advantages, disadvantages, current status, outlook
Course details:	Course is devoted to new nuclear power systems. Students get familiar with reactor designs for near term future as well as with designs under consideration for mid-term and long-term outlook. Course covers reactor systems of generation III+, gen. IV., accelerator driven systems, fusion systems, their concept, advantages, disadvantages, evolution, current status, outlook.
Formal requirements to apply:	Open for foreign students incoming to CTU Prague for study stay
Tuition fee:	?
How to apply?	?
Course website:	http://en.katedra-reaktoru.cz/?page_id=195
Available financial support possibilities:	?
Any other important details:	?
How much IVth generation reactors are discussed?	Gen. IV systems, along with the gen. III/III+ systems and other future nuclear systems are objective of the course.

CZECH REPUBLIC

Course No. 6

Title: Practical course on reactor physics and operation

Country: Czech Republic

Organizing institution: CTU Prague, FNSPE

Language: English

Venue: FNSPE

Start date: By agreement

End date: By agreement

ECTS points (if applicable): ?

Course outcome: Hands-on experience with experimental reactor physics techniques and research reactor operation

Course details: Course is offered to foreign universities and institutions. The course term is based on agreement. Course content could be tailored to the participants according to their need and knowledge level. Typical duration is one week. Typical experiments cover neutron detection, characteristics of delayed neutrons, reactivity measurements and control rod calibration, reactor dynamics, control and safety systems, approaching the critical state.

Formal requirements to apply: All information concerning fees and course details for the course can be obtained at reaktor@reaktorvr1.eu

Tuition fee: Yes

How to apply? Through email reaktor@reaktorvr1.eu

Course website: No

Available financial support possibilities: No

Any other important details: Intended to group of students/experts from foreign universities / institutions

How much IVth generation reactors are discussed? Little. Experimental techniques applicable to many types of reactors.