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ročník 3 [68] 2022

V tomto čísle, které vychází kompletně v angličtině se věnujeme mezinárodní spolupráci v oblasti jaderné energie. Představíme vám Alianci českých technologických dodavatelů pro energetické zdroje, seznámíte se s činností Evropského společenství pro atomovou energii, s Technologickou platformou pro udržitelnou jadernou energii a s dalšími organizacemi, které jsou našimi partnery v projektech z oblasti jaderné energie. V medailonku si připomeneme význačného československého diplomata JUDr. Pavla Winklera, který stál u zrodu IAEA. Na následujících stránkách se také dozvíte, jaký je přínos Reaktoru Julese Horowitze pro ČR, jaká energetická témata jsou připravena pro naše nadcházející předsednictví v Radě EU, nebo jaké je poslání Evropského jaderného fóra.

jaderná energie

jadrová energia

Jaderná energie
Jadrová energia

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editorial

Dear readers,

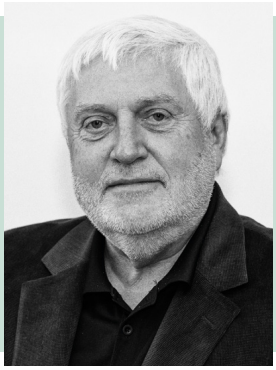
The new issue of the Jaderná energie/Jadrová energia (Nuclear Energy) magazine, which you are now holding in your hand, focuses on a very important area of nuclear energy. This area is international cooperation. At the political level, we are waiting this year for the Czech Presidency of the European Union, the ENEF meeting. In the Czech Republic, a tender was announced for the selection of a supplier for a new nuclear unit in Dukovany. The involvement in the activities of the IAEA and the NEA cannot be neglected. In the field of science and research, there is extensive cooperation between Czech research institutes and research institutes in the world and, in this way, participation in international research projects. The UJV Group and Slovakian company VUJE, universities and research institutes of large suppliers and production plants play a key role here. For all, I would like to mention, for example, the Czech Energy Alliance in the field of capital construction or activities within WANO (World Assotiation of Nuclear Operators). And so I could go on. Unfortunately, there is not enough space in the magazine to present all the activities, so many will certainly be included in the next issues.

It is important to note that cooperation with Russia plays an important role. Unfortunately, Russia's unprecedented and inexcusable attack on Ukraine has trampled on many personal friendships and long years of cooperation. I do not understand the Russian position, I do not understand it and I strongly disagree with it. The magazine joins many calls to end the barbaric invasion of Ukraine.

The magazine has found its new format in the autumn of the year 2019 and is beginning to fulfill its readership. So I thought it was time to pass on the oar to younger colleagues. In agreement with the publisher, the new chairman of the editorial board will be Daneš Burket, PhD, Director of the Research and Development Strategy section at the Research Centre Řež and President of the Czech Nuclear Society. I wish him a successful future personally, the editorial board and the magazine, and I thank all the kind readers and collaborators for their cooperation and I wish everyone involved a lot of success in their further work.

Aleš John

outgoing chairman
of the editorial board



content

CVŘ Centrum výzkumu Řež

ÚRAD JADROVÉHO DOZORU SLOVENSKEJ REPUBLIKY

Czech Power Industry Alliance

In the interest of the development and future of the Czech energy sector and industry

Josef Perlík
Czech Power Industry Alliance

Joint coordination of strategic activities in any industry, and all the more so in the turbulent energy and hydrogen technology sector, is the basis for establishing long-term strategic and stable partnerships that benefit all stakeholders. It was for this purpose that the Czech Power Industry Alliance was founded in 2015. The Alliance, which has been expanding and developing dynamically over the past two years, constitutes an umbrella organisation for Czech technology companies operating in the field of energy and hydrogen technologies.

The Czech Power Industry Alliance is a coordinator of strategic interests, strategic partnerships and cooperation of Czech technology suppliers of energy sources including nuclear energy and hydrogen technologies. Founded in 2015, it brings together 13 key companies in the energy sector with an annual turnover of CZK 15 billion (2020 figure). Members of the Alliance have experience of operating in markets in 60 countries; employing nearly 5,000 highly skilled professionals. They have made a significant contribution to building the Czech power industry and contribute to its day-to-day operations. 90% of the Czechoslovak power plant facilities were manufactured by domestic companies, which also provide maintenance and modernisation.

The Alliance members are able to participate in all phases of nuclear projects. They are able to deliver major technology parts of all key NPP components, including the nuclear island, the turbine island, auxiliary and common systems, control and electrical systems and related design

activities. They also offer fuel cycle assurance and can be involved in the decommissioning of the power plant at its final stage. Today, of course, they offer their skills and capacities mainly for the project of construction of the fifth unit at the Dukovany Nuclear Power Plant, but also for other potential new nuclear power sources not only in the Czech Republic. Their experience in demanding foreign markets has demonstrated their ability to work in international supply chains and according to demanding foreign standards.

It is therefore logical that the Alliance and its member companies have close relations with all three bidders for the construction of the new Dukovany unit. Representatives of the Alliance visited the Republic of Korea, where they held talks with representatives of KHNP, a leading actor in the construction of nuclear power plants in the world, and signed a declaration with KHNP on future cooperation in the field of nuclear energy. A number of meetings with Korean partners were also held in the Czech Republic; for example, I&C Energo signed a memorandum of cooperation with KEPCO E&C on the project of Construction of the New Nuclear Power Plant Dukovany 5.

Representatives of the Alliance, together with representatives of member companies, attended EdF's Supplier Day at the French Embassy in Prague. This followed the meeting of representatives of Czech industry and EdF in Paris. During the WNE Exhibition in Paris in December, representatives of I&C Energo, ZAT, Sigma Group and ŠKODA JS signed memoranda of future cooperation with Electricité de France.

The Alliance and its member companies have also been in long-term discussions with Westinghouse Electric Company about possible involvement in its supply chain. I&C Energo and Sigma Group signed memoranda of cooperation with the American bidder for the construction of the new nuclear power plant at the Ministry of Industry and Trade of the Czech Republic.

The Alliance plays an important role in relation to the Czech state administration authorities. Since its establishment, it has been a partner for the Ministry of Industry and Trade of the Czech Republic and the Ministry of Regional Development of the Czech Republic, and also the Ministry of Education, Youth and Sports of the Czech Republic in order to train new professionals. Naturally, it also has close ties with the State Office for Nuclear Safety, expert committees at state authorities and the Technology Agency of the Czech Republic. The Alliance cooperates with the Confederation of Industry and Transport of the Czech Republic and the Association of Building Entrepreneurs of the Czech Republic; its collaboration with the academic community and universities is also significant.

The Alliance has a long-standing and very beneficial relationship with the Ministry of Industry and Trade. It provides the Ministry with the necessary knowledge and documents and is an equal partner in the preparations for the construction of the new nuclear power plant in the Czech Republic. The Ministry has repeatedly emphasised its interest and that of the Czech Republic as a whole in maximising the share of Czech companies in this key investment (not only energy) project. The transfer of know-how from the contractor to Czech companies will also be absolutely necessary and indispensable. The prerequisite is to ensure the development prospects of Czech companies by participating in the projects of the selected contractor in third countries. The Czech share is important not only for the period of preparation and construction of the new unit; it will also bring significant savings and increased self-sufficiency throughout its operation. This will not only ensure an increase of the technological and knowledge level of the Czech economy and the development and strengthening of its industry, but it will also increase the life security and living standards of a significant group of the population. The prospect of a job in a modern and promising sector will attract young people's attention to technical fields in general.

Czech companies can participate in the construction of the new unit in virtually all its components, except for the design of the nuclear island. According to the Road Map prepared by the Alliance for the bidders for the construction of Unit 5 of the Dukovany NPP, Czech companies are able to offer 65% of the spectrum of required supplies and to provide adequate banking instruments and standard Western contractual terms and conditions for the execution of these supplies.

Obviously, Czech companies could gain a significant share in the preparation of buildings and other structures. In the field of technology supply, they are able to participate in the supply for the primary circuit including the manufacture of steam generators and volume compensators, participate in the supply of main circulating pumps and supply all pumps for the nuclear island, turbine island and auxiliary systems. They are also capable of supplying NPP auxiliary systems (BoP), radioactive waste disposal systems and nuclear fuel handling systems. Czech companies can also provide significant supplies of valves of all types. As far as the turbine island is concerned, they can offer to supply or participate in the supply of the turbine, engine room, generator, condensing system, main steam and feedwater pipelines as well as auxiliary systems. They would no doubt be able to provide a turnkey turbine island. The same applies to electrical systems such as generator switches and low- and high-voltage substations, transformers, block transformers and block reserve transformers as well as low-voltage transformers, cables, cable glands and connection systems. The know-how of Czech companies in the field of control and management systems is significant. The same goes for the area of water inlet and outlet. In terms of auxiliary systems, they can offer participation in ventilation systems, fire protection and fire warning systems and demineralisation systems, and supply cranes and lifts. They are able to provide these supplies including the related engineering, i.e., in particular, participate in the creation of the detail design, installation documentation and start-up documentation, etc.

It cannot be ignored that Czech companies can also offer and provide an additional range of activities from design through to management and control of installation activities, site infrastructure, commissioning and start-up and staff training. This presents a really broad opportunity for potential Czech participation in the construction and operation of the new Czech nuclear power source. Most of the aforesaid supplies can be provided by member companies of the Czech Power Industry Alliance. They have presented their potential to all three bidders with the support of the Alliance.

In conclusion, it should be emphasised that the Alliance's activities are not limited to the new nuclear power source in the Czech Republic and nuclear power as a field; the Alliance, in accordance with its objective, is also active in other segments and fields (petrochemicals, conventional energy, hydrogen technologies, etc.), where it tries to find the right strategic partnerships for Czech energy supply companies and the sector they represent.

Josef Perlík, MSc

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Josef Perlík has accumulated more than 21 years of experience in the power industry. He joined ŠKODA JS in 2001 and finished as General Manager and Chairman of the Board of Directors being in this position from 2016 till 2018. He participated in the most significant nuclear power projects in Central Europe in modern history and currently he was appointed Chairman of the Board of Directors of SIGMA Group and COO of Czech Power Industry Alliance.

Dr. Pavel Winkler

Czechoslovakian who was at the birth of the International Atomic Energy Agency

Fig. 1: Dr. Pavel Winkler, first Chairman of the Board (photo: IAEA)

Pavel Winkler, a prominent Czechoslovak diplomat, was born on the 13 September 1910, in Zvolen, Banská Bystrica region. He came from a clerical family, most of whom were deported during World War II and subsequently murdered by the Nazis at Auschwitz.

After studying at secondary schools in Lučenec and Rimavská Sobota, Winkler graduated from the Faculty of Law at the Comenius University in Bratislava in 1936 and for the next few years, worked in the legal profession. After the independence of Slovakia in March 1939, he joined the Communist Party, and in the same year he became a member of the Communist resistance. In 1941, he was arrested and interned in Ilava, and from 1942 to 1944, he lived illegally in Hungary. Afterwards, he actively participated in the Slovak National Uprising, the following its suppression in October 1944, he hid in the mountains.

From April 1945, Winkler worked at the repatriation department at the Ministry of Social Welfare for the Czechoslovak government in Košice. In the summer of the same year, he was recruited to the Ministry of Foreign Affairs, where he dealt with multilateral issues.

Fig. 2: The first IAEA General Conference held at the Konzerthaus in Vienna from 1 to 23 October 1957, with the participation of diplomats and scientists from 57 nations (photo: IAEA)

He was assigned to the office of the Government Delegate in Budapest in June 1946, but from the spring of 1947 he was off duty for 16 months as he was treated for severe tuberculosis in a sanatorium in Davos. In July 1948, he was appointed as the Legation Counsellor at the Embassy in Bern, and from February 1949, he held the post of Consul General in Zurich.

Less than a year later, Winkler was summoned back to Prague for consultations in connection with the Field affair, but instead was interrogated for two months at the Ministry of the Interior and placed under house arrest. In Prague, he then began working in the Contract Law (from 1957 International Law) Department of the Ministry of Foreign Affairs, to which he connected most of his subsequent career.

After the end of the Korean Peninsula War in 1953, Winkler became a member of the Neutral Nations Repatriation Commission in Panmunjom. Alongside the head of the Czechoslovak delegation, Colonel Dr. Ladislav Šimovič, and other delegates from Poland, Sweden, Switzerland, and India, he supervised the living conditions of the prisoners of war and the mutual progress of their repatriation until the end of February 1954. Pavel Winkler left an even more significant mark on international diplomacy during his subsequent engagement.

In the mid-1950s, there was a relaxation in the field of peaceful uses of nuclear energy. US President Dwight D. Eisenhower's speech to the VIII United Nations (UN) General Assembly on the 8 December 1953 entitled “Atoms for Peace” was the main impetus for the creation

Fig. 3: Senior representatives of the Neutral Nations Repatriation Commission, September 1953 (photo: Pavel Winkler)

of the International Atomic Energy Agency (IAEA). This creation, together with the proposal to assemble the first international conference on the peaceful uses of atomic energy, was embodied in a UN resolution adopted a year later.

As a producer of natural uranium and a country aiming to build nuclear power plants, Czechoslovakia was actively involved in establishing international cooperation from the very beginning. Its 17-member delegation attended the 1st International Conference on the Peaceful Uses of Atomic Energy in Geneva in August 1955, and in the following year, Czechoslovakia was invited to work on the final draft of the IAEA Statute. As a lawyer, Winkler was one of the twelve members of the working group in New York that participated in their preparation. He travelled to the subsequent negotiations regarding the final draft of the IAEA Statute in Washington as well as the International Conference on the Statute of the IAEA in New York as the head of a 6-member Czechoslovak delegation where he was given the rank of ambassador. In October 1957 in Vienna, where the first IAEA General Conference was held, Winkler became a representative of the 23-member Board of Governors and was immediately thereafter elected Chairman of the first Board of Governors.

From 1958–1964, Pavel Winkler served as head of the International Law Department to the Ministry of Foreign Affairs. Afterwards he became an advisor to Foreign Minister Václav David, and from September 1966 to October 1969, an ambassador to Switzerland. After the invasion of Czechoslovakia by Warsaw Pact troops, he was dismissed in October 1970 from state service and retired early because of his views and activities in Switzerland.

Fig. 4: Major General K. S. Thimayya with Dr. Pavel Winkler (photo: Pavel Winkler)

After the fall of communism, Winkler was listed as an 'enemy person' in the personal files of the State Security Service. He was approached by Foreign Minister and Deputy Prime Minister Jiří Dienstbier, and on the 1st of February 1990, was hired back as a consultant for the International Law Department at the Ministry of Foreign Affairs. In September of the same year, he represented the Czech and Slovak Federative Republic at the 34th conference of the International Atomic Energy Agency. In the 1990s, he also published a number of analyses concerning various issues, including the unjustified claims of German and Austrian displaced persons. He died in Prague on the 15 May in 2003 at the age of 92.

Michal Šafránek

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Presidency of the Czech Republic in the Council of the EU

in the second half of 2022

Lucie Hertlová
State Office for Nuclear Safety

The Czech republic will hold the EU council presidency in the second half of the year 2022. Peaceful development and use of atomic energy and issues related to this topic fall at the European level under the Treaty establishing the European Atomic Energy Community (Euratom) and the Working Party on Atomic Questions. The State Office for Nuclear Safety is going, as well as in in the first half of 2009, manage the meetings and agenda of this working party.

The Czech Republic will hold the EU Council presidency from July to December 2022. The **EU Council** is one of the top EU institutions. Its main tasks include negotiating and adopting EU legislation presented by the European Commission, coordinating policies of the Member States in specific areas, developing the Common Foreign and Security Policy of the European Union, concluding international agreements and adopting the EU budget. Despite encompassing **10 different configurations** by fields of EU action and subject-matter of negotiation, it must be seen as a single entity. For the Council to succeed in any configuration at the ministerial level, its agenda must be well discussed and agreed on in advance. This is the task of the Committee of the Permanent Representatives of the Governments of the EU Member States (Coreper I, Coreper II) and of more than 150 preparatory bodies of the Council, which are working parties and committees. The Presidency of the Council, except for the Foreign Affairs configuration, is held by pre-established **groups of three Member States** for a period of 18 months. The Czech Republic forms this "trio" together with France (which holds the presidency in the first half of 2022) and Sweden (which will hold the presidency in the first half of 2023) [1]. The joint programme of the trio [2], as well as the programme to be adopted by the Czech Republic for the period of its presidency of the Council of the EU, will set the direction of work of all Council configurations for CZ PRES 2022, affecting the agenda

(planned legislative tasks and decisions at operational level) of each Council configuration. The Presidency of the Council of the EU means that the representatives of the presiding country lead the meetings of all configurations and working bodies of the Council for a period of 6 months, determine their agenda and control their course. (Only some established bodies of the Council are presided by permanent chairs.)

The **General Affairs Council** (so-called GAC) is important for the State Office for Nuclear Safety (SÚJB). This includes the Working Party on Atomic Questions (hereinafter referred to also as WPAQ referred to aslo as WPAO or Working Party), which is under the responsibility of SÚJB and which will be chaired by SÚJB for CZ PRES 2022. **Coreper II** prepares the meeting of the General Affairs Council. Coreper II seeks to reach agreements and compromise solutions that can be subsequently adopted by GAC. The **Working Party on Atomic Questions** was set up to discuss issues governed by the Treaty establishing the European Atomic Energy Community (Euratom) (hereinafter referred to as the "Euratom Treaty"). Specifically, WPAQ deals mainly with legislation on protection against ionising radiation, safety of nuclear facilities, radioactive waste and spent fuel management, safeguards system, international cooperation with third countries in the peaceful utilisation of nuclear energy. Each presidency has an assistant – the **General Secretariat of the Council (GSC)**. Its staff assists Chairs of the Council of all configurations and at all levels (from ministerial to working) in organising and coordinating the work of the EU Council. GSC also assists the presidency in negotiations with other EU bodies, provides logistical support and is responsible for the practical organisation of meetings (reservation of meeting rooms, creation, distribution and translation of background materials for negotiations, etc.). An important component of GSC is the **Legal Service**. In negotiations of the Council bodies, it ensures that the acts of the Council are formally and legally correct. A representative of GSC is present at every meeting of the Council and, with his/her knowledge of the procedures and past events, is an almost indispensable person for the Chairperson.

The Czech Republic **held the presidency of the Council of the EU** in the past, in the first half of 2009. SÚJB then, as now, chaired WPAQ and succeeded in reaching an agreement on the text of the Nuclear Safety Directive [3], which was firstly discussed under the presidency of France in 2008. This was the second proposal of the European Commission, as the first proposal for a directive of 2003 [4] had not been supported by the Member States in the Council.

The **programme of WPAQ** is defined with regard to the programme of the trio and the programme of the current presiding country of the Council of the EU. Its form is largely influenced by the actions of previous presidencies, legislative and non-legislative activities of the European Commission, events in the EU, in the world and in international fora. The specific agenda for each meeting is defined by the Chairperson of the Working Party in cooperation with the General Secretariat of the Council. The outlook of the presidency – priorities, activities, significant events and expected events – is usually presented by the Chairperson of the Working Party at the first meeting of the Working Party under his/her leadership. The European Commission also adheres to this practice and regularly follows the presidency by presenting its plans and priorities. At WPAQ, the Commission most often includes representatives of the Directorate-General for Energy (DG ENER), namely the Directorate for Nuclear Energy, Safety and ITER (ENER.D). The **legislation discussed at WPAQ** (presented by the Commission on the basis of Articles 31 and 32 of the Euratom Treaty, Article 203 of the Euratom Treaty) has a specific adoption scheme compared to other EU legislation. The **European Parliament**, which is for the EU legislative acts adopted under the ordinary legislative procedure as important as the Council, only has an advisory role. Its opinion is by no means binding and need not be considered. The text of this legislation is therefore not negotiated in trialogues between the Commission, the Council and the European Parliament, but it is only adopted by the EU Council.

For illustration, examples can be given of the most interesting topics that appeared at WPAQ from the last CZ PRES in 2009 up to the present. The presidency of Sweden in 2009 discussed two conclusions of the Council – the ENSREG report and security of supplies of medical radioisotopes. The **presidency of Spain** included in the agenda a study commissioned by the European Commission on nuclear liability legislation in the EU Member States. The study analysed whether it is possible to present a proposal for uniform legislation under the provisions of the Euratom Treaty and outlined potential political solutions to differing legislation in the EU. The EC dealt intensively with this issue until 2013, but then it was refrained from the initiative without a specific outcome. A communication on the utilisation of ionising radiation in medicine and the security of supplies of radioisotopes for nuclear medicine was presented in the second half of 2010 (**presidency of Belgium**), and the presidency of Belgium adopted the Council conclusions on this topic. It also began the discussion on the proposal for a Council Directive on the safe management of spent fuel and radioactive waste (the Directive was adopted under the presidency of Poland in the second half of 2011). The **presidency of Hungary in 2011** was marked by the accident at the Fukushima I nuclear power plant in Japan. Extraordinary meetings of the European High Level Group on Nuclear Safety and Waste Management (ENSREG) and WPAQ took place before the meeting of the European Council on 24 and 25 March, which decided to perform stress tests of nuclear power plants in the EU. In the second half of 2011, two important legislative proposals were presented to the Council, i.e., a proposal for a Council Directive laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption and a proposal for a Directive laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation. Member States discussed both proposals in the following two years. A proposal for a Council Regulation establishing a Community system for registration of carriers of radioactive materials was presented at the last WPAQ in 2011. The regulation was the subject of many discussions at WPAQ in the following years, but it did not receive the support of the Czech Republic and some other Member States and its adoption was blocked in the Council. The **presidency of Denmark** in 2012 opened discussions on the proposal for a Council Regulation establishing an Instrument for Nuclear Safety Cooperation. The presidency of Lithuania (2nd half of 2013) opened discussions on a proposal to revise the Nuclear Safety Directive. The presidency of Greece (1st half of 2014) opened discussions on a draft regulation laying down the maximum permitted levels of radioactive contamination of food and feed following a nuclear accident (discussions finished under the presidency of Italy in 2014). The main topic of WPAQ in the first half of 2015 (under the **presidency of Latvia**) was the preparation of the mandate of the Council for a diplomatic conference to consider and adopt amendments to the Convention on Nuclear Safety and the updating of Guidelines on cooperation in the framework of international conventions to which the European Atomic Energy Community (Euratom) and its Member States are parties. The presidency of Luxembourg prepared the Council conclusions on two topics – justification of medical imaging involving exposure to ionising radiation, and off-site nuclear emergency preparedness and response. The Netherlands, which held the presidency of the EU Council in the first half of 2016, focused the discussion on issues relating to the need to secure the supply of medical radioisotopes. The European Commission has presented a Nuclear Illustrative Programme prepared on the basis of Article 40 of the Euratom Treaty. Under the presidency of Slovakia, the Council agreed on conclusions for the special report of the European Court of Auditors "EU nuclear decommissioning assistance programmes in Lithuania, Bulgaria and Slovakia: some progress made since 2011, but critical challenges ahead." Slovakia expected the EC to present a revision of the Regulation under Article 41 of the Euratom Treaty (Investment projects Notifications – Council Regulation (Euratom) 2587/1999, Commission Regulation (Euratom) No 1209/2000), but the Commission did not adopt this initiative (and it has not been adopted it to this day). Slovakia, in agreement with the **Maltese party**, took over the presidency of WPAQ in the first half of 2017. In the second half of 2018, under the **presidency of Austria**, WPAQ addressed

three legislative proposals – a proposal for a Council Regulation establishing the nuclear decommissioning assistance programme of the Ignalina nuclear power plant in Lithuania (the Ignalina Programme) and repealing Council Regulation (EU) No 1369/2013, a proposal for a Council Regulation establishing a dedicated financial programme for the decommissioning of nuclear facilities and the management of radioactive waste and repealing Council Regulation (Euratom) No 1368/2013, and a proposal for a Council Regulation establishing a European Instrument for International Nuclear Safety Cooperation Complementing the Neighbourhood, Development and International Cooperation Instrument – Global Europe on the basis of the Treaty establishing the European Atomic Energy Community (however, they were not adopted until the presidency of Germany in 2020; progress had to be made in negotiating the multiannual financial framework). The **presidency of Romania** (1st half of 2019) proposed, with the support of the EC, the adoption of Council conclusions enhancing safety of nuclear facilities and materials through a better physical protection. However, this proposal did not receive the support of the Member States (the area of physical protection is considered by the Euratom Member States to be their exclusive competence) and had to be abandoned after several rounds of persuasion. However, the presidency of Romania succeeded in negotiating Council conclusions on a less sensitive issue – on non-power nuclear and radiological technologies and applications. Under the **presidency of Slovenia**, a Euratom mandate was agreed to modernise the Energy Charter Treaty. In the nuclear field, the **presidency of France** is rather active in the area of nuclear research (under the Joint Working Party on Research/Atomic Questions). Education and training in non-energy areas of nuclear research should be the subject of conclusions of the Council.

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[1] The order in which the Member States hold the presidency of the Council from 1 July 2017 to 31 December 2030, as well as the division of this order into groups of three Member States, are set out in COUNCIL DECISION (EU) 2016/1316 of 26 July 2016 amending Decision 2009/908/EU, laying down measures for the implementation of the European Council Decision on the exercise of the Presidency of the Council, and on the chairmanship of preparatory bodies of the Council
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She graduated from the Faculty of Law of Palacký University in Olomouc. She has been working on the European agenda since graduating from university, and she was posted to the Permanent Representation of the Czech Republic in Brussels between 2010–2014. Since April 2014, she has been working at the Legal Department of SÚJB. For CZ PRES 2022, she should be the Chairperson of the Working Party on Atomic Questions.

Topic for the presidency of the Czech Republic: low-carbon electricity, heat and hydrogen - the possibilities of nuclear energy

Jan Prášil
Ministry of Industry and Trade of the Czech Republic

As jointly declared in the EU Presidency Trio Programme, France, the Czech Republic and Sweden want to strive for fulfilment of the European Climate Law and European Atomic Energy Community objectives. The row of three Presidencies of nuclear States is unique and so far the main issue in nuclear energy was the proposal of the Taxonomy complementary delegated act during the French Presidency. The Czech Presidency will build on the activities of France, focus on heat and hydrogen production from nuclear and co-organize the European Nuclear Energy Forum and SET Plan Conference in Prague.

Electricity, heat and hydrogen from nuclear energy are green in the EU – this is one of the important messages of the taxonomy of sustainable finance, which identifies the production of electricity, heat and hydrogen from nuclear power plants as a sustainable activity for investor orientation. The Czech presidency of the Council of the European Union will address these topics at a number of events, including the conference before the informal Energy Council in Prague.

During their presidencies, France, the Czech Republic and Sweden want to meet the objectives of the European Climate Law and the objectives of the European Atomic Energy Community, as jointly declared in the programme of the presidency trio. They want to make progress on transparent and inclusive alliances, strategic value chains and, where necessary, overcome market failures on Important Projects of Common European Interest (IPCEI). The presidency of these three nuclear countries in a row is unique, and the issue of nuclear energy has already resonated loudly during the presidency of France, when the Member States commented on a draft supplementary delegated act, which includes activities in the field of nuclear energy and natural gas into the taxonomy under specified conditions. The Czech Republic will have the opportunity to set the agenda by focusing its presidency events. The aim will be to support the development of nuclear energy as well as the entire nuclear industry including subcontracting chains.

On 11 October 2022, a conference will be held at the Ministry of Industry and Trade on the future of district heating, production of low-carbon hydrogen and the role of nuclear energy in the transformation to a system that will guarantee climate neutrality and secure electricity and heat supply for households and industry. Supporting the development of nuclear energy and renewable resources with an emphasis on energy security, self-sufficiency, climate objectives and affordable energy supplies is one of the government's top priorities. The conference fits within the context of the task of the Government Programme Statement to reinforce research and development and international cooperation in nuclear energy and to prepare a concept for the use of small modular reactors in the Czech Republic. The use of heat from the Temelín nuclear power plant, experience in the production of pink hydrogen in Sweden, the vision of heating using small modular reactors in Finland, the perspective of the OECD Nuclear Energy Agency, the European Commission and SÚJB will be presented.

In November 2022, the Ministry of Industry and Trade will hold two conferences in Prague together with the European Commission. The European Nuclear Energy Forum will open the question of system costs of the European carbon-free energy system, involving representatives of transmission system operators, OECD economists and non-profit organisations, to present their views on the wider consequences of energy system transformation and production adequacy as a whole. When considering the future energy mix, it is desirable to reflect the costs of stability and security of energy supply, inter alia, in the policies of individual Member States in order to make optimal use of national and European resources. The second part of the forum will open the question of trends in nuclear energy, radioisotopes in medical diagnosis and treatment, Generation IV, research and new challenges. The panel should address the need to maintain the operation of nuclear reactors due to the transfer of knowledge and experience in the academic sphere and industry. It will also investigate whether nuclear reactors will be replaced by cyclotrons or whether mutual complementarity takes place, thus requiring new reactors such as Pallas. As part of the European Strategic Energy Technology Plan (SET Plan) conference, the European Commission will present an update of this strategy paper and the Ministry of Industry and Trade will host a panel on nuclear technologies for a reliable and resilient energy system – sustainable fission and fusion, raising taxonomy-related issues such as the use of low-carbon heat, accident-resistant fuel and sustainable long-term operation. It will also build on the work of the renewed Working Party IWG 10, which is attended by representatives of the Ministry of Industry and Trade and ÚJV Řež.

Within the Working Party on Atomic Questions, the Czech Republic will follow up on the activities of France, continuing the necessary preparations of Euratom positions for the purposes of international negotiations, specifically for the purposes of the Joint 8th and 9th Review Meeting of the Contracting Parties to the Convention on Nuclear Safety (March 2023).

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Euratom programme complementing the Horizon 2020 programme. Country participation analysis in the calls of work programmes of Euratom Fission 2014 to 2020. Survey of the involvement of subjects from the Czech Republic in topics under call 2019-2020.

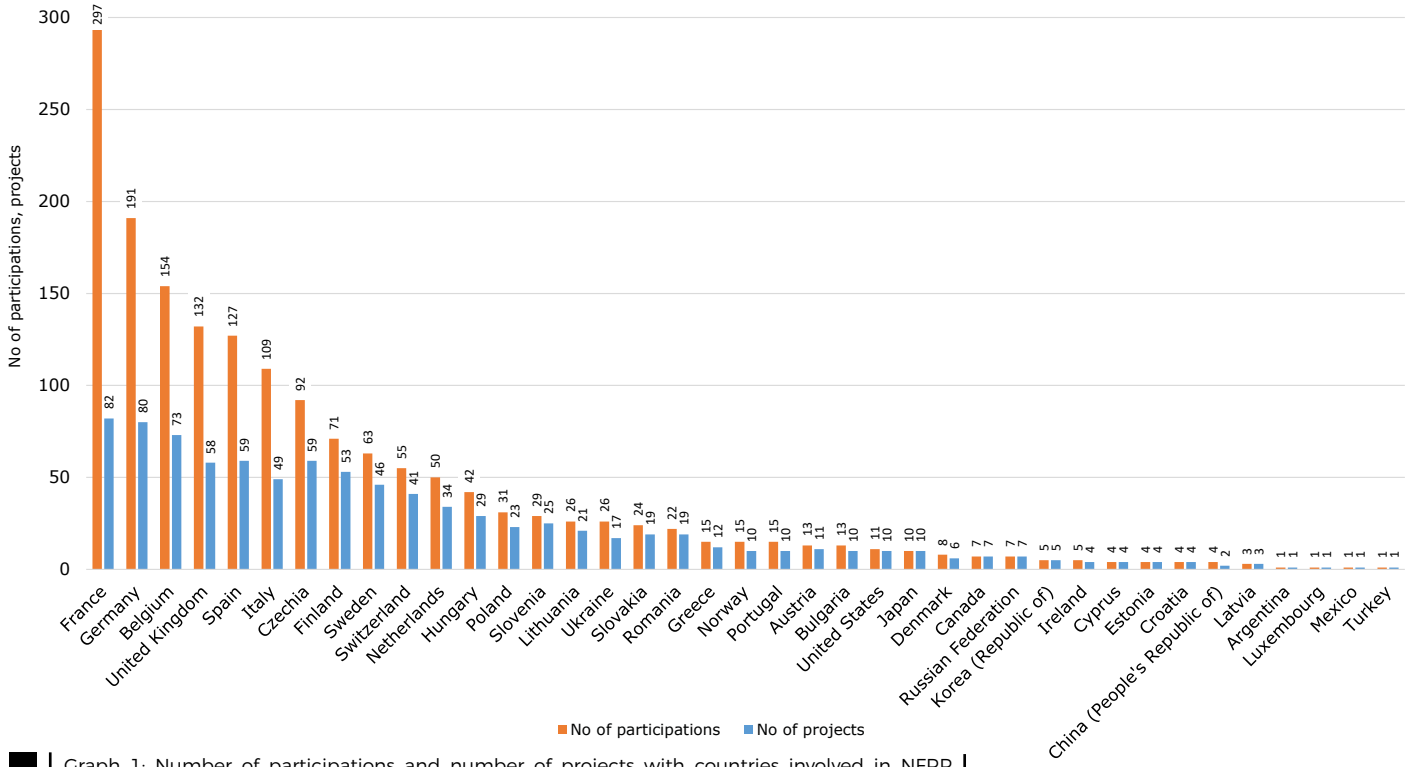
Veronika Korittová, Daniel Frank
The Technology Centre of the Czech Academy of Sciences

The article analyses in brief the participation of countries and institutions in the EURATOM programme in the field of nuclear fission and radiation protection in the years 2014–2018 and 2019–2020. The second part of the article is devoted to the six sections of the Euratom work programme for the period 2019–2020 [1] and to a description of the projects implemented in the 17 topics that these sections contain, with an emphasis on the participation of the subjects from the Czech Republic in these projects.

BRIEF ANALYSIS OF COUNTRY AND INSTITUTION PARTICIPATION IN EURATOM PROGRAMME ON FISSION AND RADIATION PROTECTION IN THE YEARS 2014–2018 AND 2019–2020

1,688 research teams from 39 countries and 531 institutions participated as beneficiaries in EURATOM programme, focusing on Nuclear Fission and Radiation Protection – NFRP. They are involved in the consortia of 95 projects realised. Total financial support of € 411.1 M was asked for, from which more than 85% went to EU-15 countries. Number of countries with projects and participations is shown in Graph 1.

EU-15 countries were considerably active also in project coordination. From 95 projects being realised in total, 84 are coordinated by universities, research, private and public institutions from EU-15 countries, with 30 of them being located in France. The rest, 10 projects, are led

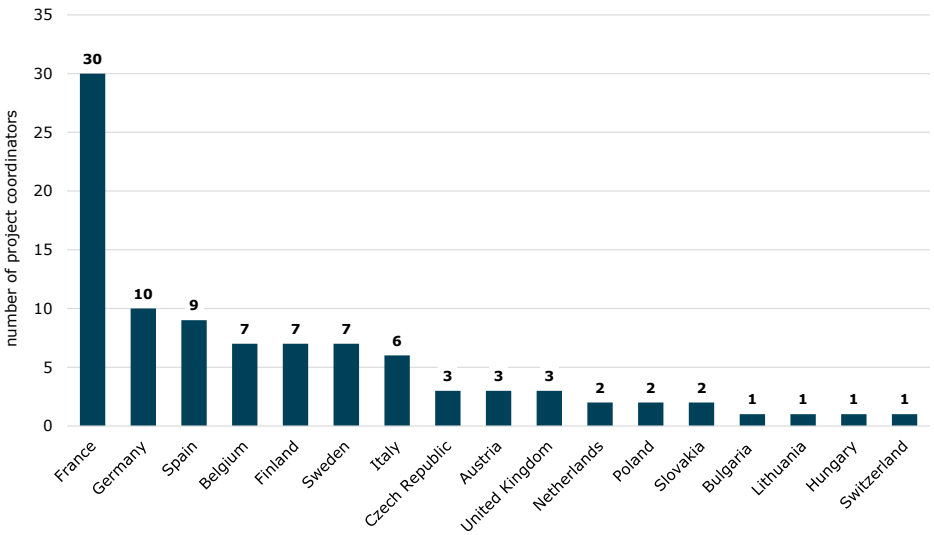


Graph 1: Number of participations and number of projects with countries involved in NFRP calls of EURATOM programme 2014–2018 and 2019–2020. *JRC and other European institutions participations focusing on support and research in nuclear field is presented under Belgium. [2]

by institutions from EU-13 countries (Czechia, Hungary, Poland, Latvia, Slovakia and Bulgaria), one project has Swiss coordination. Number of project coordinators per country is shown in graph 2. The Czech Republic occupies the first place as regards the number of coordinators from EU-13 countries.

Table 1 summarises Czech participation in NFRP calls. Between 2014–2020 there were 92 research teams from 15 institutions as beneficiaries involved in 59 projects from the total of 95. Czechia cooperates with researchers from 36 countries and receives up to € 18 M, twice as much as the sum received by Czech subjects in previous, 7th, framework programme.

Graph 2: Number of coordinators of projects resulting from calls of NFRP programme EURATOM 2014–2018 and 2019–2020. [2]



Institution	Number of participations as beneficiaries	Number of coordinated projects	Eligible costs spent by partner beneficiary institutions on project solving (€)	Eligible costs spent by coordinators on project solving (€)	Contribution from Euratom programme claimed for partners – beneficiaries in projects (€)	Contribution from Euratom programme claimed for project coordinators (€)	Total number of participations	Czechia – project eligible costs (€)	Czechia – total claimed support from Euratom budget (€)
Centrum výzkumu Řež	28	1	5,447,052.48	1,151,258.75	4,452,294.54	1,138,508.75	29	6,598,311.23	5,590,803.29
ÚJV Řež	26	1	6,373,000.50	466,751.25	4,664,898.82	466,751.25	27	6,839,751.75	5,131,650.07
České vysoké učení technické v Praze	12	1	2,403,417.50	198,625.00	2,326,979.50	198,625.00	13	2,602,042.50	2,525,604.50
Správa úložišť radioaktivních odpadů	4		3,146,985.63		1,756,854.60		4	3,146,985.63	1,756,854.60
Státní ústav radiační ochrany	4		1,294,785.75		1,144,475.20		4	1,294,785.75	1,144,475.20
Evalion	4		624,437.50		591,812.50		4	624,437.50	591,812.50
Technická univerzita v Liberci	2		355,125.00		355,125.00		2	355,125.00	355,125.00
Ústav jaderné fyziky AV ČR	2		51,667.50		45,001.00		2	51,667.50	45,001.00
Státní ústav jaderné, chemické a biologické ochrany	1		219,600.00		219,600.00		1	219,600.00	219,600.00
Univerzita Karlova v Praze	1		137,750.00		137,750.00		1	137,750.00	137,750.00
Český metrologický institut	1		118,375.00		118,375.00		1	118,375.00	118,375.00
Vysoká škola chemicko-technologická v Praze	1		111,875.00		111,875.00		1	111,875.00	111,875.00
Ústav anorganické chemie AV ČR	1		88,687.50		88,687.50		1	88,687.50	88,687.50
Technologické centrum AV ČR	1		46,250.00		46,250.00		1	46,250.00	46,250.00
ČEZ	1		38,125.00		36,218.75		1	38,125.00	36,218.75
Total	**89**	**3**	**20,457,134.36**	**1,816,635.00**	**16,096,197.41**	**1,803,885.00**	**92**	**22,273,769.36**	**17,900,082.41**

Tab. 1: Beneficiaries from the Czech Republic in EURATOM programme in the years 2014–2018 a 2019–2020. Only those receiving direct support from the EURATOM programme are listed. [2]

WORK PROGRAMME 2019–2020 OF EURATOM PROGRAMME

Last work programme for 2019–2020 of Euratom programme consisted of one call with 17 topics, divided into 6 sections [1]. We focus on subjects from the Czech Republic, through several tables corresponding to sections. In total, there were 62 proposals presented to this call from which 33 proposals were chosen for financing. Subjects from the Czech Republic were involved in 18 of them.

Nuclear safety section consists of eight topics representing almost half of the topics of the work programme. This section was the greatest success for Czech participants, they are involved in each of the eight topics, as shown in the table 2.

What is more, two projects from this section are coordinated from the Czech Republic. One of these is within the topic on safety assessment for long term operation (LTO) upgrades of generation II a III reactors – APAL project is coordinated by ÚJV Řež. The other deals with support for safety research of small modular reactors. ECC-Smart project is coordinated by Centrum výzkumu Řež (CVŘ), with VŠCHT Praha (University of Chemistry and Technology Prague) as beneficiary.

Tab. 2: Survey of financed projects and their coordinators in the topics of the section Nuclear Safety of the EURATOM work programme 2019–2020

Project acronym	Project name	Project type	Coordinator		Participant from the Czech Republic	No of parti-cip.	Total cost thous. €	EU con-tr_total thous. €	EU con-tributi-on CZ subjects thous. €	Project duration
NFRP-01-2019 Ageing Phenomena of Components and Structures and Operational Issues										
ACES	Towards improved assessment of safety performance for long-term operation of nuclear civil engineering structures	RIA	Finland	Teknologian tutkimuskeskus VTT Oy	CENTRUM VÝZKUMU ŘEŽ	11	5,452	4,000	390	2020-09-01 to 2024-08-31
					ČVUT v Praze				291	
ENTENTE	European Database for Multiscale Modelling of Radiation Damage	RIA	Spain	CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBINTALES Y TECNOLOGICAS-CIEMAT	ÚJV Řež	27	4,938	4,000	65	2020-09-01 to 2024-08-31
INCEFA-SCALE	INcreasing safety in NPPs by Covering gaps in Environmental Fatigue Assessment - focusing on gaps between laboratory data and component SCALE	RIA	United Kingdom	Jacobs Clean Energy Limited	ÚJV Řež	17	6,807	4,000	113	2020-10-01 to 2025-09-30
STRUMAT-LTO	STRUctural MATerials research for safe Long Term Operation of LWR NPPs	RIA	Hungary	ENERGIATUDOMANYI KUTATOKOZPONT	ÚJV Řež	19	4,827	3,965	312	2020-09-01 to 2024-08-31
NFRP-02-2019 Safety Assessment for Long Term Operation (LTO) Upgrades of Generation II and III Reactors										
AMHYCO	TOWARDS AN ENHANCED ACCIDENT MANAGEMENT OF THE HYDROGEN/CO COMBUSTION RISK	RIA	Spain	UNIVERSIDAD POLITECNICA DE MADRID	xx	12	4,071	3,974	xx	2020-10-01 to 2024-09-30
APAL	Advanced PTS Analysis for LTO	RIA	Czech Republic	ÚJV Řež	xx	14	4,567	3,999	467	2020-10-01 to 2024-09-30
CAMIVVER	Codes And Methods Improvements for VVER comprehensive safety assessment	RIA	France	FRAMATOME	xx	7	3,989	3,989	xx	2020-09-01 to 2023-08-31
NFRP-03-2019 Safety Margins Determination for Design Basis-exceeding External Hazards										
BESEP	Benchmark Exercise on Safety Engineering Practices	RIA	Finland	Teknologian tutkimus-keskus VTT Oy	ÚJV Řež	7	2,760	2,760	291	2020-09-01 to 2024-02-29
METIS	METHODS AND TOOLS INNOVATIONS FOR SEISMIC RISK ASSESSMENT	RIA	France	ELECTRICITE DE FRANCE	xx	16	6,045	3,965	xx	2020-09-01 to 2024-02-29
NFRP-04-2019 Innovation for Generation II and III Reactors										
El-Peacetolero	Embedded Electronic solutions for Polymer Innovative Scanning Tools using Light Emitting devices for diagnostic Routines	IA	France	SORBONNE UNIVERSITE	xx	9	3,652	2,999	xx	2020-09-01 to 2024-08-31
FRACTESUS	Fracture mechanics testing of irradiated RPV steels by means of sub-sized specimens	IA	Belgium	STUDIECENTRUM VOOR KERNENERGIE	ÚJV Řež	22	4,982	2,987	127	2020-10-01 to 2024-09-30
NUCOBAM	NUclear COmponents Based on Additive Manu-facturing	IA	France	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	xx	13	4,068	2,999	xx	2020-10-01 to 2024-09-30
PASTELS	PAssive Systems: Simulating the Thermal-hydraulics with ExperimentaL Studies	IA	France	ELECTRICITE DE FRANCE	ÚJV Řež	11	3,801	2,993	186	2020-09-01 to 2024-02-29
NFRP-05-2019 Support for Safety Research of Small Modular Reactors										
ECC-Smart	Joint European Canadian Chinese development of Small Modular Reactor Technology	RIA	Czech Republic	CENTRUM VÝZKUMU ŘEŽ	VŠCHT v Praze	19	8,912	3,997	112	2020-09-01 to 2024-08-31
									1 139	

McSAFER	High-Performance Advanced Methods and Experimental Investigations for the Safety Evaluation of Generic Small Modular Reactors	RIA	Germany	KARLSRUHER INSTITUT FÜR TECHNOLOGIE	ÚJV Řež	13	4,045	3,996	147	2020-09-01 to 2023-08-31
NFRP-06-2019 Safety Research and Innovation for Advanced Nuclear Systems										
PASCAL	PROOF OF AUGMENTED SAFETY CONDITIONS IN ADVANCED LIQUID-METAL-COOLED SYSTEMS	RIA	Italy	AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE	xx	16	4,610	3,799	xx	2020-11-01 to 2024-10-31
PUMMA	Plutonium Management for More Agility	RIA	France	COMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ÚJV Řež	20	6,750	3,796	21	2020-10-01 to 2024-09-30
SafeG	Safety of GFR through innovative materials, technologies and processes	RIA	Slovakia	VUJE	ÚJV Řež	15	4,495	3,800	450	2020-10-01 to 2024-09-30
					CENTRUM VÝZKUMU ŘEŽ				452	
					ČVUT v Praze				181	
					EVALION				209	
NFRP-07-2019 Safety Research and Innovation for Partitioning and/or Transmutation										
PATRICIA	Partitioning And Transmuter Research Initiative in a Collaborative Innovation Action	RIA	Belgium	STUDIECENTRUM VOOR KERNENERGIE	CENTRUM VÝZKUMU ŘEŽ	27	8,925	6,500	50	2020-09-01 to 2024-08-31
NFRP-08-2019 Towards Joint European Effort in Area of Nuclear Materials										
ORIENT-NM	Organisation of the European Research Community on Nuclear Materials	CSA	Spain	CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBINTALES Y TECNOLOGICAS-CIEMAT	CENTRUM VÝZKUMU ŘEŽ	15	1,756	1,099	28	2020-10-01 to 2023-03-31

There is only one topic in the section Decommissioning and Environmental Remediation. None of the four projects financed involves participant from Czechia. All of the financed projects have French coordinators, as presented in table 3.

Project acronym	Project name	Project type	Coordinator		Participant from the Czech Republic	No of particip.	Total cost thous. €	EU contr_total thous. €	EU contribution CZ subjects thous. €	Project duration
NFRP-09-2019 Fostering Innovation in Decommissioning of Nuclear Facilities										
CLEANDEM	Cyber physicaL Equipment for unmAnned Nuclear DEcommissioning Measurements	IA	France	COMMISSARIAT A L´ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	xx	11	3 415	2 796	xx	2021-03-01 to 2024-02-29
INNO4GRAPH	INNOvative tools FOR dismantling of GRAPHite moderated nuclear reactors	IA	France	ELECTRICITE DE FRANCE	xx	13	3 814	3 011	xx	2020-09-01 to 2023-08-31
LD-SAFE	Laser Dismantling Environmental and Safety Assessment	IA	France	ONET TECHNOLOGIES CN	xx	6	4 045	2 799	xx	2020-07-01 to 2024-06-30
PLEIADES	PLatform based on Emerging and Interoperable Applications for enhanced Decommissioning processES	IA	France	COMMISSARIAT A L´ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	xx	15	4 346	2 800	xx	2020-10-01 to 2023-09-30

Tab. 3: Survey of financed projects and their coordinators in the topics of the section Decommissioning and Environmental Remediation

Radioactive Waste Management section consists of one topic only, with one project financed, having four participants from the Czech Republic (table 4).

Project acronym	Project name	Project type	Coordinator		Participant from the Czech Republic	No of particip.	Total cost thous. €	EU con-tr_total thous. €	EU contri-bution CZ subjects thous. €	Project duration
NFRP-10-2019 Developing Pre-Disposal Activities Identified in the Scope of the European Joint Programme in Radioactive Waste Management										
PREDIS	PRE-DISposal management of radioactive waste	RIA	Finland	Teknologian tutkimuskeskus VTT Oy	ČVUT v Praze	47	23,774	14,000	71	2020-09-01 to 2024-08-31
					CENTRUM VÝZKUMU ŘEŽ				314	
					Státní ústav radiační ochrany				73	
					ÚJV Řež				426	

Tab. 4: Survey of financed projects and their coordinators under section Radioactive Waste Management

Education and Training section is once again composed of only one topic. Two projects were selected for financing. One of these is coordinated from the Czech Republic, being one of the three projects with Czech coordinator in Euratom within the period 2014–2020. A-CINCH project is coordinated by the Czech Technical University in Prague. And there is also a Czech beneficiary, EVALION, as stated in table 5.

Project acronym	Project name	Project type	Coordinator		Participant from the Czech Republic	No of particip.	Total cost thous. €	EU con-tr_total thous. €	EU contri-bution CZ subjects thous. €	Project duration
NFRP-10-2019 Developing Pre-Disposal Activities Identified in the Scope of the European Joint Programme in Radioactive Waste Management										
A-CINCH	Augmented cooperation in education and training in nuclear and radiochemistry	CSA	Czech Republic	ČVUT v Praze	EVALION	17	3,221	2,490	142	2020-10-01 to 2023-09-30
									199	
GREaT-PIO-NEeR	GRADUATE EDUCATION ALLIANCE FOR TEACHING THE PHYSICS AND SAFETY OF NUCLEAR REACTORS	CSA	Sweden	CHALMERS TEKNISKA HOGSKOLA AB	xx	10	2,633	2,319	xx	2020-11-01 to 2023-10-31

Tab. 5: Survey of financed projects and their coordinators under section Education and Training

Radiation protection and medical application section is represented by three topics, with one financed project per each topic. Three subjects from Czechia participate in the RADONORM project. The information are summarised in table 6.

Project acronym	Project name	Project type	Coordinator		Participant from the Czech Republic	No of particip.	Total cost thous. €	EU con-tr_total thous. €	EU con-tribu-tion CZ subjects thous. €	Project duration
NFRP-12-2019 Further Integrating Radiation Protection Research in the EU										
RADONORM	Towards effective radiation protection based on improved scientific evidence and social considerations - focus on radon and NORM	RIA	Germany	BUNDESAMT FÜR STRAHLENSCHUTZ	Státní ústav radiační ochrany	56	22,035	18,000	869	2020-09-01 to 2025-08-31
					ČVUT v Praze				213	
					Státní ústav jaderné, chemické a biologic-ké ochrany VVI				220	
NFRP-13-2019 Research Roadmap for Medical Applications of Ionising Radiation										
EURAMED rocc-n-roll	EURopeAn MEDical application and Radiation prOteCtion Concept: strategic research agenda aNd ROadmap interLinking to heaLth and digitisation aspects	CSA	Austria	EIBIR GEMEINNUTZIGE GMBH ZUR FORDERUNG DER ERFORSCHUNG DER BIOMEDIZINISCHEN BILDGEBUNG	xx	29	1,959	1,959	xx	2020-09-01 to 2023-08-31
NFRP-14-2019 Improving Low-Dose Radiation Risk Appraisal in Medicine										
SINFONIA	Radiation risk appraisal for detrimental effects from medical exposure during management of patients with lymphoma or brain tumour	RIA	Austria	EIBIR GEMEINNUTZIGE GMBH ZUR FORDERUNG DER ERFORSCHUNG DER BIOMEDIZINISCHEN BILDGEBUNG	xx	14	6,000	6,000	xx	2020-09-01 to 2024-08-31

Tab. 6: Survey of financed projects and their coordinators under section Radiation Protection and Medical Application

Research Infrastructures section consists of three topics as well. In each of them one project is financed. There are two subjects from Czechia per in two topics of three, see table 7.

Project acronym	Project name	Project type	Coordinator		Participant from the Czech Republic	No of particip.	Total cost thous. €	EU con-tr_total thous. €	EU con-tribu-tion CZ subjects thous. €	Project duration
NFRP-15-2019 Optimised Fuels for Production of Medical Radioisotopes										
EU-QUALIFY	EUropean QUalification Approach for Low EnrIched Fuel sYstems for secure production supply of medical isotopes	RIA	Belgium	STUDIECENTRUM VOOR KERNENERGIE	xx	6	9 044	7 799	xx	2020-10-01 to 2024-09-30
NFRP-16-2019 Roadmap for Use of Euratom Access Rights to Jules Horowitz experimental Capacity										
JHOP2040	JULES HOROWITZ OPERATION PLAN 2040	CSA	Finland	Teknologian tutkimuskeskus VTT Oy	CENTRUM VÝZKUMU ŘEŽ	10	1 572	1 101	56	2020-09-01 to 2023-02-28
					ÚJV Řež				44	
NFRP-17-2019 Optimised Use of European Research Reactors										
TOURR	Towards Optimised use of Research Reactors in Europe	CSA	Belgium	European Nuclear Education Network	CENTRUM VÝZKUMU ŘEŽ	9	1 096	1 096	57	2020-10-01 to 2023-09-30
					EVALION				120	

Tab. 7: Survey of financed projects and their coordinators under Research Infrastructures section

CONCLUSION:

Countries with a large number of nuclear reactors tend to be at the top of the statistics for the NFRP calls of Euratom (France, United Kingdom), big European countries (Germany, Spain, Italy), Belgium, seating one part of the Joint Research Centre, JRC, and small and medium size countries as Czechia, Finland, Hungary, Poland, Slovenia, Slovakia and Romania. Nuclear energy is seen as basic and reliable source of energy for low carbon future. Strong position is also that of the two countries associated to Euratom programme in Horizon 2020 – Switzerland and Ukraine. Euratom Programme helps with high specialisation and international cooperation in nuclear field in Europe. Subjects from Czechia are successful in this.

New Euratom programme for 2021–2025 and 2026–2027 periods bring new work programmes with new calls and new challenges. We wish our researchers to go on their successful way.

Sources:

[1] European Commission | [online]. Copyright © [cit. 24. 02. 2022]. Accessible form: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/euratom/h2020-wp1920-euratom_en.pdf

[2] European Commission database: H2020 eCORDA grants, data as of: 25 January 2022

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SNETP and the involvement of Czech members

Jiří Duspiva
ÚJV Řež

SNETP is a non-profit platform, which associates industrial, research and academical entities with the aim to support and promote safe, reliable and efficient civil nuclear application via. its three pillar – NUGENIA for Gen II and III reactors, ESNII for Gen IV reactors, and NC2I for non-electric energy needs (industry, transport, district heating). Representatives of Czech member organizations play important role in all levels of the organization and contribute to its achievements.

The Sustainable Nuclear Energy Technology Platform (SNETP) [1] was established in September 2007 as a R&D&I platform to support and promote safe, reliable and efficient operation of Generation II, III and IV of civil nuclear systems. Since May 2019, SNETP has been operating as an international non-profit association (INPA) under the Belgian law pursuing a networking and scientific goals.

It is recognised as a European Technology and Innovation Platform (ETIP) by the European Commission. The international membership base of the platform includes industrial actors, research and development organisations, academia, technical and safety organisations, SMEs as well as non-governmental bodies.

SNETP is composed of a General Assembly, a Presidency, a Governing Board, three pillars, a Scientific Committee and a Support Office. The **General Assembly** gathers all members and votes on key decisions. Every year, a meeting of the General Assembly is convened as a means to facilitate the widest involvement of SNETP members. The **Presidency** is responsible for the high-level representation of the association and channels the positions of the General Assembly to external stakeholders. The Presidency is composed of a President and a Vice-President. SNETP is steered and monitored by a **Governing Board** which is in charge of executing the decisions taken by the General Assembly.

The three pillars (NUGENIA, ESNII & NC2I) and the **Scientific Committee** carry out technical work of the association. The Scientific Committee is composed of at least one representative of each pillar and experts representing different technical domains.

The **Support Office** is composed of the General Secretariat, an Administrative Secretariat and a Treasurer. The General and Administrative Secretariats are jointly responsible for supporting day to day management of the association. The General Secretariat ensures that the association's activities are consistent with long-term strategy defined by the General Assembly, whereas the Administrative Secretariat focuses on administrative management of the association.

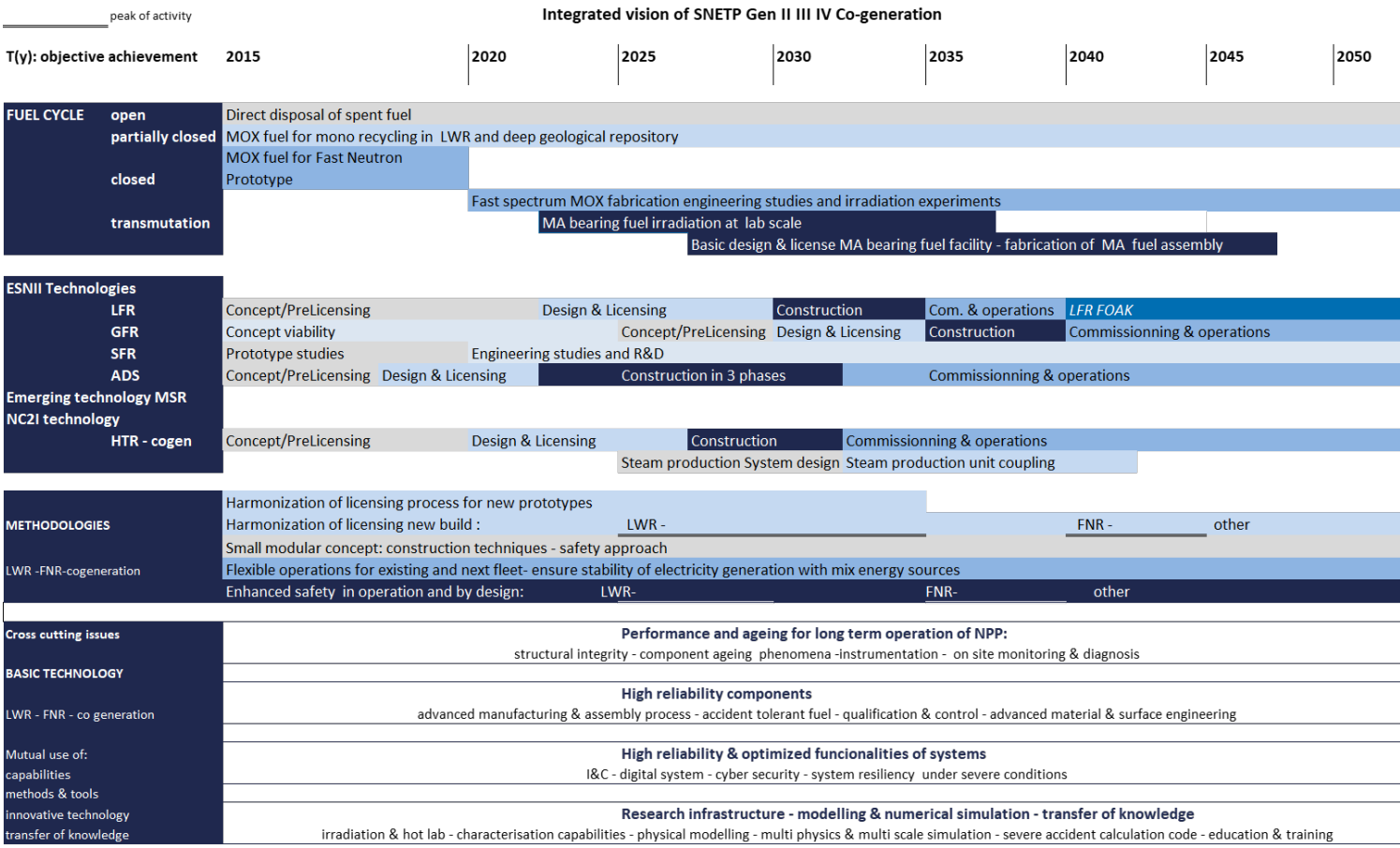

Fig. 1: Integrated vision of SNETP activities in Gen II and Gen III (NUGENIA), Gen IV (ESNII) and Co-generation (NC2I) [14]

The most active Czech SNETP members are ČEZ and ÚJV Řež that have their representatives in the Governing Board and pillars committees. Especially ÚJV Řež played important role in the SNETP history. ÚJV Řež director was SNETP president for several years after organisation establishment. ÚJV Řež was one of the 7 organizations that founded NUGENIA as non-profit association focused on Gen II & III nuclear plants research and ÚJV Řež representative was first NUGENIA ExCom chair. ČEZ and ÚJV Řež were also active in SNETP transformation from platform to international non-profit association. The transformation was performed by change of NUGENIA association statutes approved by the General Assembly. This transformation was important for effective SNETP function in today EU and proved to be successful.

Active work in SNETP enables ÚJV Řež experts to have current information related to European energy policies. We discuss, present our views and help to prepare the SNETP position papers with the goal to shape these policies. The latest example can be SNETP reaction to the draft of Complementary Delegated Act that include nuclear technology within the sustainable finance taxonomy.

For ÚJV Řež, expertise and business development are important activities related to building strategic vision & roadmapping. Our experts attending those activities can communicate and present their statements and better understand views of others. Last document prepared with active involvement of ÚJV experts is SNETP STRATEGIC RESEARCH AND INNOVATION AGENDA published in July 2021 [2].

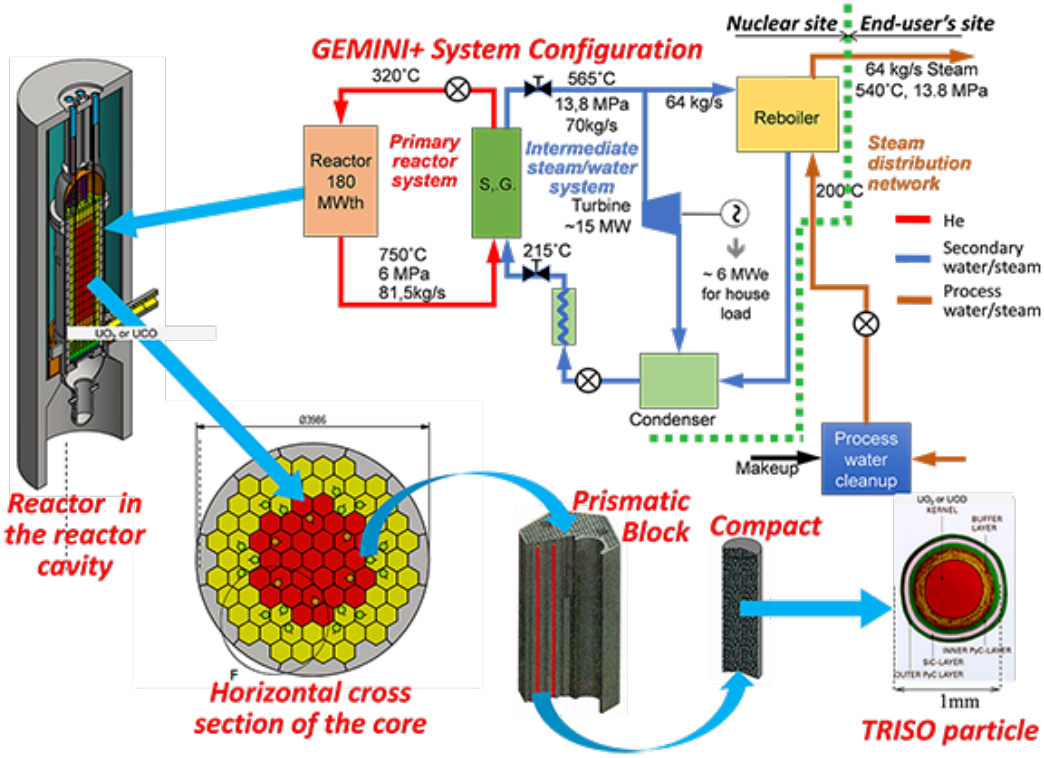

Fig. 2: The main features of the GEMINI+ system [13]

ÚJV Řež intensively utilizes SNETP services and activities focused on supporting nebo aimed to support preparation, realisation and financing of the research projects as open SNETP project creation and labelling process, project portfolio, annual SNETP Forum, and others.

The figure 1 summarizes the time table of the activities in all pillars of the SNETP with specific emphasis on selected technology topics and the cross cutting with other pillars and their main topics.

NUGENIA PILLAR

NUGENIA is a pillar of the Sustainable Nuclear Energy Technological Platform (SNETP) dedicated to innovation, research and development of nuclear fission technologies, with a focus on Generation II and III nuclear technologies. It gathers international stakeholders from industry, research, safety organizations, SMEs and academia committed to cooperate and develop joint collaborative projects in the field.

The NUGENIA research programme has been organized in eight technical areas (TA) with their own fields of expertise:
TA 1 – Plant safety and risk assessment
TA 2 – Severe accidents
TA 3 – Improved nuclear power plant operation
TA 4 – Integrity assessments of systems, structures & components
TA 5 – Waste management and decommissioning
TA 6 – Innovative LWR design & technology
TA 7 – Fuel elements
TA 8 – European Network for Inspection and Qualification (ENIQ)

The activities of NUGENIA are carried out within a general scope defined by the SNETP Strategic Research and Innovation Agenda (SRIA) [2] and technical scope outlined in the NUGENIA Vision document [3]. Harmonization and cross-cutting issues are tackled within the different technical areas and streamlined by the pillar governance: the coordination board composed by the leaders of each technical area.

The NUGENIA governance, the coordination board, operational teams and technical experts focus on monitoring of R&D&I activities and defining high level challenges and priorities within the context of the European Union policies and its Member States interests. For increased visibility and credibility at international level, a number of cross-cutting initiatives were launched in the past years and formalized interactions put in motion at different levels. This covers relations with other SNETP pillars, EU bodies, international organizations and national public and private actors.

ÚJV Řež and Czech Republic plays important role in activities of NUGENIA from its birth in 2011. At present, ÚJV Řež representative Pavel Kral leads technical Area 1 and acts as vice-chair of the whole NUGENIA. Also, the CEZ representative Aleš Laciok is leading Technical Area 3.

ESNII PILLAR

The European Sustainable Nuclear Industrial Initiative (ESNII) [4] was launched in 2010 as one of three pillars of the SNETP. The main objective of its mission is the energy needs assessment focused on the Generation IV systems with the closed fuel cycles in line with the integrated Strategic Energy Technology Plan, which was issued by the European Commission (SET-Plan) [5]. Similar and comparable objective has also the Generation IV International Forum (GIF), which was founded in 2001 and gathers worldwide research teams on comparable R&D subjects. The GIF studies more systems than the four ESNII technologies and projects, so the GIF is not committed to demonstrator projects like ESNII.

The use of fast reactors in closed U-Pu fuel cycle, like recycling of spent fuel, can contribute to a large increase in efficiency with regard to natural resources consumption. Such an increase is estimated to factor of at least 50, which indicates a more sustainable implementation of nuclear technologies in long term. The fast spectrum reactors with a closed fuel cycle can allow significant reduction of volume and radiotoxicity of the high-level nuclear waste, which is the societal concerns regarding nuclear energy. Apart from the deployment of fast reactors, advanced reprocessing and remote fuel manufacturing techniques are necessary to recycle the minor actinides in order to meet this goal.

The principal objectives of ESNII can be summarized in several tasks to be fulfilled in upcoming period. First, to share a common technological roadmap and to develop synergies among national and EU-funded programs, based on sustainable industrial initiatives supported by the following technologies and projects.

1. The Lead-cooled Fast Reactor (LFR) and the **ALFRED** (Advanced Lead-cooled Fast Reactor European Demonstrator) project, an initiative with the goal of construction of a European demonstrator of the LFR technology in Europe, having SMR-oriented features
2. The Gas-cooled Fast Reactor (GFR) and the **ALLEGRO** project, an initiative with the goal of construction of an experimental facility to demonstrate the technological viability of the GFR concept
3. The Sodium-cooled Fast Reactor (SFR) technology: it is the most mature technology internationally with operating reactors in the Russian Federation. The challenges prior to an industrial deployment in western Europe are to improve the economics and to consolidate the safety demonstrations. Major issues are addressed in the French R&D programme in connection with European skills

The members of ESNII recognize that the above consensus will benefit from the realization of the Lead-Bismuth cooled **MYRRHA** (Multi-purpose HYbrid Research Reactor for High-tech Applications), a fast neutron Accelerator-Driven System, which is the leading European R&D project on fast neutron technology as of today and will generate useful information for the various Sustainable Industrial Initiatives.

Second, to promote and support the research and demonstration programmes needed to implement this roadmap, when the hereunder conditions will be fulfilled for construction decision:

i. Availability of the necessary R&D results for design options selection,
ii. Relevance for future utilities' needs,
iii. Positive feedback from licensing authorities.

Third, to consolidate the technology roadmap and to promote the construction of the research and testing facilities that are necessary for the demonstration programmes leveraging on synergies with other research initiatives included in the ESFRI (European Strategy Forum on Research Infrastructures) [6] and taking into account the ERA (European Research Area) vision [7].

Fourth, to establish the common basis of an R&D, industrial and financial partnership, facilitating the constitution of consortia and private-public partnerships for the best exploitation of the developed technologies and projects.

Fifth, to provide indications on the design, safety and operational criteria under which the assessment of the identified technological options as well as various complementary and emerging technologies shall be made to establish a sound and timely process for the evaluation of the technologies, the associated projects and their potential.

One of the latest activities within the ESNII pillar is merging of the Molten Salt Reactor technology to the portfolio of the technologies. This issue is not yet closed and will continue during year 2022.

NC2I PILLAR

The Nuclear Cogeneration Industrial Initiative (NC2I) [8] is one of the three pillars of the (European) Sustainable Nuclear Energy Technology Platform (SNETP) [1] and acknowledges that non-electric energy needs (industry, transport, district heating) represent most of the energy needs in Europe and in most industrialized countries. The executive body of NC2I is the NC2I Coordination Board and it consists of representatives from NC2I members where Centrum výzkumu Řež is one of them. NC2I Chairman is Józef Sobolewski from NCBJ, Poland. Currently, NC2I is putting efforts to enlarge its membership base within SNETP and beyond.

NC2I aims to contribute to the achievement of European Green Deal ambitions by providing innovative and competitive low-carbon energy solutions. This contribution will be made through nuclear cogeneration plants using mature and ready-to-deploy HTGR (High Temperature Gas cooled Reactor). The HTGR (outlet temperature 750°C) is considered as the first step of VHTR (Very High Temperature Reactor) GIF technology [9], and it is a realistic candidate for near-term demonstration of nuclear industrial high temperature cogeneration, producing high temperature heat and electricity for numerous applications. These solutions can greatly reduce emissions in the industrial sector, including the production of clean hydrogen at a large scale. The first fourth generation (GEN IV) NPP of High Temperature gas cooled Reactor of Pebble bed Module (HTR-PM) has been connected to the grid at the Shidaowan Nuclear Power Plant (NPP) in Shandong province of east China on 20 December 2021 [10].

Next to that significant international achievement, Poland is also intending to develop the HTGR in view of substituting coal and imported natural gas for providing process heat to its chemical and petrochemical industries [11] Thirteen industrial sites were identified with a combined heat demand of 6.4 GWth. The first step for launching the project is demonstration of the feasibility at the level of a test reactor by the Polish government – the European High Temperature Experimental Reactor (EUTHER) [12]. The reactor will be a prismatic type HTGR using TRISO fuel producing approximately 30–40 MW_{th} at an outlet temperature of 750 °C and it is based on the design options developed in the H2020 Euratom funded project GEMINI+ (2017–2021) [13]. Its main results has been a 180 MW_{th} block-type HTR layout optimized for process steam supply at 540°C to industrial steam networks (in Fig. 2). A safety case for this system was described and reviewed by TSOs (Technical Support Organisation of regulators).

In frame of the new Euratom Programme Horizon Europe, the NC2I partners including Czech Republic submitted the GEMINI 4.0 proposal in 2021. The proposal is based on the results of GEMINI+ and on identified residual technology gaps requiring R&D. This new proposal is addressing open questions related to system safety demonstration and confirmation of its licensing readiness, the capacity of polygeneration of process heat, hydrogen and electricity with this system and the identification of the conditions for the development of a European HTGR fuel supply chain fuel cycle management.

NUGENIA
Nuclear Generation II&III Alliance

ESNII
European Sustainable
Nuclear Industrial Initiative

NC2I
Nuclear Cogeneration
Industrial Initiative

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Jiří Duspiva has been the Director of the Nuclear Safety and Reliability Division at ÚJV Řež since 2018. He graduated from the Czech Technical University in Prague, Faculty of Mechanical Engineering, majoring in Thermal and Nuclear Machines and Equipment. After graduation, he joined ÚJV Řež, where he worked as a researcher in the field of severe accident research and since 2012 as the Head of the Department of Severe Accidents and Thermomechanics. During his work at ÚJV Řež he held positions as a team leader of national projects or parts of them (CR MIT, TA ČR, SONS) and international projects in EC Framework Programmes, OECD/NEA, and IAEA projects, where he also worked as an external specialist/lecturer or member of the author team of the report on the accident at Fukushima NPP. He has represented ÚJV Řež or the Czech Republic in Cooperative Severe Accident Research Programme organized by the US NRC, OECD NEA WGAMA WGAMA for a long time and still represents or still represents in a number of international programs (OECD/NEA CSNI, SNETP GA, ESNII, V4G4 NoE). He has also been involved in a number of severe accident management projects for Czech NPPs, with a specific focus on Temelín NPP. He is also a long-term member of the CNS, where he has served as Vice-President since 2014 and has represented the CNS in the ENS since 2017 and is also a member of the ENS Board.

ETSON
European Technical Safety Organizations Network: missions, objectives and scope of activities

Miroslav Hrehor
National Radiation Protection Institute

The article informs about the existence of ETSON, a major international association of European scientific and research organisations whose mission is to provide expert support to national regulatory authorities in the field of nuclear safety and radiation protection. The composition of the association, its structure, working groups and selected examples of outputs of joint activities are briefly presented. The Czech Republic is represented in the Association by the National Radiation Protection Institute.

Mission of Technical Safety Organizations – TSOs – can be briefly defined as the support of state regulatory authorities in the form of an independent expert, analytical and research services in the field of nuclear safety and radiation protection applied for both, nuclear facilities in operation and newly builts as well.

TSO objectives can be summarized as follows:

- to build a knowledge-based environment with working potential for continuous support of regulatory activities in the field of nuclear safety of existing nuclear facilities as well as in licensing new ones
- to provide experimental infrastructure for verification research (confirmatory research), deepening and dissemination of knowledge and addressing safety issues
- to establish a scientific network to provide expert services
- to build a training infrastructure for long-term on-the-job training of regulatory authorities workers (inspectors).

The limited national human and financial resources to solve current problems and research topics of nuclear safety lead to the need for international cooperation and exchange of information and experience. It is therefore important that the TSO organizations are linked together and support each other in their missions.

For this purpose the European TSO Network ETSON (European Technical Safety Organisations Network) was established in May 2006 in European Union by its founding members: Bel V (formerly AVN, Belgium), GRS (Germany) and IRSN (France). At present, the ETSON members are:

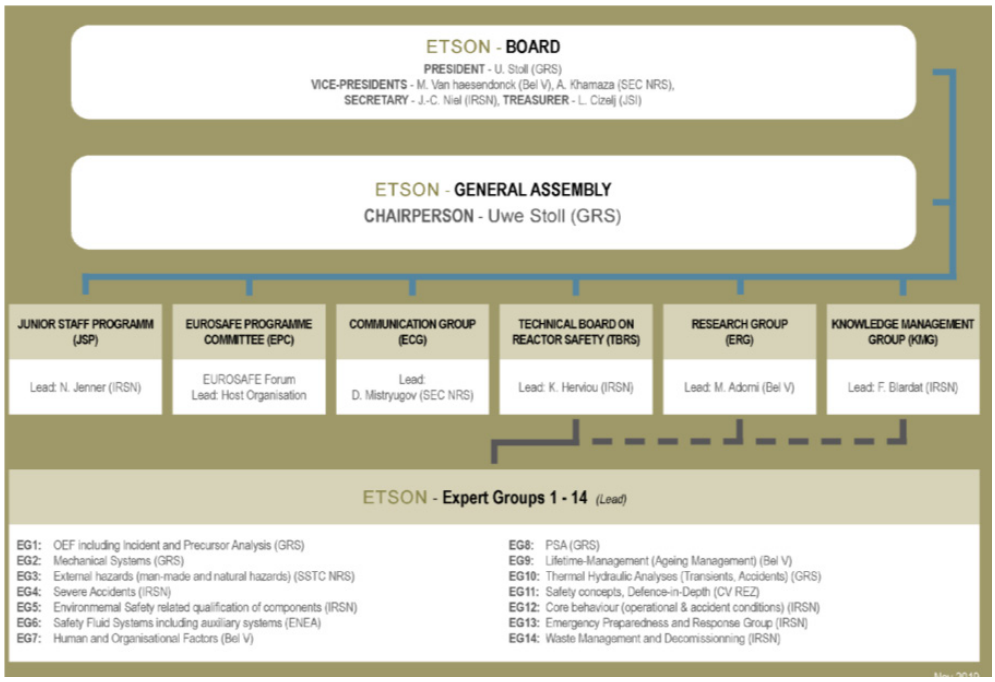
- Bel V – BELGIUM (www.belv.be)
- National Radiation Protection Institute – SURO – CZECH REPUBLIC (www.cvrez.cz)
- Technical Research Centre of Finland – VTT – FINLAND (www.vtt.fi)
- Gesellschaft für Anlagen-und Reaktorsicherheit mbH – GRS – GERMANY (www.grs.de)
- Centre for Energy Research – EK – HUNGARY (https://www.ek-cer.hu/en/the-research-centre/)
- Institut de Radioprotection et de Sûreté Nucléaire – IRSN – FRANCE (www.irsn.fr)
- National Agency for New Technologies, Energy and Sustainable Economic Development – ENEA – ITALY (https://www.enea.it/en)
- Lithuanian Energy Institute – LEI – LITHUANIA (www.lei.lt)
- Institute for Nuclear Research Pitesti – RATEN ICN – ROMANIA (www.nuclear.ro)
- VUJE TRNAVA – VUJE – SLOVAKIA (www.vuje.sk)
- Jožef Stefan Institute – JSI – SLOVENIA (www.ijs.si)
- Paul Scherrer Institute – PSI – SWITZERLAND (www.psi.ch)
- JACOBS – UNITED KINGDOM (www.jacobs.com)

For TSOs from non-EU countries which expressed interest to join ETSON, a status of so-called associated members have been created. Currently to the associated members belong:

- State Scientific and Technical Center – SSTC – UKRAINE (www.sstc.kiev.ua)
- Scientific and Engineering Center for Nuclear and Radiation Safety – SEC NRS – RUSSIA (www.secnrs.ru)
- Nuclear Regulation Authority – NRA – Japan (www.nsr.go.jp).

ETSON Structure

By signature of the statutes of the ETSON Association on 23 August 2010, the ETSON partners prepared the transition to a legal entity. By its registration in Paris on 5 March 2011, ETSON became a non-profit-making Association according to French law with registered office in Châtillon near Paris. In accordance with the statutes, the governing bodies of the Association are the General Assembly, where all members are represented, and an elected Board consisting of the president, vice-president, secretary and treasurer.



ETSON technical work focuses on safety assessment and research and development. Safety assessment activities are performed under the umbrella of the Technical Board for Reactor Safety (TBRS) and are based on R&D activities being handled by the ETSON Research Group (ERG).

EG1: Operating Experience Feedback
EG2: Mechanical Systems
EG3: Electrical Systems
EG4: Severe Accidents
EG5: Environmental Safety-Related Qualification of Components
EG6: Safety Fluid Systems, including auxiliary systems
EG7: Human and Organizational Factors
EG8: Probabilistic Safety Assessment PSA
EG9: Lifetime-Management (Ageing Management)
EG10: Thermal Hydraulic Analyses (Transients, Accidents)
EG11: Safety concepts, Defence-in-Depth
EG12: Core Behaviour (operational and accident conditions)
EG13: Emergency Preparedness and Response Group
EG14: Waste and Decommissioning

The Expert Groups are the technical and scientific base of ETSON, bringing together leading experts from all ETSON members and thereby contributing to the harmonization of safety standards and to the strengthening of nuclear safety practices in Europe. Czech Republic is represented in most of these goups.

Knowledge Management Group (KMG)

The task of the Knowledge Management Group (KMG) is directed to develop, implement, maintain and manage ETSON common necessary knowledge and cooperation tools for voluntary exchange of assessment and R&D results in the field of nuclear safety. The statutes of the ETSON association highlight the need of ETSON members to increase co-operation and to encourage sharing of knowledge and experience. To create, share and diffuse knowledge is one of the pillars of nuclear safety enhancement and constitutes a powerful tool to enforce the network and the collaboration between ETSON members.

EUROSAFE Programme Committee (EPC)

The EPC is a body organizing annually the EUROSAFE international forum for discussions and exchange of information among experts from TSOs, research institutes, safety authorities, utilities, the industry, public authorities and non-governmental organisations concerning the status and recent achievements in nuclear installation safety, waste management, radiation safety and nuclear material security. The EUROSAFE Forum 2021 took place in Paris with the topic "Nuclear and Radiation Safety in Disruptive Word" with 34 presentations in the fields of:

- Nuclear installation safety assessment and research
- Waste management, decommissioning, and disposal
- Radiation protection, environment, and EP&R (including research)
- Nuclear installation and materials security

Junior Staff Programme (JSP)

The ETSON Junior Staff Programme (JSP) brings together young experts from all ETSON members and associates. The JSP aims at improving the long-term partnership of the member TSOs, establish a network for cooperation between young expert from different countries, and to encourage intercultural interaction. The main yearly events within this framework are the ETSON Junior Staff Summer Workshops. The last JSP workshop organized in 2019 was devoted to Innovative Systems for Safety Functions – including Passive Systems, on Gen III+, Gen IV, SMRs, Floating Power Plants and Other New Designs. The workshop was hosted by ENEA (Italy).

The ETSON Communication Group (ECG)

The ECG was fully established in 2019 in order to increase the recognition of ETSON's values and activities at the international level as well as to support ETSON's internal and external communication. The main activity of the group focuses on the intranet and internet website development.

Experts' groups developed number of technical reports dedicated to various technical issues, e.g.:

- TSAG on Event Review and Precursor Analysis
- TSAG on Deterministic Severe Accidents Analysis
- TSAG on Human and Organisational Factors in Nuclear Facilities Design and Modification Processes
- TSAG on Transients and Design Basis Accident Analyses
- TSAG on Safety Fluid Systems
- TSAG on Environmental Safety Related Qualification of Components

Recently the TBRS Work Plan 2022–2025 has been published which gives the objectives identified in the main areas of interest for the ETSON members and deliverables that are envisaged in the coming years.

The participation of SÚRO in this association of leading research organisations in Europe is a confirmation of its strong position in the field of scientific and technical expertise in nuclear safety and a further strengthening of its prestige in the field of international cooperation.

ETSON EUROPEAN TECHNICAL SAFETY ORGANISATIONS NETWORK

TECHNICAL BOARD AND REACTOR SAFETY WORK PLAN 2020-2025

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Miroslav Hrehor is a graduate of Czech Technical University – Faculty of Nuclear Sciences and Physical Engineering, Department of Nuclear Reactors. Since graduation in 1972, he has spent his professional life in the field of nuclear power engineering with a focus on nuclear safety. As a member of the team of nuclear safety inspectors of the Czechoslovak Atomic Energy Commission and later as Deputy Chairman of the State Office for Nuclear Safety (SÚJB), he actively participated in the development of nuclear legislation and licensing of nuclear facilities. In 1999–2006, he worked as the first Czech delegate to the OECD Nuclear Energy Agency in Paris. From 2006 to 2011, he worked as the Scientific Secretary in ÚJV Řež. Since 2012 he was the Director of the Safety Research Section at Research Centre Řež. Currently he is the Deputy Director for Nuclear Safety at the National Radiation Protection Institute.

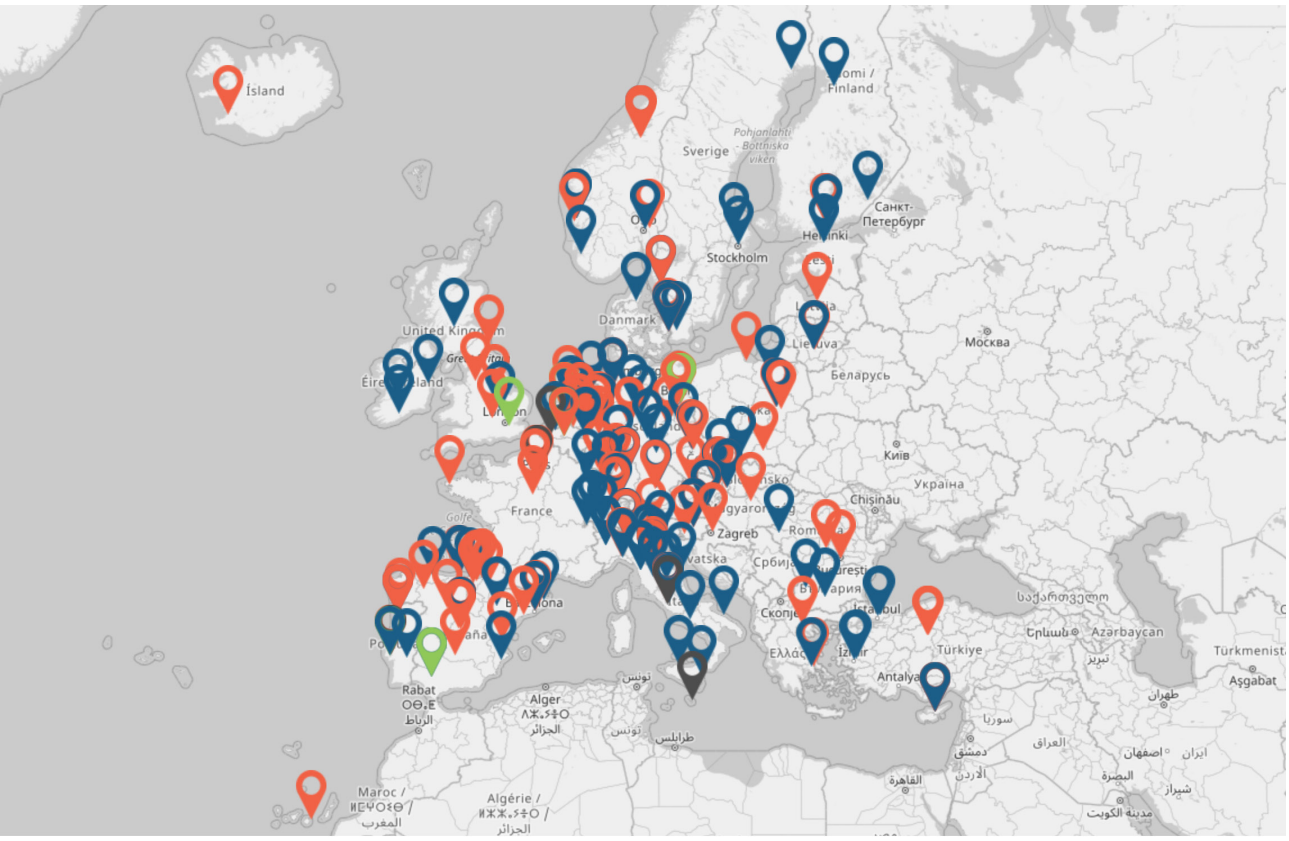
Involvement of Czech companies in The European Energy Research Alliance

Jana Kalivodová, Daneš Burket
Research Centre Řež

Regardless of the source of energy, demand is growing. With the global population expected to increase by about two billion over the next two decades, and with improving standards of living, it is estimated that by 2040 electricity generation is expected to increase by 52%. Recent Russia's invasion of Ukraine combined with an enduring energy price crisis have parked the necessity for urgent and concerted actions in the EU on energy matters.

Energy and specifically energy research and development are becoming even more important vehicle for the achievement of a wide variety of societal and policy goals. This paper is focusing on the international collaboration of Czech research organizations, companies and academia with the largest energy research community in Europe, organized by the European Energy Research Alliance (EERA). EERA is non-profit association of European public research centres and universities (more than 250 organisations from 30 countries) with the mission to catalyse European energy research for a climate-neutral society by 2050.

This paper shall zoom in on the international collaboration of Czech research organizations, companies and academia with the largest energy research community in Europe, organized by the European Energy Research Alliance (EERA). EERA is non-profit association of European public research centres and universities with the mission to catalyse European energy research for a climate-neutral society by 2050. Bringing together more than 250 organisations from 30 countries, EERA's mission is to coordinate and promote low-carbon energy research efforts, help streamline regional, national and European funding, and deliver research results from basic research to the demonstration phase. To date, EERA operates 18 distinct Joint Programmes that cover the whole range of low-carbon technologies as well as systemic and cross-cutting topics. The EERA Joint Programmes cover research in the whole range of low-carbon technologies as well as cross-cutting topics and develop research activities based on shared priorities of the participating research centres and universities. Czech organizations are actively participating in several of them, described in following parts of the paper. Beyond that, they collaborate with industry stakeholders, aligning research and innovation priorities to foster world-class technology and innovation in Europe's energy sector and reduce its time-to-market. At policy level, EERA supported the elaboration of the SET-Plan Implementation Plans and is now contributing to their execution. Furthermore, EERA provides strategic advice to policy makers on how to achieve the energy transition toward a low-carbon Europe.



Universities | Associations | Research organisations | Industry

Fig. 1: The map of distribution of the EERA members

EERA was created to align the research and development activities of individual research organisations with the needs of the Strategic Energy Technology Plan (SET-Plan) priorities, and to establish a joint programming framework at the European Union (EU) level in 2008. In the same year, the Strategic Energy Technology Plan (SET-Plan) was adopted by the EU, as a first step to establish an energy technology policy for Europe. There were 10 founding bodies, European organisations, CEA, CIEMAT, CRES, ECN, ENEA, Helmholz Association, LNEG, Riso – DTU, UK-ERC and VTT, concerned with the energy research.

EERA as an association regularly participates in EU projects that are directly linked to the EU energy strategy and/or are of strategic importance to the Alliance. Some of the ongoing projects can be found at the EERA website www.eera-set.eu/research/projects.html. One of the successful example of the ongoing project is SUPEERA project (supeera.eu) that shall help better connect research and innovation, foster a stronger engagement of the EU-13 countries, and assess EU policies to allow for better policymaking and the implementation of the targets defined in the SET-Plan. Next to projects inside the structure of EERA, the Policy Working Group (POL WG) focuses on policy issues relevant to EERA's strategy and contributes to ensuring that EERA is an active player in European energy R&I policy development. The Policy Working Group Updates include latest information on selected policy dossiers such as analyses of policy documents, information on public consultations and additional ways

to interact with EU institutions. One of the recent important documents is the EERA White Paper on the Clean Energy Transition. It suggests a radically new approach, addressing the transition from a holistic and systemic perspective, driven by societal objectives and EERA has derived a set of key policy recommendations to be regarded as pre-requisites for successfully making the Clean Energy Transition possible.

EERA is led by President (Nils A. Røkke) and Vice-Presidents that preside over the Executive Committee and the General Assembly of the Members, another governing bodies of the association. CVŘ is represented in the Executive Committee (ExCo) by Daneš Burket. The ExCo members amongst other roles are influencing the preparation and approval of the EU research programmes, as well as the activities of the Alliance.

EERA covers the whole range of low-carbon energy technologies and addresses systemic topics and operates 18 joint research programmes. The topics of the EERA Joint Programmes range from energy materials over technologies to systemic topics and they are aligned with the EU SET-Plan. Each EERA member organisation participates in at least one JP, but often they join several. A Joint Programme is a permanent structure within EERA. It allows EERA members which work on a specific topic to define a common research agenda, coordinate their activities, build up a sustainable network, and elaborate joint project proposals. It also is a way to speak with a common voice and increase impact. Most Joint Programmes distinguish between full and associate members and are divided into sub-programmes that address key areas of the respective research field and cross-cutting issues. The different governing bodies within a Joint Programme are typically: the Steering Committee, which consists of a representative of each member organisation; the Management Board, which is composed of the leaders of the different sub-programmes; the Joint Programme Coordinator, who is the head of management. All these bodies are filled with staff from the EERA member organisations that participate in the Joint Programme; the work is provided in-kind. A dedicated person at the EERA Secretariat links the respective Joint Programme to the umbrella organisation in Brussels. EERA Joint Programmes are no funding bodies; the work is provided as in-kind contribution. While the participation in some Joint Programmes is free of charge, others have participation fees. These fees are used for joint activities, for instance for organising workshops and other events. In some cases, they are also used for internal funding schemes. An overview of all Joint Programmes can be found below.

AMPEA	**UFCH JH, CAS**	**Fuel Cells and Hydrogen**	**CVŘ; UCT Prague**
Bioenergy	VŠB–TUO	Geothermal	
Carbon Capture and Storage		Hydropower	VUT; VŠB–TUO
Concentrated Solar Power		Nuclear Materials	CVŘ; IPM, CAS
Digitalization for Energy		Ocean Energy	
E3s	CVŘ	Photovoltaic Solar Energy	
Energy Efficiency in Industrial Processes		Smart Cities	VUT; CTU; VŠB–TUO
Energy Storage	VUT; IT, CAS; UTB	Smart Grids	VŠB–TUO
Energy System Integration		Wind Energy	

Tab. 1. An overview of EERA Joint Programmes

Next to EERA, the Czech Energy Research Alliance (EERA-CZ) has been found in 2016. EERA-CZ is the umbrella organization for several academic research institutes which are developing sustainable technologies in Czech Republic. Through the EERA-CZ, the members participate in European Joint Programmes (in table green), and to create a functional structure for knowledge transfer between European and national level, between academia and industry, and between the research community and public administration in EERA JPs and Horizon 2020 and HEU projects arising from them. Next to CVŘ, other partners of the Czech umbrella organisation are Czech Technical University in Prague (CTU), Technical University of Ostrava (VŠB-TUO), Brno University of Technology (VUT), University of Chemistry and Technology, Prague (UCT Prague), J. Heyrovský Institute of Physical Chemistry, CAS (UFCH JH, CAS), Institute of Physics of Materials (IPM, CAS), Institute of Thermomechanics, CAS (IT, CAS) and Tomáš Baťa University, Zlín (UTB). The involvement of the CZ organisations in the JPs is summarised in Table 1.

CTU is participating in the JP Smart Cities, specifically Michal Kuzmic is the coordinator of the Module 4: Positive Energy Districts (PED) Replication & Mainstreaming. Building the PEDs in different EU cities is a goal of H2020 project SPARCs (Sustainable energy Positive & zero cARbon CommunitieS, www.sparcs.info). CTU, UCEEB is providing expert support in the SPARCs and one of the partner cities is the municipality of Kladno (https://www.sparcs.info/cities/kladno).

Three Czech research organizations are participating in the Joint Programme Energy Storage and its subprogrammes SP3 Thermal Energy Storage – VUT, SP4 Mechanical Energy Storage – VUT and IT, CAS and SP6 Energy Storage: Technoeconomic and Sustainability – UTB. The activities of VUT Brno in SP4 has been transferred into a newly JP Hydropower and the collaboration immediately led to the international project Digitalization of water supply infrastructure to optimize the Water-Energy Nexus (DIWIEN, TK70020001).

UCT Prague has the long-term interest in the problems related to the hydrogen economy and it is a member of FCH JU Research Grouping from 2009 as well as member of the JP Fuel Cells and Hydrogen. The broad international collaboration in the field of hydrogen is demonstrated by several international projects. (www.eera-fch.eu/component/projects/projects.html?id=182)

Another successful example of the collaboration within EERA is the SUNERGY, the European Research and Innovation initiative founded by JP AMPEA organizations, including UFCH JH, CAS.

CVŘ is mainly participating in the Joint Programme Nuclear Materials (EERA JPNM, www.eera-jpnm.eu) that has been found in 2010 and the CVŘ has representatives in both governing bodies of the JPNM (Management Board and the Steering Committee). The objective of the EERA JP on Nuclear Materials is to improve safety and sustainability of Nuclear Energy by focusing on materials aspects. The goal is to enable the selection of the most suited materials and to define safe design rules for advanced nuclear systems, considering especially radiation and temperature effects, as well as compatibility issues, while ensuring improved component lifetime management. The JPNM consists of four subprogrammes: SP-A: Pre-normative research on materials and component qualification and data management; SP-B: Physical modelling and advanced microstructure examination; SP-C: Development of advanced materials solutions and fabrication processes; SP-D: Materials health monitoring and non-destructive examination for nuclear materials.

The backbone of the research work of the JPNM are the Pilot Projects (PP). PP is a project focused on a specific research issue consistent with the Strategic Research Agenda of the EERA JPNM (SRA) and linked to at least one of the JPNM subprogrammes. It involves at least 3 participants, from 3 different European countries and the call is approximately every 3 years. Overall, the Pilot Projects are a tool facilitating the advisory role of EERA JPNM to European Commission and Member States that these institutions expect. Through the Pilot Projects, EERA JPNM can provide clear indications about research needs, costs, and gaps. The EERA JPNM Pilot Projects' portfolio proved to be a key tool for shaping important strategic documents and to be used for funding at European and national level, such as Work Programme of the Euratome. The example of the past PP are Wellmet, Restress, Alcore, Star-trec, Joisic, TASTE +, HEAFNA from which some of them became the EU H2020 project GEMMA, M4F or project INNUMAT (INNovative structural materials for fusion and fusion) to the Euratom 2021 HEU call within a strong international consortium. Another strategic project ORIENT-NM is ongoing. It is a preparatory project for research European Partnership in Euratom WP 2023–2024, HEU focused on nuclear materials including structural materials and fuel for Generation reactors II, III and IV. Many EU member states need to share the same goals, which should inherently allow each of them to valorise own research assets, in terms of knowledge and skills, as well as facilities and infrastructures, irrespective of their specific interests as to current and/or future nuclear systems. This coordinated use of resources, in the specific area of materials, should serve equally well different nuclear energy strategies and policies, from current to next generation, from fission to fusion. The European partnership on nuclear materials is the instrument to realize the above purposes is a built around the grand goals detailed in the Strategic Research Agenda that is being prepared in the ORIENT-NM project, while the opportunities offered by present and future large infrastructures in Europe will be analysed in a dedicated document.

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Jana Kalivodová works as a scientific secretary at Research Centre Řež. She graduated from the University of Chemistry and Technology in Prague, and she has more than 15 years of experience in the field of high-temperature degradation of materials in power engineering and other applications. She is a member of the Management Board of the Joint Programme on Nuclear Materials in EERA (EERA JPNM). She also represents the EU in the international organization GIF in the V/HTR system Materials project, and she is also a member of the Coordination Board of the European Industrial Initiative for Nuclear Cogeneration (NC2I).

Conclusion

Energy needs to be sustainable (to preserve our environment), secure (to avoid shortage), efficient (to avoid wasting it) and come at a low cost (to be affordable for everyone). EERA is one of the cornerstones of the European Union's Strategic Energy Technology Plan (SET-Plan) and coordinates energy research for the low carbon Europe. EERA's mission is catalysing European energy research for a climate-neutral society by 2050 and to help streamline regional, national, and European funding, and deliver research results from basic research to the demonstration phase.

The participation in EERA and its JPs brings:

- Acquisition and exchange of knowledge and experience in the field of energy research with top European institutions – joint pilot projects, EU projects,
- Involvement and use of our research infrastructures,
- Mobility of students and experts,
- Deepening cooperation at the national level thanks to EERA-CZ umbrella.

EERA
European Energy Research Alliance

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After graduating from the Faculty of Nuclear and Physical Engineering of the Czech Technical University in Prague in 1994, he worked at the Dukovany Nuclear Power Plant, where he held various positions up to the head of the Reactor Physics Department. In 2007, he moved to ČEZ's headquarters, where he worked as the Director of the Technical Support Section and, among other things, recommended the implementation of life management programs at nuclear and conventional power plants and documentation for extending the life of the Dukovany Nuclear Power Plant. Since 2016, he has been the director of the Research and Development section at the Research Centre Řež.

Daneš Burket received his PhD in the field of nuclear engineering, he served on the Scientific Board of the Faculty of Nuclear and Physical Engineering of the Czech Technical University in Prague and the Supervisory and Scientific Boards of the Research and Testing Institute in Pilsen. He was a member of the WANO (World Association of Nuclear Operators) Peer Review teams at TEPCO in Japan and the Fukushima Daiichi and Kashiwazaki Kariwa nuclear power plants, and at the Tianwan nuclear power plant in China. He has been the President of the Czech Nuclear Society since 2010.

Participation of the Czech Republic in OECD/Nuclear Energy Agency activities

Miroslav Hrehor
National Institute of Radiation Protection

The article informs about the participation of the Czech Republic in the activities of the OECD Nuclear Energy Agency. The history of the Agency, its mission, membership and main working committees are briefly presented. The committees dealing with nuclear safety issues – Committee on the Safety of Nuclear Installations (CSNI) and Committee on Nuclear Regulatory Activities (CNRA) – are discussed in more detail. As examples of joint activities, selected international research projects in which the Czech Republic is actively involved are briefly presented.

The Nuclear Energy Agency (NEA) is a specialised agency within the OECD (Organisation for Economic Co-operation and Development). It is an intergovernmental organisation based in Paris.

The origins of the OECD date back to the post-war period of the late 1940s, when the Organisation for European Economic Co-operation (OEEC), the predecessor of the OECD, was established in 1948 in the context of the Marshall Plan for the European Recovery Programme. The present OECD was established in 1961 through a transformation of the OEEC, when the USA and Canada, and later Japan and Australia, became members. In 1958, the OEEC Council established the European Nuclear Energy Agency (ENEA), from whose name the word European was dropped in 1972 in order to allow non-European countries to become members. Japan (1972), Australia (1973), Canada (1975), the USA (1976) and others subsequently became members of the NEA. The Czech Republic joined the OECD in 1995 and the NEA in 1996.

The mission of the NEA is to maintain and further develop, through international cooperation, the scientific, technical and legislative basis for the safe and economic use of nuclear energy for peaceful purposes.

The NEA today consists of 34 member countries, namely:
Argentina (2017), Australia (1973), Austria (1958), Austria (1958), Belgium (1958), Bulgaria (2021), Canada (1975), Czech Republic (1996), Denmark (1958), Finland (1976), France (1958), Germany (1958), Greece (1958), Hungary (1996), Iceland (1958), Ireland (1958), Italy (1958), Japan (1972), Korea (1993), Luxembourg (1958), Mexico (1994), Netherlands (1958), Norway (1958), Poland (2010), Portugal (1958), Romania (2017), Russian Federation (2013), Slovak Republic (2002), Slovenia (2011), Spain (1959), Sweden (1958), Switzerland (1958), Turkey (1958), United Kingdom (1958), United States (1976).

The NEA has about 100 employees forming the so-called Secretariat. The Director General is currently William D. Magwood (USA), the Deputy Director General is Nobuhiro Muroya (Japan). The governing body of the NEA is the OECD Council (the supreme governing council for the whole OECD) and then the NEA Steering Committee (chaired by M. Žiaková – NRA SR). Similarly to the UN (including the IAEA), OECD member countries have permanent missions to the OECD with appointed ambassadors. At present, Helena Čížková, Chargée d'affaires ad interim, is in charge of the Permanent Mission of the Czech Republic to the OECD.

Current OECD NEA working bodies

The NEA currently has 8 specialised technical committees composed of representatives of NEA member countries:

1. Committee on the Safety of Nuclear Installations (CSNI)
2. Committee on Nuclear Regulatory Activities (CNRA)
3. Committee on Radioactive Waste Management (RWMC)
4. Committee on Radiological Protection and Public Health (CRPPH)
5. Committee for Technical and Economic Studies on Nuclear Energy Development and the Fuel Cycle (NDC)
6. Nuclear Law Committee (NLC)
7. Nuclear Science Committee (NSC)
8. Management Board for the Development, Application and Validation of Nuclear Data and Codes (MBDAV)

Key activities in the field of nuclear safety

Two committees in particular are key from a nuclear safety perspective – CSNI and CNRA. Their structure indicates where both committees concentrate their current activities.

The Committee on the Safety of Nuclear Installations – CSNI organises the work of the following standing working groups:

- CSNI Programme Review Group (PRG)
- Working Group on Risk Assessment (WGRISK)
- Working Group on Accident Analysis and Management (WGAMA)
- Working Group on Integrity and Ageing of Components and Structures (WGIAGE)
- Working Group on Human and Organizational Factors (WGHOF)
- Working Group on Fuel Safety (WGFS)
- Working Group on Fuel Cycle Safety (WGFCS)
- Working Group on External Events (WGEV)
- Working Group on Electrical Power Systems (WGELEC).

The State Office for Nuclear Safety is involved in the activities of the CNRA and its working groups.

Committee on Nuclear Regulatory Activities – CNRA chairs the work of the following standing working groups:

- Working Group on Safety Culture (WGSC)
- Working Group on Inspection Practices (WGIP)
- Working Group on Operational Experience (WGOE)
- Working Group on New Reactor Regulation (WGRNR)
- Working Group on Advanced Reactor Safety (WGSAR)
- Working Group on Digital Instrumentation and Control (WGDIC)
- Working Group on Codes and Standards (WGCS)
- Working Group on Public Communications of Nuclear Regulatory Organizations (WGPC)
- Working Party on Boiling Water Reactors (WPBW)

The State Office of Nuclear Safety is involved in the activities of the CNRA and its working groups.

Not all NEA committees have a fixed working group structure. Some of them work on specific topics by setting up temporary "working parties" – for example, the Nuclear Science Committee has a Working Party on Nuclear Criticality Safety (WPNCS) or ad-hoc groups.
Beyond its standing committees, the NEA has other important activities: since 2004, the Agency has been the technical secretariat for the Generation IV International Forum (GIF), which organises international cooperation on the development of Generation IV reactors. Since 2006, it has also served as the technical secretariat for Phase 2 of the Multinational Design Evaluation Programme (MDAP) for the pre-licensing assessment of current nuclear reactor designs such as the EPR, AP-1000, MIR 1200, etc.

International research projects

Since its inception, the NEA has been involved in scientific and technical cooperation between OECD countries in the field of peaceful uses of nuclear energy. Mutual exchange of information and the production of joint reports, including the so-called SOAR (State of the Art Report) – reports summarising the latest state of knowledge in particular research areas or "safety issues" – is organised both in specialised working groups and in the form of international research projects co-financed by their participants. As a rule, the research is closely related to nuclear safety, addressing current "safety issues" such as the behaviour of "high burnup" fuel under LOCA or RIA accident conditions, the "boron dilution" problem, the interaction of corium with concrete, etc. These projects are a unique (and for current conditions in the Czech Republic practically the only) source of experimental data, which are necessary for verification and validation of computational codes. In most cases, this is research at the cutting edge of current scientific research knowledge – i.e., the latest know-how.

The co-financing of these projects has clear rules: the host country of the project usually pays 50% of the costs, the rest is paid by other project participants according to a key based on the ratio of the individual countries' membership contributions to the OECD. For the Czech Republic, this key is quite favourable, which is why our financial share in participation in these projects amounts to tens of thousands of EUR per year. In the following section, examples of joint research projects are given, without claiming completeness. The Czech Republic is actively represented in most of them (ÚJV Řež, Centrum výzkumu Řež).

CIP project (IRSN, France) – The international CABRI project (CIP) is focused on the experimental investigation of the behaviour of high burnup fuel in power excursions of power reactors (RIA – Reactivity Initiated Accidents).

SCIP project (Studsvik, Sweden) – The Fuel Cladding Integrity Project (SCIP) focuses on the failure mechanism of fuel claddings during high burnup, on the interaction between fuel pellets and claddings (PCI – Pellet Cladding Interaction), and on fuel fragmentation during a LOCA accident.

ATLAS project – This is an experimental project on the ATLAS loop (KAERI – Korea), aimed at studying the thermal-hydraulic integral effects of advanced light water reactors (LWRs).

The PKL and ETHARINUS projects – They represent experimental investigations of thermal-hydraulic complex phenomena on loops simulating primary and secondary circuits of light water reactors, namely PKL (Primary Coolant Loop Test Facility – Germany), PACTEL (LUT University – Finland) and PSB-VVER (Electrogorsk – Russian Federation).

The RBHT (Rod Bundle Heat Trans – Pennsylvania State University, USA) project is focused on thermohydraulic measurements of fuel bundles and validation of channel calculation codes.

The LOFC (Loss of Forced Cooling – JAEA, Japan) project – the safety assessment of advanced gas cooled reactors, especially high temperature reactors.

The ROSAU (Reduction of Severe Accident Uncertainties) project is aimed at reducing knowledge gaps and uncertainties associated with the development of severe accidents and to mitigate their consequences.

The STEM (Source Term Evaluation and Mitigation – IRSN, France) project addresses severe accidents and the release of radionuclides into the environment.

The ESTER (Experiments on Source Term and Delayed Releases) project aims at experimental research on delayed remobilisation phenomena of radionuclides in severe accidents, which have been identified as potential significant contributors based on analyses of the Fukushima Daiichi accident.

THAI and THEMIS (Thermal-hydraulics, Hydrogen, Aerosols and Iodine) projects to investigate the behaviour of hydrogen and fission products in the reactor containment based on experiments at the THAI and THAI+ facilities operated by Becker Technologies GmbH in Germany.

The HYMERES project (PANDA – PSI experimental facility, Switzerland) aims to improve the understanding of hydrogen burning phenomena and the functioning of the associated hydrogen mitigation systems.

The PRISME project (IRSN, France) addresses the issue of fire propagation in nuclear facilities, namely: heat and smoke propagation between rooms, including the effect of openings and ventilation systems, the resulting stresses to sensitive safety systems, fire propagation in complex systems, etc.

The HEAF project (NRC, USA) addresses electrical discharges referred to as High Energy Arc Faults (HEAF) that occur in shutdown components of nuclear power plants worldwide. The aim is to better understand the importance of specific variables such as bus bar material, operating voltage, current and arc duration, etc.

FIDES and its contribution to nuclear energy research in the Czech Republic

Following the recent closure of the Halden Research Reactor (HBWR), which was the main tool for research on nuclear fuels and materials within the Halden Reactor Project (HRP), the member organisations of this project initiated the development of the Framework for Irradiation Experiments (FIDES). FIDES differs from other OECD projects in that it does not have a fixed service provider ("operating agent") and primarily uses the irradiation capabilities of research reactors. The FIDES Governing Board selects which activities will be paid for from a common budget from a range of organisations within FIDES, and will try to balance the activities supported to cover all needs. The Czech Republic is represented by the UJV Group, specifically by the ÚJV Řež and Centrum výzkumu Řež.

The first three-year period of FIDES started in 2021 and thus kicked off the first so-called JEEPs (Joint ExpErimental Programmes). These projects cover the qualification of new fuel cladding materials under normal operating conditions ("INCA"), the safety of transients associated with

the load-follow mode of the NPP operation ("P2M") and limiting design basis accidents with loss of coolant ("LOCA-MIR") and reactivity injection – RIA in the TREAT reactor ("HERA").

The INCA (IN-pile Creep studies of ATF claddings) project, which is led by Centrum výzkumu Řež, s.r.o., is focused on the evaluation of the impact of the application of protective Cr and CrN layers on existing cladding alloys on their mechanical behaviour in the reactor, especially on the rate of radiation-induced creep. The main part of the project is to irradiate pressurized samples of several variants of cladding tubes in the LVR-15 reactor and to perform post-irradiation evaluation of these materials in hot cells.

Conclusion

Membership of the Czech Republic in the OECD/NEA is clearly positive, as this membership is a source of new knowledge and information that, in the absence of our own experimental facilities and with very limited funding for research and development, could not otherwise be obtained and thus keep pace with global developments.

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Miroslav Hrehor is a graduate of Czech Technical University – Faculty of Nuclear Sciences and Physical Engineering, Department of Nuclear Reactors. Since graduation in 1972, he has spent his professional life in the field of nuclear power engineering with a focus on nuclear safety. As a member of the team of nuclear safety inspectors of the Czechoslovak Atomic Energy Commission and later as Deputy Chairman of the State Office for Nuclear Safety (SUJB), he actively participated in the development of nuclear legislation and licensing of nuclear facilities. In 1999–2006, he worked as the first Czech delegate to the OECD Nuclear Energy Agency in Paris. From 2006 to 2011, he worked as the Scientific Secretary in ÚJV Řež. Since 2012 he was the Director of the Safety Research Section at Research Centre Řež. Currently he is the Deputy Director for Nuclear Safety at the National Radiation Protection Institute.

International cooperation under the auspices of the International Atomic Energy Agency

Ján Štuller[1], Jan Chára[2],
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[2] State Office for Nuclear Safety

International co-operation in the peaceful use of nuclear energy among the IAEA´s Member States provides the largest variety of opportunities worldwide from which the Czech Republic has been taking benefit for decades. The IAEA´s working platforms, services, publications and activities cover practically all segments of nuclear energy applications, from medicine, agriculture, water preservation, environment protection to industrial applications and energy. The article summarizes main areas of the international cooperation under the auspices of the IAEA and underlines specific results and interests important to the Czech Republic.

The International Atomic Energy Agency (IAEA) is the world's centre for international cooperation in the peaceful uses of nuclear energy. The IAEA currently has 173 Member States and their cooperation under the auspices of the IAEA has a wide range of different mechanisms and forms of multilateral cooperation to choose from.

To describe the various options for international cooperation, it is worth recalling at the outset that the main lines of IAEA activities are the safety of nuclear installations, radiation protection, security of nuclear and other radioactive materials, management of nuclear waste and spent nuclear fuel, emergency preparedness, nuclear applications in energy, health, agriculture and food, industry, water security and environmental protection (including the seas). The IAEA also plays an important role in nuclear science and research, operating, among other things, laboratories in Austria (Seibersdorf) and Monaco, and has a number of cooperation agreements with renowned scientific institutions in various parts of the world. A particular sector of activity, and one of the most important, is international safeguards in the field of nuclear non-proliferation.

The above-mentioned main lines of IAEA activities are also the main lines of international cooperation under the auspices of the IAEA. For each of these, the IAEA provides one of the following products, instruments or mechanisms for international cooperation:

1) Publications. These are for the most part free and freely available on the IAEA website. IAEA publications build on the existing state of knowledge and incorporate best existing practice and experience. In particular, they are international safety standards, which include Safety Fundamentals, Safety Requirements and Safety Guides. All IAEA Member States participate

in the development of the standards and make their best subject matter experts available for this purpose. The main advisory body to the IAEA Director General on safety standards is the so-called Safety Standards Commission (CSS). The prestigious post of the CSS Chair was held by the Chair of the State Office for Nuclear Safety (SÚJB), D. Drábová, from 2012 to 2019. The Czech Republic has representatives from among the experts of the SÚJB in all committees that prepare drafts of IAEA safety standards and their amendments.

Another part of the publications consists of scientific or technical publications (including technical reports and conference proceedings). IAEA recommendations also cover areas related to the necessary infrastructure for specific nuclear applications, the necessary legislative framework and human resources. With regard to nuclear publications in general, it is worth noting that the IAEA is the world's leading publisher of technical publications, with a total of over 9,000.

2) IAEA services in the form of assessment or advisory missions at the request of a Member State. These include, for example, IRRS missions to assess the regulatory framework in a given Member State, OSART missions to assess the operational safety of a specific nuclear power plant, specialised site evaluation missions to assess the safety of nuclear facilities (SEED), to assess emergency preparedness, optimal infrastructure for radiotherapy or nuclear medicine, radioactive waste management practices, security of nuclear materials and facilities (IPPAS), etc. The assessment teams are international in scope consisting of experienced experts in the field.

   The Czech Republic has already successfully completed a number of missions. The most recent IRRS mission in 2013 concluded, inter alia, that the system of nuclear safety and radiation protection regulation in the Czech Republic is robust and that the SÚJB is an effective and independent regulator, using experienced, technically competent and well-motivated staff. The next IRRS mission is scheduled for 2023. A number of other missions have been carried out in the Czech Republic in recent years, e.g., the SEED mission in 2013, and more recently the successful IPPAS mission in 2021. Other missions are planned for the coming years, such as the SEED mission in May 2022 or the IRRS mission mentioned above, which should precede the ARTEMIS mission in 2023, focusing on the safe management of spent fuel and radioactive waste.

3) Participation in IAEA courses. The IAEA organizes dozens of e-learning, online and face-to-face courses annually. In the area of nuclear security, for example, nearly 22,000 representatives of operators, nuclear safeguards, government agencies, academics and students from 170 IAEA Member States have completed e-learning programmes between 2010 and 2020. The IAEA has developed syllabi and standardised course programmes for virtually all areas of its activities. Attendance at IAEA face-to-face courses is usually possible by nomination by the IAEA National Coordinator for Cooperation with the IAEA, while access to e-courses is also possible directly with the knowledge of the National Coordinator. In the Czech Republic, this role is fulfilled by the SÚJB. On average, 30 Czech specialists are nominated annually for courses organised in the different areas of peaceful uses of nuclear technologies.

4) The opportunity to exchange information and experience at international technical meetings, workshops, seminars, webinars and conferences, where the number of participants varies from a few individuals to many dozens. The IAEA organises several dozens of events of this type each year, and participation is either completely open to the professional public or subject to nomination confirmed by the National Coordinator for Cooperation with the IAEA. Nominations for participation in these events are confirmed annually for approximately 140 Czech experts.

5) Opportunities to participate in international research programmes in collaboration with agency laboratories, or in collaboration with laboratories or research institutes in Member States. One of the functions of the IAEA is to promote research for the development and peaceful uses of nuclear

energy. Member States (and their research institutes) are therefore regularly invited by the IAEA Secretariat to participate in IAEA-coordinated research projects (so-called CRPs) under research, technical and doctoral contracts and agreements. Research institutions in Member States have the opportunity to propose R&D projects within the agreed themes. For each approved proposal, a research, technical or doctoral research contract or agreement is subsequently awarded to the institution assigned to carry out the specified work and the government of the Member State concerned is informed.

For the period 2020-2021, the following have participated and succeeded in international research programmes: ÚJV Řež with the project Economic Appraisal of Site Selection and Methodology for Multicriteria Evaluation of SMR Concept for Implementation of SMRs in the Czech Republic, as well as CTU/FJFI with the project Testing and Simulation for Advanced Technology and Accident Tolerant Fuels (ATF-TS) and Centrum výzkumu Řež with the project Measurement of Prompt Capture Gamma Coming from Chlorine and Iron Neutron Capture.

6) Possibility to participate in national and regional technical cooperation projects. Most States in Central and Eastern Europe (including the Czech Republic), Asia and Africa have the opportunity to use the mechanism of national and regional technical cooperation projects under the auspices of the IAEA to address specific national needs, based on the Framework National Profile agreed with the IAEA Secretariat and the Technical Cooperation Programme approved by the IAEA Board of Governors.

   Within the framework of the IAEA Technical Cooperation Programme, the Czech Republic actively participates in the preparation and implementation of the national project and regional projects in two-year cycles. The national project is normally focused on the development of human resources, with an emphasis on young experts who have the opportunity to undertake internships or short scientific trips or courses abroad. During the implementation of the regional projects, around 50 Czech specialists are nominated annually for seminars, courses and workshops, while internships and short scientific trips for foreign experts are also carried out; in the period before the COVID-19 pandemic, an average of 30 foreign experts were nominated annually.

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Ján Štuller graduated from the Czech Technical University in Prague – Faculty of Nuclear and Physical Engineering where he obtained the engineering degree in nuclear reactor theory and technology. His career for more than 35 years included design activities at Škoda Works in Plzeň, Czechoslovak Atomic Energy Commission field inspections at NPPs and in the workshops of the main Czech nuclear manufacturers, safety inspections, assessments and licensing of NPPs, Chairman role at the Czech nuclear regulatory authority (the State Office for Nuclear Safety), promotion of the use of nuclear energy applications in the IAEA Member States, diplomatic activities and coordination activities related to preparing building new nuclear power plants in the Czech Republic. At present, Mr. Štuller is active as a senior nuclear safety specialist in the National Institute for Radiation Protection in Prague.

Involvement of ÚJV Řež in shipments of spent nuclear fuel from research nuclear reactors

Josef Podlaha
ÚJV Řež

ÚJV Řež is significantly involved in the programme of spent nuclear fuel shipment from research nuclear reactors to the countries of origin. Within the framework of the Russian Research Reactor Fuel Return programme, spent fuel from the LVR-15 research reactor in Řež was shipped to Russia in 2007 and 2013. ÚJV Řež also participates in shipments of spent fuel from other countries. In total, ÚJV Řež participated in seventeen shipments from twelve countries. This is an indisputable contribution of Czechia to the global efforts to secure nuclear materials against misuse.

ÚJV Řež is significantly involved in the programme of spent nuclear fuel shipment from research nuclear reactors to the countries of origin. One of the goals of the Global Threat Reduction Initiative (GTRI) is reducing the global threat connected with use of highly enriched uranium (HEU) fuel in research nuclear reactors. The programme is carried out in cooperation with the USA, the International Atomic Energy Agency, the Russian Federation and China, and is primarily funded by the USA. A significant fact is the use of the Czech ŠKODA VPVR/M cask which was developed and produced by ŠKODA JS. Within the framework of the Russian Research Reactor Fuel Return (RRRFR) programme, spent fuel from the LVR-15 research reactor in Řež was shipped to Russia in 2007 and 2013. Non-irradiated fuel and other nuclear materials were also shipped from Czechia to Russia in the frame of the RRRFR programme.

ÚJV Řež also participates in shipments of spent fuel from other countries. In total, ÚJV Řež participated in seventeen shipments from twelve countries, when 3,328 kg of uranium were shipped, of which 713 kg of HEU. This is an indisputable contribution of Czechia to the global efforts to secure nuclear materials against misuse.

INTRODUCTION

In 2004, the US Global Threat Reduction Initiative (GTRI) was announced. Its mission is to reduce and protect vulnerable nuclear and radiological material located at civilian sites worldwide. One of its goals is to minimize the amount of available nuclear material that could

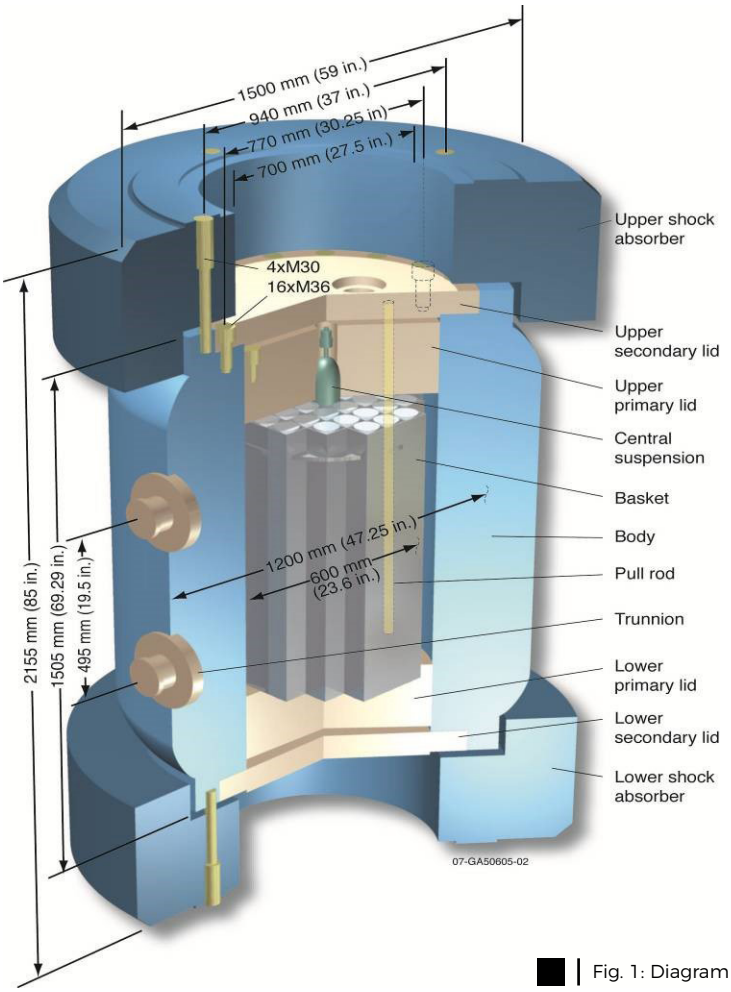

Fig. 1: Diagram of the ŠKODA VPVR/M cask

be used for nuclear weapons production. In the field of research nuclear reactors utilization, the programme aims at conversion of research reactors from highly enriched uranium (HEU) to low enriched uranium (LEU) fuel and eliminating stockpiles of HEU.

Research reactors use fuel with a higher enrichment of ^{235}U than that used in nuclear power plants. Fuel with enrichment of up to 90%, sometimes more than 90%, has been commonly used in research reactors. In order to avoid possible misuse of HEU, research reactors are converted to LEU with enrichment below 20%.

In 2004, the United States and the Russian Federation signed a government-to-government agreement concerning cooperation for the shipment of Russian-produced research reactor nuclear fuel to Russia (Russian Research Reactor Fuel Return (RRRFR) programme). Czechia joined the RRRFR programme immediately in 2004.

HEU spent nuclear fuel (SNF) is taken to Russia for reprocessing, non-irradiated HEU materials are downblended to LEU. The programme is implemented in cooperation among the participating countries and the US Department of Energy (US DOE), the Russian State Corporation ROSATOM, the International Atomic Energy Agency (IAEA) in Vienna and is primarily funded by the US DOE. Later, a similar programme was launched to ship irradiated fuel to China.

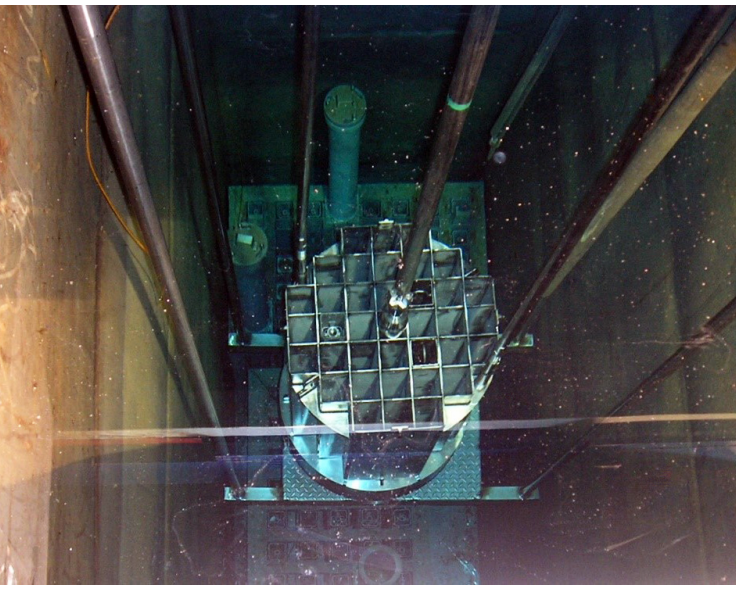

Fig. 2: ŠKODA VPVR/M basket in the SNF storage pool (LVR-15 reactor facility)

Fig. 3: ŠKODA VPVR/M cask fixed in ISO container

ŠKODA VPVR/M CASK

The ŠKODA VPVR/M cask was selected for transport of spent fuel under the RRRFR programme in addition to the Russian casks already in use. The cask succeeded in the IAEA tender in a strong competition with other renowned manufacturers. The ŠKODA VPVR/M cask was developed by ŠKODA JS with the support of the Czech Ministry of Industry and Trade in close cooperation with ÚJV Řež. It is a large-capacity B(U) and S type cask for transport and storage of SNF with a capacity of 36 fuel assemblies (FA). The unique design of the cask (see Fig. 1) with its ability to load FA from above and below allows easy use at almost any research reactor facility. Most commonly, the cask is loaded from the bottom, where a basket is lowered into the storage pool (see Fig. 2) and pulled back into the cask after loading.

The ŠKODA VPVR/M cask is type approved for road, rail, river and sea transport. The casks are fixed during transport in specially modified ISO containers (also of Czech design of DMS), see Fig. 3.

Sixteen ŠKODA casks have been fabricated in total, ten casks under the IAEA contract and six casks were financed by the Czech Ministry of Finance.

The Russian company SOSNY has developed the TUK-145/C Type C cask based on the ŠKODA VPVR/M cask. The Type C package is designed for transportation of radioactive material without any restrictions on activity through different transport modes, including air transport. It is a vertical cylinder made of two titanium halves with a flange joint and filled with hollow titanium spheres (see Fig. 4). The cask can withstand an aircraft crash without significant damage.

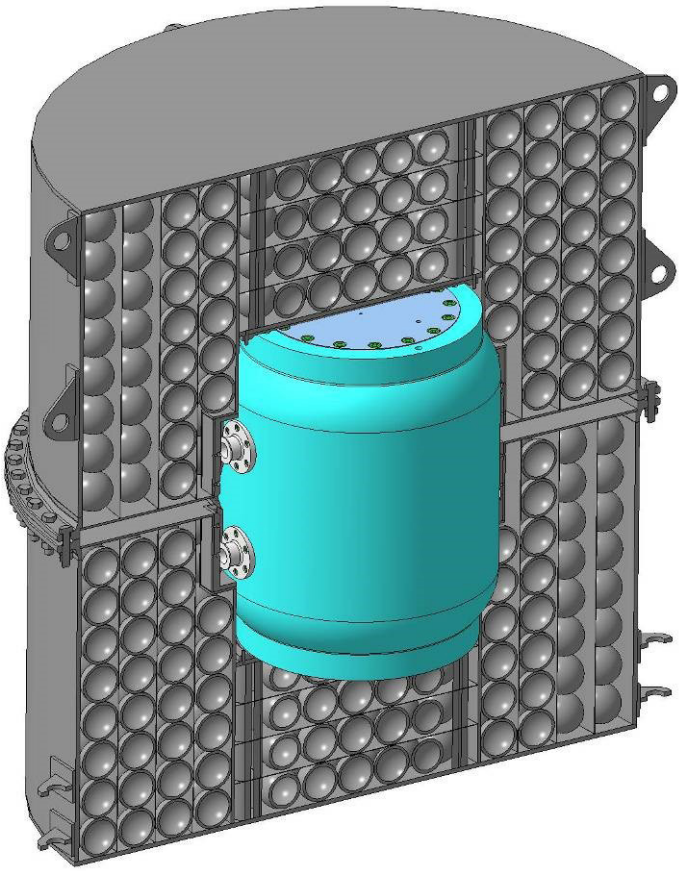

Fig. 4: Diagram of the TUK-145/C cask

SHIPMENT OF SNF FROM CZECHIA TO RUSSIA

The first SNF shipment from Czechia took place in 2007. It was a transportation of 568 FA in 16 ŠKODA casks to the Russian reprocessing plant in Mayak. It was the first time that HEU SNF from a research reactor had been sent to Russia from a European Union country. This was a combined road and rail transport via Czechia, Slovakia, Ukraine and Russia. The second SNF shipment of SNF took place in 2013 (112 FA in 6 casks). This was a combined road, rail and sea transport via Czechia, Poland and Russia. The shipments were financed by the US DOE, part of the costs was covered by the Czech Ministry of Finance. In total, 415 kg of uranium was shipped, of which 134 kg was HEU.

The preparation and implementation of the SNF shipment was a complex, legislative, administrative and technical task for all involved, including regulatory authorities, ministries, expert and transport organizations, police and emergency services. More than sixty bilateral and multilateral agreements, treaties, licenses, permits and certificates have been signed and issued to fulfil the terms of project implementation.

In addition to SNF, non-irradiated fuel and other nuclear materials were also shipped from Czechia. Currently, no HEU materials are present in the territory of Czechia. The LVR-15 research reactor operated by the Research Centre Řež was fully converted to LEU with enrichment of 20% in 2011. Figures 5, 6 and 7 show photographs of the second shipment from Czechia.

< Fig. 5: Rail SNF transport

v Fig. 6: Reloading of the ISO container with casks on a ship, Gdyna port, Poland

v v Fig. 7: Sea transport of SNF

SHIPMENTS OF SNF FROM OTHER COUNTRIES IN RRRFR PROGRAMME

ÚJV Řež also participates in shipments of SNF from other countries in the RRRFR programme. ÚJV Řež provides the equipment (ŠKODA casks and accessories) and its transport and maintenance, expert staff, training of personnel in cask use and technical oversight and expertise during the cask handling.

In 2008–2015, thirteen shipments from nine countries (Bulgaria, Hungary, Poland, Ukraine, Belarus, Serbia, Vietnam, Uzbekistan and Georgia) were successfully carried out with the ÚJV Řež support and a total of 2,911 kg of SNF was transported, including 572 kg of HEU.

Some of the shipments were different from others, such as the following:

- Leaky SNF was transported in canisters, which were loaded to the ŠKODA casks using a transfer cask from Serbia
- Transfer cask was used to load FA into the ŠKODA cask in Vietnam. It was the first air shipment of spent HEU fuel using the TUK-145/C cask.
- Spent liquid fuel was transported in canisters and a transfer cask was used for loading into the ŠKODA cask in Uzbekistan.

Photographs of selected transports are shown in Figures 08 and 09.

Fig. 8: Reloading of FA to ŠKODA VPVR/M cask in Dalat, Vietnam

Fig. 9: Preparation of ŠKODA VPVR/M cask for loading into TUK-145/C cask, air transportation from Uzbekistan

SHIPMENT OF IRRADIATED FUEL TO CHINA

ÚJV Řež is also involved in the project of shipment of irradiated HEU cores of the Miniature Neutron Source Reactors (MNSR) to China. These are Chinese-built pool-type research reactors with a power of 30 kW_t. The reactors have been installed in Ghana, Nigeria, Syria, Pakistan and Iran and use a compact core containing about 1 kg of uranium with enrichment of 90%. The reactors are then converted to fuel with 20% enrichment.

For the transport of the irradiated core, ŠKODA JS a.s. modified two ŠKODA VPVR/M casks to the ŠKODA MNSR casks (new cask baskets were fabricated). Russian specialists from SOSNY company have developed equipment for the removal of the irradiated core and a transfer cask to transfer the core to the ŠKODA cask. Irradiated cores are transported to China by air in the TUK-145/C-MNSR cask, which is based on the ŠKODA MNSR cask. A centre for training MNSR operators to remove irradiated HEU core and to load it in the TUK-145/C-MNSR cask has been built in Ghana. The equipment for shipments is also stored there.

In 2017, irradiated core was shipped from Ghana and in 2018 from Nigeria. The ÚJV Řež staff then participated in the unloading of irradiated cores at the China Institute of Atomic Energy in Beijing. The preparation of fuel shipments from other countries has been interrupted by the pandemic and political problems. The following pictures show photos of the implemented shipments.

SUMMARY OF SNF SHIPMENTS WITH PARTICIPATION OF ÚJV ŘEŽ

Table 1 summarizes all SNF shipments with involvement of ÚJV Řež. In total, ÚJV Řež participated in seventeen shipments from twelve countries when 3,328 kg of uranium were transported, of which 713 kg was HEU. The ŠKODA casks were used a total of one hundred and ten times and almost 3,600 FA were transported using these casks.

Fig. 10: Team of ÚJV Řež with the loaded ŠKODA MNSR cask in Accra, Ghana

Fig. 11: Loading of TUK-145/C-MNSR cask with irradiated core into an aircraft in Nigeria

PREPARATIONS FOR FORTHCOMING TRANSPORTS

Currently, a modification of the ŠKODA VPVR/M cask is being prepared for shipments of SNF from the MTR (Material Testing Reactor) and TRIGA research reactors. MTR reactors are research reactors with high power (tens of MWt) and high neutron flux. TRIGA reactors are research reactors with a power output most often between 0.1 and 2 MW_t.

ŠKODA JS a.s. is developing a universal basket for both fuel types with a capacity of 20 MTR FA and 80 TRIGA FA. This once again demonstrates the versatility of the ŠKODA cask for use with different types of SNF.

CONCLUSIONS

All SNF from the ÚJV Řež was transported to Russia in 2007 and 2013 under the RRRFR programme. In addition, fresh HEU fuel and other nuclear materials were transported out of Czechia. Czechia thus became one of the HEU free countries. ÚJV Řež is also involved in shipments of SNF from other countries to Russia and China. In total, ÚJV Řež has participated in seventeen shipments from twelve countries. The ŠKODA casks have been used a total of one hundred and ten times and almost 3,600 FA have been shipped using these casks. No accidents occurred during the transports and the ŠKODA cask proved its quality. Czechia is thus making a significant contribution to the global effort to secure nuclear materials against misuse.

Country (Facility)	Shipment date	No. of casks	No. of FA	Route
Czechia 1 (LVR-15)	2007	16	568	Road, rail
Bulgaria (IRT-2000)	2008	3	108	Road, rail, river
Hungary 1 (BRR)	2008	16	576	Road, rail, sea
Poland 1 (EWA)	2009	16	864	
Poland 2 (EWA)	2010	8		
Ukraine 1 (VVR-M)	2010	7	252	Road, rail
Belarus (PAMIR-630D, IRT-M)	2010	4	144	
Serbia (RA)	2010	16	576	Road, rail, sea
Ukraine 2 (VVR-M)	2012	4	98	Road, rail
Poland 6 (EWA)	2012	3	90	Road, rail, sea
Czechia 2 (LVR-15)	2013	6	112	
Vietnam (DNRR)	2013	1	36	Road, air, rail
Hungary 2 (BRR)	2013	6	144	
Uzbekistan (Foton)	2015	1	16*	
Georgia (Breeder-1)	2015	1	1**	Road, air
Ghana (GHARR-1)	2017	1	1**	
Nigeria (NIRR-1)	2018	1	1**	
Total		110	3,587	

Tab. 1: Summary of SNF shipments with participation of ÚJV Řež

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Graduate of the Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University of Prague (1996). After graduation he started working in ÚJV Řež, where he worked as a researcher in the field of decontamination and radioactive waste management, then as a head of the Centre of Radioactive Management and now he is a head of the Project Management Department in the Radioactive Waste and Decommissioning Division. He manages projects of shipment of spent fuel from research reactors and decommissioning projects. He is also involved in research and conceptual projects in the field of radioactive waste management.

International peer reviews to strengthen nuclear safety

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Nuclear Regulatory Authority of the Slovak Republic

The article summarises international instruments to support national regulatory activities, with emphasis on the use of international peer reviews in the Slovak Republic and the Czech Republic. Each state has the responsibility to establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations under its jurisdiction. International peer reviews, whether under international conventions (e.g., Convention on Nuclear Safety) or within EU legal framework (e.g., TPR) or conducted on a voluntary basis (e.g., IAEA OSART), are considered as an integral part of the regulatory framework. Several instruments exist which contain peer review mechanism named in different ways (Topical Peer Review, expert missions, Meeting of the Parties, Review Meeting) but the common objective for all these activities is to demonstrate the safe use of nuclear energy. Peer Reviews are an integral part of a transparent decision-making process and indicator of a good governance.

Introduction

The objective of nuclear safety is to provide for the protection of human beings and of the environment from the harmful effects of ionising radiation. The instruments to be used for executing this responsibility are in the hands of each state based on the generally recognised principle of national responsibility for nuclear safety. Each state has the responsibility to establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations under its jurisdiction. The regulatory framework is usually created by a system of legal instruments like acts of regulations, directives, decisions etc., which are enforced by a regulatory body. To support regulatory activities the regulatory authority may invite international expert missions on a voluntary basis which are offered by the IAEA, like the IRRS and OSART. The operator of a nuclear installation may also invite expert missions to assess the safety of the nuclear installation such as the missions offered by WANO. Within the EU, peer review became obligatory, as introduced by Directive 2009/71/Euratom.

Review of nuclear safety in EU candidate countries

A significant development in the use of expert advice in the EU was introduced in 1999 by the establishment of WENRA. One of the main objectives of WENRA at that time was to provide an independent capability to examine nuclear safety in applicant countries (at

that time 10 applicant countries out of which 5 operated nuclear power plants). This "peer review" exercise became mandatory for the acceding countries as part of their negotiating process. The reason behind was that the governments of the then EU Member States asked their regulators about the status of nuclear safety in applicant countries. To carry out this task the regulatory bodies of the then 15 EU Member States decided to join their efforts and to use their knowledge gained by bilateral co-operation with the applicant countries. The joint efforts resulted in two reports making a comparison between reactors licensed in the existing European Union and the reactors licensed in the applicant countries as well as the legal systems and the mandate and power of the nuclear regulators. The WENRA reports were used for the preparation of the report on nuclear safety in applicant countries issued by the Working Party on Nuclear Safety (WPNS) under the Atomic Questions Group of the European Council. The result of the WPNS report were expressed as recommendations in the accession negotiations for the new members to the European Union. The countries acceding, in agreement with the accession negotiations, had to take adequate measures to comply with the recommendations. This approach was also used in the negotiating process for the two new EU Member States in 2007.

International peer review of regulatory framework

In the past, self-assessments have been carried out in Member States in close connection with international peer reviews under the auspices of the IAEA as International Regulatory Review Team and later as Integrated Regulatory Review Service missions. These self-assessments were carried out and missions were invited by Member States on a voluntary basis in the spirit of openness and transparency.

The EU Directive 2009/71/Euratom establishing a community framework for the nuclear safety of nuclear installations introduced in 2009 was a new and by its content a revolutionary development. It was the first legally binding directive in the area of nuclear safety in the EU. Negotiations on the text were completed during the Czech presidency. The directive made mandatory for the Member States at least every 10 years to arrange for periodic self-assessments of their national framework and competent regulatory authorities and invite an international peer review of relevant segments of their national framework and/or authorities with the aim of continuously improving nuclear safety. An important statement contained in the preamble is that "... the self-assessments followed by international peer reviews are neither an inspection nor an audit, but a mutual learning mechanism that accepts different approaches to the organisation and practices of a competent regulatory authority, while considering regulatory, technical and policy issues of a Member State that contribute to ensuring a strong nuclear safety regime. The international peer reviews should be regarded as an opportunity to exchange professional experience and to share lessons learned and good practices in an open and cooperative spirit through advice by peers rather than control or judgement. Recognising a need for flexibility and appropriateness in regard to different existing systems in Member States, a Member State should be free to determine the segments of its system being subject to the specific peer review invited, with the aim of continuously improving nuclear safety." This statement is a self-explanatory statement emphasising the objective of (any) peer review which is mutual cooperation, exchange if information and confirming that peer reviews have not a nature of a supranational regulatory exercise.

Tab. 1: IRRT and IRRS in SK and CZ

CZ	2000*	2001*	2013	2017 (follow up)	2023**	2026**
SK	1998*	2002*	2012	2015 (follow up)	2022	2025 (follow up)

*International Regulatory Review Team (IRRT), ** Tentative dates

These missions identified a number of good practices and made recommendations and suggestions where improvements would enhance the effectiveness of the regulatory framework and functions in line with the IAEA Safety Standards. To respond to these findings National Action Plans have been developed by the national regulatory authorities (ÚJD, SÚJB). The purpose of the IRRS follow-up missions was to review the measures undertaken following the recommendations and suggestions of the IRRS Mission.

Stress tests and safety and risk assessment and their peer review

Following the severe accident at the Fukushima Dai-ichi NPP on 11 March 2011, the European Council of 24/25 March 2011 requested that a comprehensive safety and risk assessment, in light of preliminary lessons learned, be performed on all EU nuclear plants. The request of the Council included "stress tests" performed at national level complemented by a European peer review. This was the first time that such a multilateral exercise covering over 140 reactors in all EU countries operating nuclear power plants was conducted. The Council invited the European Nuclear Safety Regulators Group (ENSREG) and the European Commission to develop the scope and modalities for the stress tests with the support of the Western European Nuclear Regulators' Association (WENRA).

The safety track of the stress tests and peer review focused on three topics: natural initiating events, including earthquake, tsunami and extreme weather, the loss of safety systems and severe accident management were the main topics for review. The stress tests and peer review assessed these topics in a three-step process. The first step required the operators to perform an assessment and make proposals for safety improvements. During the second step, national regulators performed an independent review of the operators' assessments. The last step was a European level peer review of the national reports submitted by regulators. The objectives of the peer review were to assess the compliance of the stress tests with the ENSREG specifications, to check that no important problem has been overlooked and to identify strong features, weaknesses and relevant proposals to increase plant robustness in light of the preliminary lessons learned from the Fukushima disaster.

In March 2012, a series of country reviews began. Each participating country including Slovakia and the Czech Republic was visited by a team of reviewers for a few days. Complementary discussions were held in order to obtain appropriate answers to the questions left open after the topical review as well as clarification on important issues. A plant selected by the review team was also visited in each country. In Slovakia it was the Mochovce 1&2 nuclear power plant and in the Czech Republic Temelín NPP.

The peer review concluded that all countries have taken significant steps to improve the safety of their plants, with varying degrees of practical implementation. The peer review demonstrated the positive contribution of periodic safety reviews as an efficient tool to maintain and improve the safety and robustness of plants.

The European Council in June 2012 invited Member States to ensure the full and timely implementation of the findings from the stress test. Countries which have been subject to the stress test and of the peer review developed action plans to respond to the findings. These action plans were subject to peer review. The first peer review workshop took place in 2013, followed by a workshop in 2015. Since then the National Action Plans are updated in biannual intervals until all actions contained in the action plans are completed. As of the end of 2021, altogether there are less than 20 ongoing actions, in 7 countries. The schedule is such that most of them should be finalized by the end of 2022, with a few extending to 2023 or 2024. In Slovakia only

one action on seismic reinforcement of Mochovce 1&2 is still ongoing with a deadline end 2022. In the Czech Republic the only ongoing action is aimed at implementation of measures for maintaining long-term containment integrity in the Temelín NPP, which is scheduled to be completed by the end of 2024.

Topical Peer Review – TPR

As a consequence of the Fukushima accident, the European Council also called on the European Commission to review as appropriate the existing legal framework for the safety of nuclear installation and to propose any improvements that may be necessary. The Commission presented in June 2013 a proposal to amend, strengthen and supplement the Nuclear Safety Directive. For this purpose, the proposal introduced inter alia a six-year topical peer reviews, where the Member States together select one or more specific topics related to nuclear safety and jointly carry out the peer reviews. This new peer review mechanism was introduced based on the experience with the post Fukushima stress test. After a period of lengthy negotiations, the directive was adopted and published as Directive 2014/87/Euratom. Unlike the stress tests, national assessments, which are subject to topical peer reviews, focus each time on different specific technical safety aspects.

The first TPR took place from 2017 to 2018 and its topic was ageing management of nuclear power plants and research reactors with a power output above $1MW_t$.

Similar to the stress tests the process for the first TPR on ageing comprised three phases:

i. National assessment – performed by Member States according to a technical specification prepared by WENRA
ii. Peer Review – including a peer review workshop and publication of a summary report setting out overall findings and ENSREG's proposed follow-up activities.
iii. Follow-Up – definition and implementation of measures to address relevant findings from national assessment and peer review process including the preparation of national action plans.

The main conclusion of the first topical peer review was that Ageing Management Programmes exist in all countries for Nuclear Power Plants. In all countries, regulation of the Ageing Management Programmes is in line with the IAEA Safety Standards and WENRA Safety Reference Levels on ageing management. The review did not identify any major deficiencies in European approaches to regulate and implement Ageing Management Programmes at Nuclear Power Plants. However, this is not the situation for Research Reactors. Ageing Management Programmes are neither regulated nor implemented as systematically and comprehensively, and therefore require further attention from both regulators and licensees. These findings for which further actions were necessary were therefore included in their national action plans. For example, the peer review identified 3 actions for Slovakia and 1 for the Czech Republic which were included into the action plan.

In 2020, ENSREG started preparatory works for the second topical peer review focusing on fire safety of nuclear installations. In many aspects the second TPR will differ significantly from the first one. Firstly, it's the scope covering not only nuclear power plants under construction, operation and decommissioning and research reactors but also fuel cycle facilities and waste storage facilities. The process is also strengthened by introducing in addition to thematic sessions also country group sessions and site visits for selected nuclear installations. The thematic sessions and country group sessions will require in comparison with the first TPR an extension of the duration of the peer review workshop. The newly introduced site visits, a model, which has been implemented during the stress tests, represents also a significant

and substantial challenge for the participating countries, especially for countries with nuclear installations that are subject to the peer review. By introducing these additional peer review elements, an impression may evolve that the EU tries to follow IAEA practices in conducting peer reviews (like OSART missions) in combination with peer review mechanism of the Convention on Nuclear Safety.

The Convention on Nuclear Safety – CNS

The Convention on Nuclear Safety – CNS entered into force in 1996. The objectives of the Convention are to achieve and maintain a high level of nuclear safety worldwide, to establish and maintain effective defences in nuclear installations against potential radiological hazards in order to protect individuals, society and the environment from harmful effects of ionizing radiation from such installations, and to prevent accidents with radiological consequences and to mitigate such consequences should they occur.

The obligations of the Contracting Parties cover inter alia the legislative and regulatory framework, the regulatory body, and technical safety obligations related to siting, design, construction and operation of nuclear installations, the availability of adequate financial and human resources, the assessment and verification of safety, quality assurance and emergency preparedness.

The Contracting Parties are required to submit reports on the implementation of their obligations under the Convention for peer review at periodic meetings. The process of presenting the National Report at the Review Meeting and answering questions from the other Contracting Parties is a tool to help the Contracting Parties to achieve a high level of safety in its civil nuclear programme and to promote a high level of nuclear safety worldwide. This peer review process is the main innovative and dynamic element of the CNS.

Until now, 7 regular Review Meetings (the 8th was postponed due to the pandemic situation) and two extraordinary review meetings (one of which after Fukushima) took place. The main elements of the peer review are:

i. Self assessment and preparation of the national report
ii. Questions and answers on the national report
iii. Peer review of the national report during Review Meetings
iv. Follow up actions

This model served as a model for peer reviews during the EU stress tests and during the EU TPRs.

During the self assessment and during the peer review of each national report, findings (good practices, good performance, suggestions, challenges) are identified. As a follow up measure, each contracting party reports in the subsequent national report on measures taken to implement identified suggestions and challenges. In addition, the Review Meetings identify areas of common interest for all contracting parties. For example, the 7th Review meeting identified for Slovakia two (2) challenges and identified 9 areas of common interest (like safety culture, independence of the regulator etc.). Then the national report of Slovakia for the 8th Review Meeting reported on actions taken to implement these challenges and areas of common interest. All national reports of Slovakia are available on the regulator´s web page including answers to questions raised by other contracting parties (www.ujd.gov.sk). The same mechanism of peer review is implemented under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. In both conventions there is no enforcement mechanism. These conventions are incentive conventions encouraging Contracting Parties to cooperate with the aim to enhance safety world vide.

Peer review by the public

Other international conventions: like the Aarhus Convention (Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters) offer to the public to actively participate on the decision-making process. The convention has three Pillars:

i. Access to information: public authorities must provide all the information required and collect and disseminate it in a timely and transparent manner (they can refuse under particular situations (such as national security)
ii. Public participation in decision making: the public must be informed on all the relevant projects and it has to have the chance to participate during the decision-making and legislative process. Decision makers can take advantage from people's knowledge and expertise; this contribution is a strong opportunity to improve the quality of the environmental decisions
iii. Access to justice: the public has the right to judicial or administrative recourse procedures in case a Party violates or fails to adhere to environmental law and the convention's principles

In 2003, two EU Directives concerning the first and second "pillars" of the Aarhus Convention were adopted; Directive 2003/4/EC on public access to environmental information and Directive 2003/35/EC providing for public participation. (Com.: regarding access to environmental information, the Aarhus Regulation (EC) No 1367/2006 extends Regulation (EC) No 1049/2001 regarding public access to European Parliament, Council and Commission documents to all Union institutions and bodies).

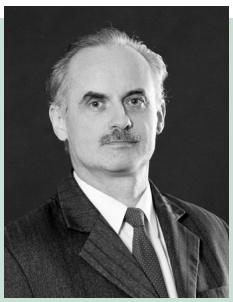
The Arhus Convention is not only an environmental agreement, it is also a convention about government accountability, transparency and responsiveness. It grants the public rights and imposes on Parties and public authorities' obligations regarding access to information and public participation and access to justice. Although the convention is not explicitly mentioning a peer review of the decision making process by actively participating in the decision making process, it could be seen as a kind of peer review of the decisions taken by national authorities, thereby contributing to transparency and good governance in the interest of stakeholders. Like the CNS the Arhus Convention has also a Compliance Review Mechanism. The difference is that in case of the CNS it is the Review Meeting of Contracting Parties and non-compliances are identified only by Contracting Parties and decisions are taken by consensus whereas the Arhus Convention allows in addition to (Contracting) Parties also members of the public to communicate concerns about a Party's compliance directly to the so-called Compliance Committee. The findings (e.g., non-compliance) are submitted by the Compliance Committee to the Meeting of the (Contracting) Parties which adopts a decision by consensus or by a simple majority. Slovakia´s experience with access to information is that in 2017 Meeting of Parties based on the findings of the Compliance Committee adopted Decision VI/8i stating that Slovakia has failed to comply with relevant articles of the Convention and requested Slovakia to submit to the Committee detailed progress reports in 2018, 2019 and 2020 on the measures taken and the results achieved in taking the necessary legislative, regulatory and administrative measures and practical arrangements to ensure that when providing access to nuclear-related information any grounds for refusal are interpreted in a restrictive way and taking into account the public interest served by disclosure and whether the information requested relates to emissions into the environment. Following the submitted reports the Meeting of Parties in 2021 approved the report of the Compliance Committee stating that the Committee welcomes the constructive engagement of the Party (Slovakia) concerned and the quality of its reporting throughout the intersessional period, which the Committee considers may serve as a model for other Parties. The Committee finds that the Party concerned has met the requirements of paragraph 2 of decision VI/8i.

The Espoo (EIA) Convention (Convention on Environmental Impact Assessment in a Transboundary Context) sets out the obligations of Parties to assess the environmental impact of certain activities at an early stage of planning. In addition it also lays down the general obligation of states to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries (transboundary impact assessment). Each Party shall take the necessary legal, administrative or other measures to implement the provisions of this Convention, including, with respect to proposed activities (like nuclear) that are likely to cause significant adverse transboundary impact, the establishment of an environmental impact assessment procedure that permits public participation and preparation of the environmental impact assessment documentation. This provision is a kind of peer review of the safety of the proposed activity and its impact on the environment by the public and by the state authorities. In December 2020, the Meeting of the Parties adopted the Guidance on the applicability of the Convention to the lifetime extension of nuclear power plants and to support the Convention's Implementation Committee in its deliberations on the numerous related compliance cases. The Implementation Committee's objective is to review compliance by the Parties with their obligations under the Convention with a view to assisting them fully to meet their commitments.

Conclusion

It is a generally recognised principle that nuclear safety is a national responsibility. Each state has the responsibility to establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations under its jurisdiction. International peer reviews, whether under international conventions (e.g., Convention on Nuclear Safety or within EU legal framework (e.g., TPR) or conducted on a voluntary basis (e.g., IAEA OSART), are considered as an integral part of the regulatory framework. Several instruments exist which contain peer review mechanism named in different ways (Topical Peer Review, expert missions, Meeting of the Parties, Review Meeting) but the common objective for all these activities is to demonstrate the safe use of nuclear energy. Peer Reviews are an integral part of a transparent decision-making process and indicator of a good governance.

The author would like to thank Mr. Jan Chára from SÚJB for his contributions.



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Mr. Turner is in his position responsible for wide and diverse regulatory activities: legal affairs, emergency preparedness, technical support and international relations. Mr. Turner graduated at the Commenius University in Bratislava as nuclear physicist in 1981. After the study he worked at different research institutes and at the utility Slovenske elektrárne in the field of nuclear fuel cycle. Mr. Turner was/is member of different expert groups and policy making organs of the IAEA, OECD/NEA and of the EU Council. He was advisor to the three Governors of Slovakia and later to the Chair of the Board of Governors to the IAEA. During Slovakia's presidency of the EU Council he chaired the Expert Group on Atomic Questions. Since 2015 he is advisor to Slovakia's representative in the IAEA Commission on Safety Standards. During 2017–2018, Mr. Turner was the Project Manager of the so-called Topical Peer Review in the EU for the Ageing Management Programmes.

A wide-ranging discussion on the opportunities and risks of nuclear energy - European Nuclear Energy Forum

Jan Prášil
Ministry of Industry and Trade of the Czech Republic

The European Council initiated the creation of the European Nuclear Energy Forum in March 2007 as a tool for a broad discussion among all relevant stakeholders on the opportunities and risks of nuclear energy. Since November 2007, a plenary co-organized by Czech and Slovak governments, has been held regularly in Bratislava and Prague. The European Commission used to organize Working Groups on Opportunities, Risks and Transparency and reports used to be published. Currently, the European Commission and Czech and Slovak governments look for a new involvement of Non-Governmental Organizations.

The Russia-Ukraine war has shown how important the supply from stable energy sources such as nuclear power plants is for the EU's energy security. Following the taxonomy and the setting of criteria for the sustainability of nuclear energy, there is a need to re-open nuclear energy issues in the context of the Green Deal for Europe and the European Strategic Energy Technology Plan.

In addition, the EU faces today the fundamental challenge of securing clean affordable energy supplies. Coal capacity is being shut down across the EU, increasing the demand for gas and, with progressive electrification, placing even greater demands on the saturation of clean energy demand. At the same time, significant low-carbon nuclear capacity in Germany is shutting down. It should also be considered that climate change increases the volatility of actual electricity generation from renewables. In addition to the security of supply issues, we now face unprecedented high energy prices. The issue of securing energy demand at affordable prices thus becomes a neuralgic point for gaining public and industrial support

for climate neutrality. In this context, we need to make efficient use of all low-carbon sources, including natural gas and nuclear energy, and it was conventional sources whose inertia helped resolve the recent emergencies in the EU energy system. Open and transparent discussions on nuclear energy and its place in the energy mix are needed.

In November, the 15th meeting of the European Nuclear Energy Forum (ENEF) will take place in Prague. Both, the Czech and Slovak Republics, have declared their interest to involve the broadest possible range of stakeholders in this discussion and to open up new topics such as non-energy uses of nuclear energy. This opinion was declared in the European Commission's preparatory committee.

The European Council initiated its creation in March 2007, when Member States took note of the Commission's assessment of the contribution of nuclear energy in response to growing concerns about the security of energy supply and reduction of CO_2 emissions while ensuring the crucial role of nuclear safety in the decision-making process. Furthermore, it proposed that a broad discussion be held among all relevant stakeholders on the opportunities and risks associated with nuclear energy. Such discussions created the ENEF platform, which included representatives of European institutions, countries, industry and civil society. On that occasion, European Commission President J. M. Barroso confirmed that the Commission is ready and willing to help launch a transparent debate on nuclear energy and ensure that the public receives relevant and reliable information on the various options available. Since November 2007, a conference has been held regularly in Bratislava and Prague. It was alternating between the two, except for the past two years when the coronavirus did not allow a physical meeting. In the first years, the conference was held twice a year.

Technology platforms were also established in 2007, including the Sustainable Nuclear Energy Technology Platform (SNETP), which has been operating as an international non-profit association under Belgian law since 2019. ENEF has also changed fundamentally since then. In 2012, environmental organisations Greenpeace, Friends of the Earth and Sortir du nucléaire left the platform, considering the industry's representation in ENEF disproportionate, the NGOs' views were undervalued and the opening speeches of the Slovak and Czech prime ministers unbalanced and pro-nuclear. The Greenpeace representative Jan Haverkamp expressed that he saw no reason why European taxpayers should help fund a nuclear propaganda machine. After Nuclear Transparency Watch (NTW) and the European Environmental Bureau (EEB) joined ENEF on behalf of environmental organisations in 2015, the European Commission changed. The Risk, Opportunities and Transparency working groups were established at the first meeting in Bratislava stopped meeting regularly. These issued final reports based on a wide-ranging discussion, for example, on the guidelines for establishing and reporting national programmes that the Member States were drawing up under the Directive on a Community framework for the responsible and safe management of spent fuel radioactive waste. They have also been involved in the activities of other working groups, e.g., in the form of joint workshops with the ERDO working group to support small countries in reporting under the above Directive. This has virtually halted preparations for the vision that the Commission declared at the joint working group meeting in Luxembourg in December 2013 – the prospect of building up to 100 new Generation III reactors by 2050. And ENEF has been reduced to a conference platform.

Central to the further discussion was the publication of Prof. William D'haeseleer's Synthesis on the Economics of Nuclear Energy. The European Commission prepared its latest Nuclear Illustrative Programme (PINC) in 2016, based on Article 40 of the Euratom Treaty, to be submitted regularly. In addition, the long-term strategies developed by the individual states were prepared based on the Energy Union Governance Regulation. And last but not least,

the European long-term strategic vision for a prosperous, modern, competitive and climate-neutral economy, in which the European Commission has declared a share of more than 80% of electricity from renewable energy sources by 2050, which, together with a nuclear share of around 15%, should form the backbone of a carbon-free European energy system.

After the newly represented NGOs achieved a change in the format of the ENEF conference, a participatory "world café" discussion was held in Prague in 2019, during which participants divided into groups shared experiences and opinions and sought answers to pre-defined questions. However, following a letter from December 2018, the NGOs again left ENEF, pointing out that ENEF was not fulfilling its mandate. In negotiations with representatives of the Slovak and Czech ministries and the European Commission, they refused to participate in the preparations for this year's edition, arguing that they had no guarantee of unbiased content. On the other hand, the European alliance weCARE, promoting an all-encompassing low-carbon energy mix, has expressed interest in participating in ENEF. Both, the Czech and Slovak Republics, sought to involve NGOs to guarantee the broad discussion mandated by the European Council, but NTW and EEB declined to participate in ENEF but appreciated the approach and setting of the "world cafés" discussions sought. However, most participants were not enthusiastic about this format, as the discussion narrowed down to advocating and explaining the basic principles of nuclear energy to opponents of nuclear power. ENEF's mission should go further. The openness of ENEF as a platform for a broad discussion of all relevant stakeholders thus remains a challenge for the preparations of the next edition, which will take place in Bratislava.

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Research Centre Řež activities

within JHR consortium

Marek Mikloš
Research Centre Řež

The JHR (Jules Horowitz Reactor) Material Test Reactor is a high-performance material test reactor designed to generate up to 100 MW_th. Once commissioned, this unique experimental irradiation tool in Europe will not only be available to the nuclear industry and research organizations, but also to nuclear safety authorities and their technical support bodies. CVŘ is playing important role in the JHR Consortium since very beginning by its in-kind contribution (Hot cells delivery), as well as active role in the governing of the project and its future utilization for Czech nuclear R&D.

INTRODUCTION

In early 2000, the European Framework Programme called FEUNMARR for FUTURE NEEDS FOR MATERIAL TEST REACTORS IN EUROPE was launched to investigate the European material testing reactors (MTRs) situation. Main conclusions were that European MTRs gave essential support for nuclear power programmes over the last 40–50 years and that the ageing fleet lead to the following (European Conference FISA 2003): "There is a strategic need to renew MTRs in Europe… A decision to build a first new MTR is required in a very near future… This new MTR should establish robust technical links with current MTRs".

Following this conclusion, the position of the French Government (for CEA) and the two main stakeholders (EDF and AREVA) was to set-up a European and International Consortium for funding and steering the Julles Horowitz Reactor (JHR) Project and this is exactly what has been done. It is important to quote, that the JHR since the beginning has been identified within the ESFRI (European Strategic Forum Research Infrastructure) roadmap as a key infrastructure in this domain.

The Czech Republic has participated in the preparatory stage of JHR since its inception and has continued to get involved also in the construction of JHR. In 2008, the Ministry of Education granted a support for the period of 45 months for the preparatory stage of the project funded within the 7th Framework Programme for Research and Technological

Development. JHR is a part both of the Roadmap of ESFRI and the Roadmap of the Czech Republic of large infrastructures for research, experimental development and innovations. Due to that, and thanks to a good reputation of researchers and designers of Centrum výzkumu Řež (hereinafter referred to as CVŘ) the Czech Republic has acquired the possibility to deliver to the construction stage of JHR its important part, the hot cells. In exchange for the supply of hot cells, the Czech Republic has got the access to the research capacity of 2% JHR, later increased by the effort of CVŘ up to 3%.

IN-KIND CONTRIBUTION OF CZECH REPUBLIC TO JHR CONSORTIUM

The JHR is currently under construction on the Cadarache site in southern France and is based on a 100 MW_th compact core pool reactor cooled by a slightly pressurized primary circuit. The core tank is located in the reactor pool. The nuclear facility comprises a reactor building with all equipment dedicated to the reactor and experimental devices and an auxiliary building dedicated to tasks in support for reactor and experimental devices operation (Figure 1). The design of the reactor provides irradiation locations situated inside the reactor core with the highest ageing rate and irradiation locations situated in the Beryllium reflector zone surrounding the reactor, with the highest thermal flux.

Regarding the construction of JHR based facilities, including hot-cells, which is in CVŘ's responsibility, several key milestones were met within last few years. During 2016, the completion of civil works of the hot cells was reached. In 2018, CVŘ finalized the stainless-steel liner including successful leak tightens tests, installation of rotating and sliding doors of the cells and more importantly installation of biological shielded doors in canals located below the hot cells. One of the most important devices – special radiation and seismic resistant handling equipment was successfully tested in factory (FAT) during autumn 2020. Last but not least, past major milestones was reached in November 2020, when reactor block was successfully installed in the reactor pool.

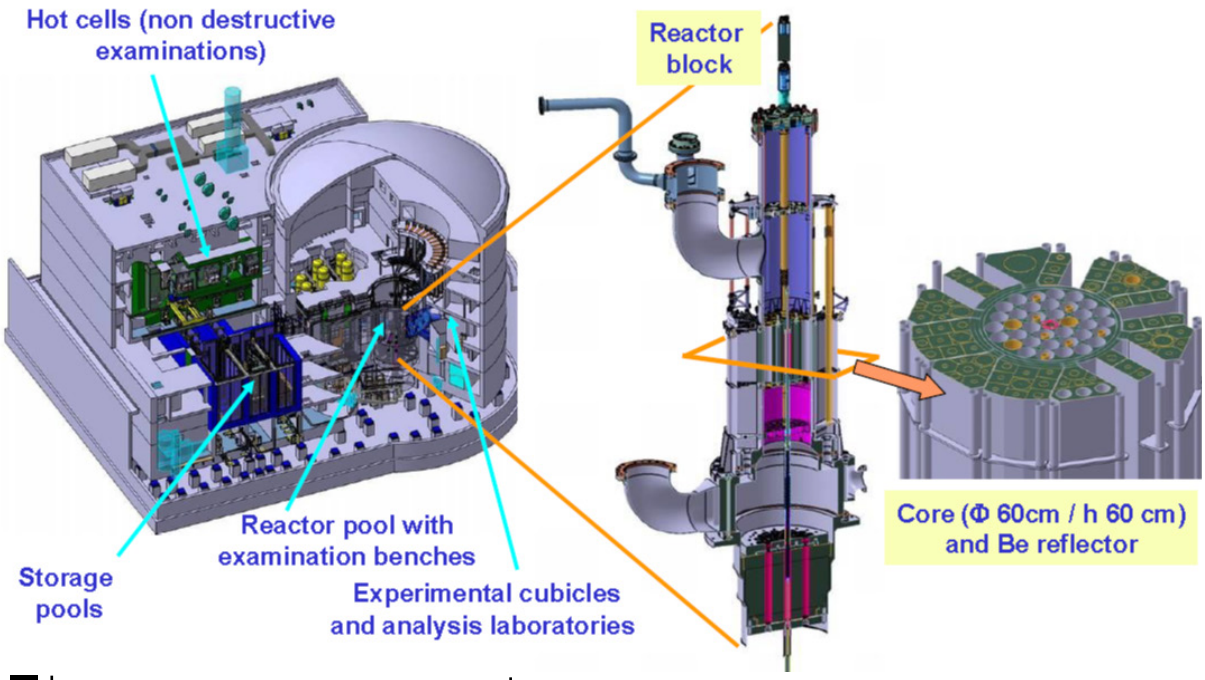

Fig. 1: Views of JHR facility and the reactor core

Fig. 2: Reactor building – concreting completed

Fig. 3: Rough construction works – hot cells

CURRENT ACTIVITIES OF JHR CONSORTIUM

To support the experimental use of the JHR reactor, three working groups (WG) have been established in the past (on Fuel, Materials and Technology). This groups consist of highly skilled scientists and managers from JHR consortium member organizations, with the role of identifying R&D needs in a broad panel. CVŘ is actively participating in all WGs, including leading of the Fuel WG. One of the main objectives of the WG's is to prepare the first "pre-JHR" International Joint Programmes using European RRs currently in operation. For this purpose, three main projects were prepared and introduced to the scientific nuclear community as well as to the industry.

The first project is denominated JHOP-2040 (Jules Horowitz Operational Plan 2040), which is a currently running project under European Commission funding (NFRP-16: Roadmap for Use of Euratom Access Rights to Jules Horowitz Reactor Experimental Capacity) and CVŘ is one of the consortia partner. The second project has an experimental basis and is called Power to Melt and Manoeuvrability (P2M). The aim is to reach incipient fuel melting at the end of long-lasting power transients in order to assess actual operational margins. The third project is called In-pile Creep Studies of ATF Claddings (INCA), launched by CVŘ, and is oriented on performing in-reactor tests focusing on the assessment of irradiation induced cladding creep, which has a significant impact on reliable and safe fuel rods performance, to study the creep properties of advanced cladding materials (standard, optimized Zr alloys and ATF). In addition, within INCA project, 2 irradiation devices (OKaP and MeLoDIE) will be qualified for further use at JHR reactor.

Fig. 4: Rotating doors – installation phase

Due to participation in the JHR consortium, CVŘ's representatives are involved in the governing board (GB) of JHR. JHR GB is deciding not only about 4–year Reference Operational Plan (ROP), but also about all type of projects planned for scientific or other purposes. ROP is carefully prepared by International Advisory Group (IAG), with CVŘ involvement, and discussed with all Working Groups. Participation in JHR consortium with up to 3% contribution of the construction cost, will consequently lead to up 3% of guaranteed access to JHR experimental capability for Czech Republic and voting rights in the JHR Consortium. This means, that Czech Republic has the right to decide about the future scientific goals and experiments at its own JHR-based part of infrastructure.

Marek Mikloš, PhD

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Marek Mikloš finished his PhD in 2008 in the field of nuclear fuel degradation and root cause analyses at Slovak Technical University in Bratislava. He continued in ÚJV Řež as a research scientist dealing with nuclear fuels and cladding behaviour studies. During 2013 and 2017, several important new facilities under project Sustainable Energy (SUSEN) were commissioned. Currently, his position as a business development manager includes close working with the customers to fulfill their needs in combination with CVŘ's research facilities. He is also leading Fuel Working Group within JHR consortium, where he is involved in preparation of future utilization of JHR reactor, as well as in preparation of international projects oriented on nuclear fuel and cladding studies.

Joint Institute for Nuclear Research

Karel Katovský[1], Ivan Štekl[2]
[1] Brno University of Technology
[2] Czech Technical University in Prague

The Joint Institute for Nuclear Research at Dubna is an international intergovernmental scientific institute with 19 member countries and with 4 countries as associate members states. The institute consists of seven laboratories and employs more than 5,000 people. The research focus of the institute is multidisciplinary and includes theoretical and experimental investigation in the field of nuclear and particle physics, neutron or neutrino physics, radiobiology, radiochemistry, computer technology, and many others. The institute is the world's best known for its research aimed at studying superheavy elements, for its unique accelerators, pulsed nuclear reactors, and discovery of new elementary particle Antisigma minus hyperon.

When we were asked by the editors of the Jaderná energie magazine at the beginning of 2022 for preparing an article about the JINR Dubna, we could not even imagine the circumstances under which it would arise. We all constantly read that we must be prepared for rapid social change, but we could not realize what this means and how quickly and easily it is possible to destroy the long-term efforts of many talented and hard-working people. The arrogance of power always leads to mistakes and sometimes even to crimes. And if one is surrounded by people with the same opinion, he repeats these mistakes constantly.

The Joint Institute for Nuclear Research is an international intergovernmental scientific institute with 19 member countries (Egypt joined the institute in 2021 and Serbia plans to join next year) and 4 countries have the status of associate members of the institute now. The institute

Fig. 1: The main office building of JINR (source: Joint Institute for Nuclear Research, www.jinr.ru)

consists of seven laboratories and employs more than 5,000 people. About 1,200 of them are researchers and 2,100 are technicians and engineers. The contributions of the member states in 2022 amount to USD 215 million, of which the Czech Republic pays USD 5.6 million.

The research focus of the institute is multidisciplinary and includes theoretical and experimental investigation in the field of nuclear and particle physics, neutron or neutrino physics, radiobiology, radiochemistry, computer technology; it also focuses on the development of particle accelerators, applications in the field of natural sciences (e.g., hadron therapy, development of radiopharmaceuticals) or nanotechnologies.

The JINR was established near the junction of the Volga and Dubna rivers close to the Volga–Moscow channel on March 26, 1956 as a joint initiative of 11 founding countries. The founding member of the JINR was also Czechoslovakia, which was represented in the first

Fig. 2: Nobel Prize in physics was awarder to I. M. Frank, jointly with P. A. Cherenkov, 1958 (source: Joint Institute for Nuclear Research, www.jinr.ru)

board of directors of the institute by the founder of the Czech School of Elementary Particle Physics and Quantum Physics, prof. Václav Votruba. The very next year, a particle accelerator called Synchrophasotron was launched at the institute. This accelerator reached the highest energies of accelerated protons at that time. The JINR has been gaining a world name since the first years of its operation. In 1958, Ilya M. Frank was awarded the Nobel Prize in Physics for discoveries related to the so-called Cherenkov radiation. Two years later, in 1960, a new elementary particle was discovered by the Synchrophasotron accelerator – the hyperon Antisigma minus.

The institute is now the world's best known for its research aimed at studying new so-called superheavy elements – transuranics. The first of these, an element with proton number 103 – lawrencium, was discovered on the U-300 accelerator. Many others followed, succeeded also by the element with proton number 118, which was discovered in 2006 and is currently the most difficult element known. Two elements discovered here are named after JINR, dubnium after the city of Dubna and moscovium, after the Moscow region where the institute is located. Two other outstading Dubna scientists gave their names to the elements flerovium and oganesson.

Unique pulsed nuclear reactors have also been operating in Dubna since 1960. The IBR-1, IBR-30, IBR-2 and IBR-2M facilities are specific in that they are able to generate an intense neutron pulse, which corresponds to the operation of the reactor at a very high power (up to 1,800 MW). However, the pulse length is very short (0.3 ms), so the energy released by the fission is not large and the reactor can be cooled. Moreover, in the pulse we achieve such a high neutron flux density that no continuously operating nuclear reactor is able to provide. Neutrons can be used in basic research on nuclear interactions, in research on materials and solid-state physics, or in the assessment of environmental pollution through biomonitoring and activation analysis.

Many other unique facilities were put into operation at the institute – Nuclotron accelerator with superconducting magnets, U-400, U-400M, IC-100, DC-280, MT-25, LUE-200 and Phasotron accelerators, high-performance tier computing centres Tier-1, Tier-2 and HybriLIT, as well as devices focused on the study of neutrinos and many others. Moreover, the institute has also a slightly different record – the Laboratory of Theoretical Physics, founded by professors Blochincev and Bogoljubov, concentrated the largest number of theoretical physicists in one place and has always been one of the best in the world.

The Czech Republic played an important role in the development of the institute. A large number of Czechoslovak and Czech physicists, engineers and technicians have worked at the institute since the 1950s; many students have prepared their diploma and doctoral theses here. After the fall of the Soviet Union and the division of Czechoslovakia, we remained a member state and all the time we were among the most active members of the institute, trying to make it one of the world's top scientific institutions. In 2010, we supported the decision to substantially increase the institute's budget (an increase of 15% over 7 years) in order to enable the ambitious construction of a new research infrastructure for the institute. Thus, new activities arose in exemplary international cooperation, such as the NICA project (complex for the study of hot and highly interacting matter), Baikal-GVD (cosmic neutrino detection), DRIBs-III (cyclotron for the study of superheavy elements), radiation biology laboratories and the University Center for education of young specialists.

The Czech Republic has also played an important role in efforts to support the international character of the JINR and in supporting cooperation with employees of member countries. There were long-term seconded workers from all over the Czech Republic (researchers, staff in the management of the department, doctoral students and graduates). Emphasis was placed also on reciprocal short-term stays of Czech experts at the JINR and JINR experts at Czech workplaces (more than 100 working stays per year). We managed to obtain interesting scientific results published in journals with high IF. We have also introduced programmes to support young doctoral and graduate students in physics, science and technology – in the form of short-term and long-term internships. We managed to establish cooperation with Czech technology companies, which won significant contracts in direct competition (return in 2021 was 125% of our contribution).

On 24 February 2022, everything changed. The Cooperation Committee between the Czech Republic and the JINR immediately responded and issued a clear statement on the same day of the aggression of the Russian Federation towards Ukraine (http://www.sujv.cz/cz/index.php?Ns=406&id=1000139). These steps are based on the position of the Czech government and are based on the cessation of all activities (including the dismissal of our staff) and the support of Ukraine. At the meeting of the Committee of Government Plenipotentiaries of the JINR, the Czech side exercised the right of special opinion as amended: the Czech delegation declares that it fully adheres to the position of the Prime Minister of the Czech Republic and its government's members regarding the situation in Ukraine and acts on their publicly

Fig. 3: Model of NICA complex (source: Joint Institute for Nuclear Research, www.jinr.ru)

expressed statements. Czech Republic condemns the Russian Federation´s aggression supported by Belarus against Ukraine and we emphasize the necessity to fully respect Ukraine´s state sovereignty. We call for immediate stop of all military actions which should enable start of resolving of the most serious humanitarian problems and concentrate on intensive diplomatic effort.

At the same time, we are aware of the complexity of the situation of Czech seconded researchers or our companies. The membership of the Czech Republic in the JINR Dubna enabled the use of the scientific infrastructure built during the 66 years of the Institute's existence by our efforts and, last but not least, it supported direct scientific contacts with other member states of the JINR outside of JINR too. Even at Dubna, there are employees who, even under the influence of meeting with us, are aware that it is not possible to remain silent about the aggression of the Russian Federation towards Ukraine. Maybe partly because of this, 12 brave young researchers sent this letter on 25 February 2022. Even with the knowledge that they face many years in prison:

Dear collaborators,
It's really hard to speak now but we feel ourselves responsible for the horrible situation between Russia and Ukraine. We do not have any explanation and do not see any reason why Russia started the invasion to Ukraine. We all have relatives, friends and colleagues in Ukraine and we are fully supporting freedom of Ukraine. We are definitely against the war and we hope that it will be stopped ASAP. It's hard to predict what will happen, however we try to keep working on our collaborative tasks at any circumstances. We want to apologize but we are not sure whether we are entitled to do so.

The Institute in Dubna will never be the same. No one can predict its future after the departure of workers from many long-term cooperating countries. This concludes the 66-year-old chapter, which has significantly influenced research in our country, at least for the Czech Republic. Students, academicians and researchers have always been the bearers of democratic ideas, and we believe that at least part of the cooperation with specific colleagues and bilaterally with JINR member states, which have clearly defined themselves within the current situation, will be maintained and might be sometimes able to support the renewed JINR in the future.

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is an associate professor at Brno University of Technology and senior researcher of Nuclear Power Group at Department of Electrical Power Engineering. He has been involved in research of Accelerator Driven Systems for many years with intense collaboration in many countries. His group is also currently working on increasing the safety and efficiency of innovated nuclear fuel and on mitigation capabilities and strategies of existing and advanced PWRs against Design Extension Conditions with cooperation of Czech and foreign industry. Together with colleagues from CTU, he is one of the initiators and organizers of the Summer School of Nuclear Engineering, which has been held regularly for 14 years and has been attended by more than 300 students from eight Czech universities.

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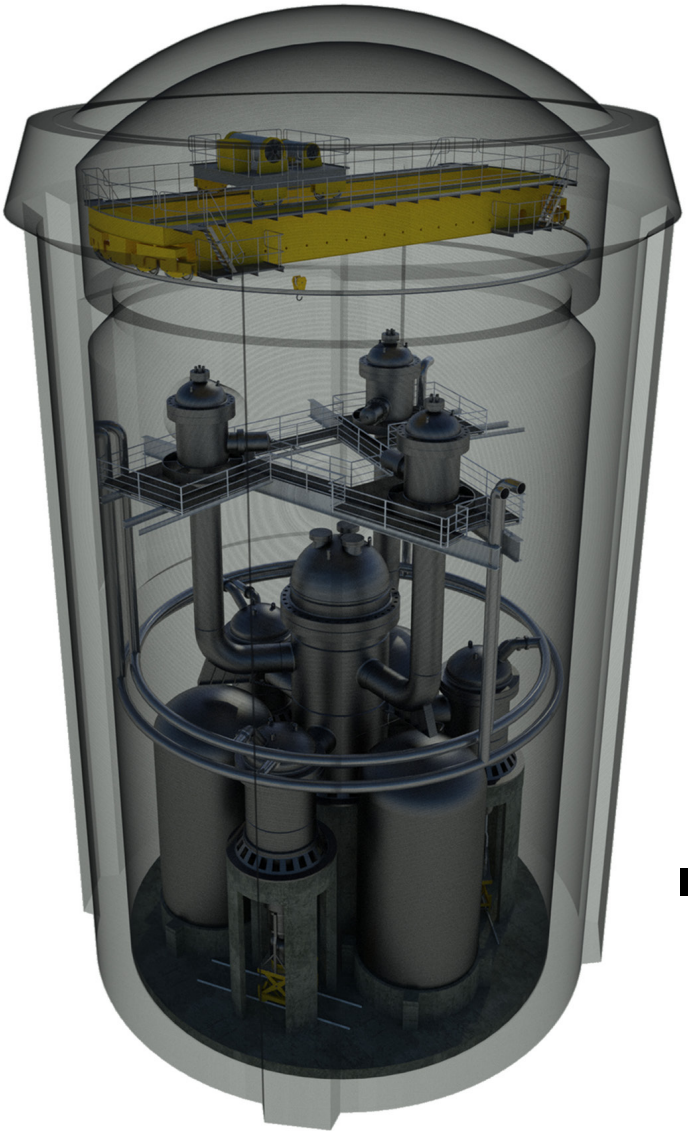
is an associate professor at Czech Technical University in Prague, leading researcher and director of the Institute of Experimental and Applied Physics. His main research focus is antineutrino physics, especially neutrinoless double beta decay. He is one of leading research personalities of this investigation in the Czech Republic and is participating in the research around the world (Modane Underground Laboratory, TGV, NEMO, and SuperNEMO experiments, Baikal-GVD, and many others). He is promoting cooperation between researchers all around the world, he has introduced cooperative students, postdocs, and junior scientists' programmes between JINR Dubna, JINR Dubna members states and Czech Republic.

News

ÚJV Řež receives patent for key safety system for high-temperature gas-cooled reactors



Since 2013, the ÚJV Řež company has been significantly involved in the development of the ALLEGRO gas-cooled fast reactor (GFR) demonstrator. Last year, the company built upon its experience in developing the GFR technology with the concept of its own small modular reactor, HeFASTo. One of the key areas of safety system design for this concept is the residual heat removal system. The technology for solving this problem, designed by the research team of the Nuclear Safety and Reliability Division of the ÚJV Řež, has now received a patent from the Industrial Property Office (number 309095). The successful research team has thus paved the way for the pre-conceptual design of the HeFASTo reactor, which should be ready by 2025, and has also contributed significantly to the nuclear safety of the international ALLEGRO demonstrator project.

The ALLEGRO gas-cooled fast reactor demonstrator project is a follow-up to the original activity of the French Alternative Energies and Atomic Energy Commission (CEA). Since 2013, the project has been

Fig. 1: The primary circuit system of the ALLEGRO demonstrator in a pressure envelope (guard vessel)

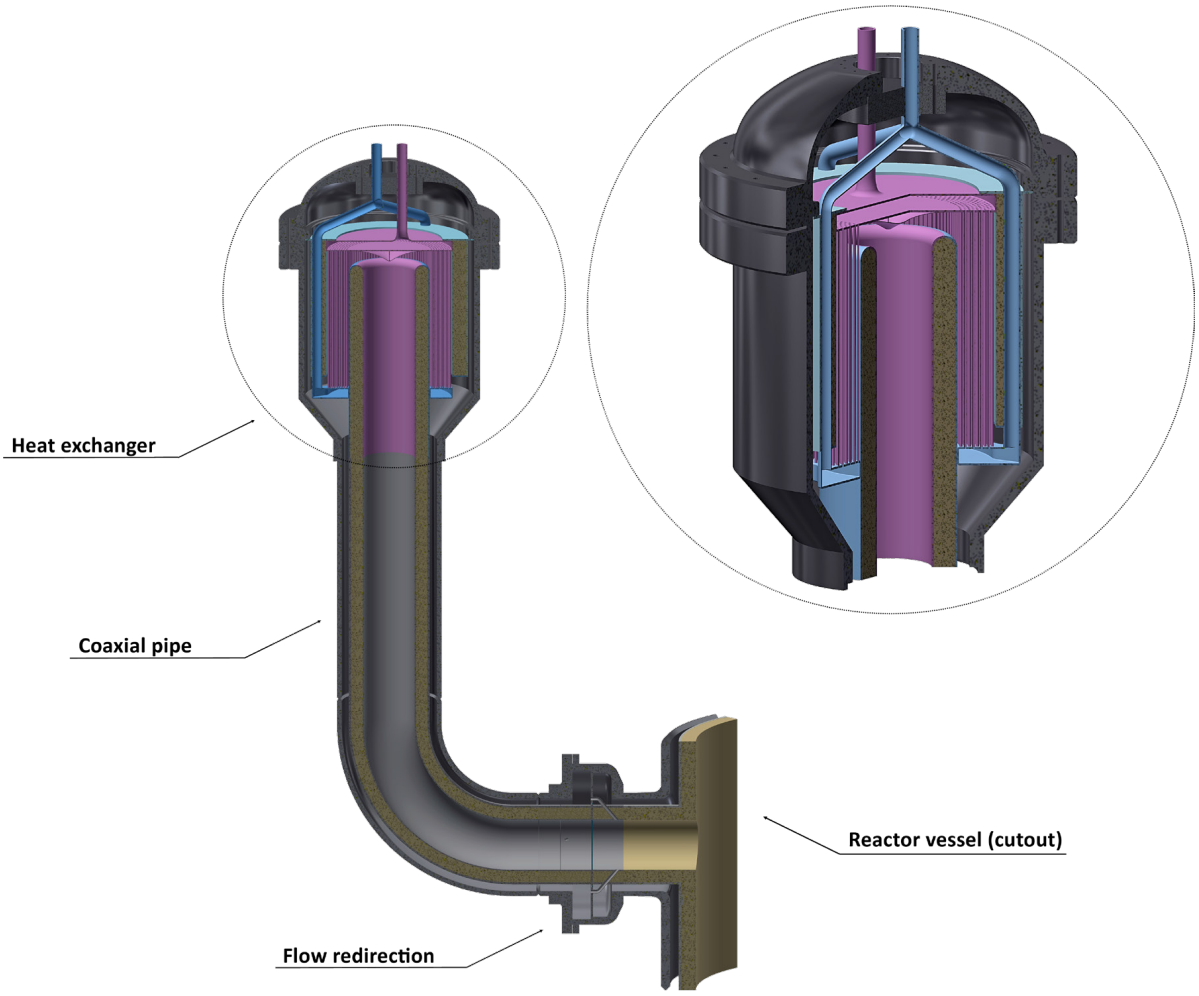


Fig. 2: Pre-conceptual design of the residual heat removal system of the ALLEGRO demonstrator

further developed within the framework of the international V4G4 Centre of Excellence (V4G4 CoE), whose members, in addition to the ÚJV Řež and its subsidiary the Research Centre Řež, are the Slovak Nuclear Power Plant Research Institute (VUJE), the Hungarian Centre for Energy Research (EK), the National Centre for Nuclear Research (NCBJ) from Poland and the French CEA. V4G4 CoE collaborates with several global research institutes and is the main user of the project's results. The ALLEGRO demonstrator is expected to be completed after 2030.

As part of its experimental research, the project makes significant use of the infrastructure of the Research Centre Řež, especially the unique experimental helium loop S-Allegro, which is operated at the site in Pilsen. The new patent is the second consecutive patent that the UJV Group has received for small modular nuclear reactor technology. The first was a patent granted in 2020 for the Energy Well reactor from the Research Centre Řež.

Alena Rosáková

News

The international APAL project has published the latest set of findings for the safety analysis of the long-term operation (LTO) of nuclear power plants in Europe

APAL (Advanced PTS Analysis for LTO), an international consortium focusing on improving the safe LTO of nuclear power plants (NPPs) through pressurised thermal shock (PTS) analysis, has announced the results of one of the main phases of the project, coordinated by the ÚJV Řež. Based on the latest findings, the main areas of improvement that may affect the results of PTS analyses for reactor pressure vessels (RPV) have been defined. Pressure vessel integrity assessment is a key parameter in terms of life management and safe operation of NPPs.

The selection of areas for further research into PTS was based on the analysis of detailed technical questionnaires completed by consortium members. The first phase of the APAL project resulted in a summary of the current state of knowledge, which included a review of existing approaches to the problem of PTS assessment, a description of identified gaps or problems and suggestions for improvement.

Outlined below are the four main areas that were selected for detailed research in the first phase of the project.

Residual stress distribution in welds (WRS) and welds of the reactor pressure vessel. WRS values for PTS analyses are usually taken from standards or technical literature. These values are based on measurements of samples or finite element calculations. A need for further research has been identified, focusing on the relaxation of residual stresses during NPP operation.

Consideration of the effect of hot overload (WPS) in PTS analyses. Most of the project participants considered the impact of WPS in their PTS assessments in accordance with the standards or methodologies used. In this context, several issues were identified and recommended for further investigation.

Thermohydraulic (TH) analysis (including definition of human factors). Expert publications and the practical experience of consortium members emphasise the Best Estimate Plus Uncertainty (BEPU) analysis method instead of using conservative assumptions. The human factor is already included in PTS analyses, but there is still little research in Europe on, for example, the impact of operator failure or the correct determination of the times required for operator intervention.

Probabilistic analyses of PTS. The output of this part of the project describes tools and software for probabilistic analysis of PTS, currently used by European and international partners, and recommendations for possible directions for improvement.

The evaluation of PTS is a complex process involving several disciplines. The aim of the APAL project is to develop advanced PTS assessment methods and quantify safety margins, which can be used to improve the LTO of NPPs. The project consortium is addressing this issue in a collaborative manner, across the various physics disciplines related to RPV safety assessment and plant life management. All the recommendations collected during the project will be used to formulate best practice procedures that address all aspects of advanced PTS analysis for LTO.

The APAL consortium consists of partners from almost all EU countries with nuclear programmes, as well as Ukraine and Switzerland. In addition, the involvement of international partners from the United States and Japan will add value in aligning probabilistic assessment approaches.

The APAL project received funding from the Euratom Research and Training Programme in 2019–2020 under grant agreement No 945253.

www.apal-project.eu

Alena Rosáková

V příštím čísle, které bude věnováno dvacetiletému výročí založení Centra výzkumu Řež, vám detailně představíme unikátní výzkumnou infrastrukturu a špičkové laboratoře, které byly v našem „jaderném údolí“ vybudovány v rámci významného investičního projektu SUSEN. Dozvíte se, proč jsou v energetice důležité mikrostrukturní a mikrochemické analýzy a jak zdejší výzkum přispívá ke zvyšování bezpečnosti provozu energetických zařízení a prodlužování jejich životnosti. V příštím čísle najdete i závěrečnou část článku o jaderných zdrojích pro vesmír, další díl seriálu o vzniku a historii státního dozoru nad jadernou bezpečností, aktuality z oblasti jaderné energetiky a po téměř dvouleté odmlce i Kalendář akcí.

CVŘ