2019

Safe and Sustainable Fuel Cycle Back-End

Booklet of abstracts

SAFE AND SUSTAINABLE FUEL CYCLE BACK-END

BEZPEČNÝ A UDRŽITELNÝ KONEC PALIVOVÉHO CYKLU

14th – 15th May 2019

SÚRAO | RADIOACTIVE WASTE REPOSITORY AUTHORITY

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Introduction

The Czech Republic is now at the stage of deciding the next steps to ensure the safe and economically justified end of the nuclear fuel cycle as well as the next stage of looking for a suitable site for a deep geological repository (DGR), respectively geological disposal facility (GDF).Neighbouring states and other European Union countries are addressing the same matter. The aim of this international conference is to exchange knowledge and experience of preparing and implementing a DGR for the direct storage of spent nuclear fuel and highly-active waste, as well as further options of how to make a nuclear fuel cycle back-end in the most effective and safe manner.

On the Day 1 we shall mostly describe the current status of individual national programmes, on the Day 2 we would like to inspire experts, representatives of all levels of public administration to stipulate the back-end of a fuel cycle even in countries with a smaller nuclear energy programme in the sustainable way, particularly in the light of the conclusions of the climate summit in Katowice – stabilizing greenhouse gas concentrations in the atmosphere by safeguarding the neutrality of the calculated equivalent of carbon dioxide emissions indigenous out of the European Union (EU) territory by 2050. Many countries – the Czech Republic among them – are to maintain or even increase the power energy production from nuclear installations in order to have a sufficient contribution to such a common EU Member States commitment.

Auspicies

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Conference partner

Posiva Oy is responsible for the final disposal of spent nuclear fuel of its owners in Finland. Posiva is in charge of R&D work as well as the construction and operation of the encapsulation plant and disposal facility. Posiva is owned by utilities Teollisuuden Voima Oyj and Fortum Power & Heat Oy, who are financing the spent fuel final disposal.

Posiva got the construction license for the final disposal facility in 2015 and started the construction of the encapsulation plant and underground final disposal facilities. The final disposal begins in mid-2020s **- first in the world!**

Posiva Solutions Oy is a subsidiary of Posiva Oy. It supports its Clients in their projects by utilizing Posiva‘s knowhow in the final disposal of spent nuclear fuel accumulated during the last 40 years in design, research & development and construction.

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Conference partner

AINS Group (A-Insinöörit Civil Oy) is a multi-discipline engineering consultancy specialised in nuclear waste management services and underground engineering. With over 40 years of experience in nuclear waste disposal, the company provides a complete range of solutions for nuclear waste management as well as specific research and engineering design services for nuclear waste disposal.
Our nuclear experience arises from work in 25 different waste repositories in 15 different countries in 500 separate contracts. In addition, we have supported six different nuclear power facilities in three countries in 15 contracts.

Our areas of core competence include: Site Selection, Site Characterisation, Repository Technology, Cost Estimation, Conceptual Design, Long Term Safety, Safety Case, Licensing Support, Layout Design, Rock Engineering, Host Rock Classification, Engineered Barrier Systems, Buffer & Backfill, Foreign Material Estimation, Monitoring, Biosphere Assessment, Requirement Management, and Description of Disposal System.

Our key clients include NPP operators, waste management organisations, scientific institutes and governmental organsiations. Examples of engineered repository facilities include: Olkiluoto SNF Repository, Onkalo (Registered trademark) URL/URCF and Olkiluoto LILW repository (VLJ) in Finland, Forsmark HLW repository and SFR LILW repository in Sweden, Wolsong LILW Repository in South Korea.

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Day 1

14 May 2019, 9.15 – 18.00

Conference will be simultaneously interpreting in Czech and English

9:15 – 9:50	Registration of Participant
	Section A: Back-end of the fuel cycle from the energy policy perspective
10:00 – 10:10	Opening of the conference by the moderator of the event Jan Kovařík;
10:10 – 10:20	**Tomáš Ehler,** Director of the Department of Nuclear Energy, Czech Republic;
10:20 – 10:30	**Jaroslav Větrovský,** Senator, Vice-Chairman of the Energy and Transport Subcommittee and Member of the Economic, Agriculture and Transport Committee, Senate of the Czech Parliament;
10:30 – 10:40	**Jan Prachař,** Managing Director of the Czech Radioactive Waste Repository Authority (SÚRAO), Czech Republic;
10:40 – 11:00	**Massimo Garribba,** Director, DG ENER - Nuclear Energy, Safety and ITER, European Commission; *"European strategic long-term vision, and Radioactive Waste Management requirements";*
11:00 – 11:20	**Martin Jašek,** Asset Management Director NPP, ČEZ a. s.; *"Ensuring the long-term operation of ČEZ Ltd's nuclear power plants";*
11:20 – 11:50	Question and Answer Session
11:50 – 12:40	**Lunch break**
	Section B: National radioactive waste and spent nuclear fuel management programmes
12:45 – 13:05	**Lukáš Vondrovic,** Head of the Deep Geological Repository Section, SÚRAO, Czech Republic; *"Development of deep geological repository and research and development in the Czech republic";*
13:05 – 13:25	**Mika Pohjonen,** Managing Director, Posiva Solutions Oy, Finland, *"Posiva's journey: from approval to construction of the world's first Deep Geological Repository for spent nuclear fuel";*
13:25 – 13:45	**Radek Trtílek,** Director of Radioactive Waste & Decommissioning Division, ÚJV Řež a.s., Czech Republic, *"The role of ÚJV Řež in the development of the Czech deep geological repository – research support for the safety case and licencing";*
13:45 – 14:05	**Marie-Delphine Salsac,** International Relations Division, Development, Innovation and International Activities Department, ANDRA, France, *"Cigéo update and relationship with hosting communities";*
14:05 – 14:25	**William J. Boyle,** Deputy Assistant Secretary, Office of Spent Fuel & Waste Disposal, US Department of Energy, *"The status of the spent fuel and high-level radioactive waste disposal programme in the USA";*
14:25 – 14:45	**Daneš Burket,** Head of Research and Development, CV (Research Centre) Řež, Czech Republic, *"Research and development for safe radioactive waste management";*
14:45 – 15:05	**Thilo von Berlepsch,** Director of Research and New Technologies, BGE (Tech), Germany, *"The German national radioactive waste disposal programme – deep geological repository preparation, construction, operation and closure";*
15:05 – 15:25	**Dagmar Dehmer,** Head of the Communications Department, BGE, Germany, *"How to promote a nuclear waste repository – German experience and suggestions";*
15:25 – 15:55	**Coffee Break**
15:55 – 16:15	**Leon Kegel,** Head of Development and Strategy, ARAO, Slovenia, *"Update to Slovenian National Strategy for RW and SF";*
16:15 – 16:35	**Bálint Nös,** Head of Strategy and Technology, PURAM, Hungary, *"Spent Fuel Management in Hungary";*

16:35 – 16:55	**Miroslav Bôžik,** Member of the Board of Directors, Head of A1 Decommissioning and the RAW and SNF Management Division, JAVYS, Slovakia, *"Decommissioning and Radioactive Waste Management Program in the Slovak Republic";*
16:55 – 17:15	**Cornelia Paraschiv,** Nuclear Agency & Radioactive Waste, General Secretary, Rumunsko, *"The responsible and safe management of radioactive waste in Romania";*
17:15 – 17:35	**Stratis Vomvoris,** Head of the International Services and Projects Division, Nagra, Switzerland, *"Geological Disposal in Switzerland: Advances in the final Stage of the site selection process";*
17:35 – 18:00	Question and Answer Session

Day2

15 May 2019, 9.00 – 16.00

Section C: Back-end of the nuclear fuel cycle – storage, reprocessing, deep disposal

9:00 – 9:20	**Marie Garcia,** ANDRA, France, Research and Development Division, European Research Projects Department, *"European Joint Programme on Radioactive Waste Management";*
9:20 – 9:40	**Sanna Mustonen,** Project Manager, Posiva Solutions Oy, Finland, *"ONKALO® – an international underground research facility";*
9:40 – 10:00	**Bernd Grambow,** IMT Atlantique, France, Representative of the research organisations involved in the 13 working groups of the EURAD project, *"EuradScience: the grouping and vision of European research entities in the first EJP EURAD";*
10:00 – 10:20	**Ingo Blechschmidt,** Director of the Underground Laboratory Section at Grimsel, Nagra, Switzerland; General Secretary for the Implementation of a Deep Geological Repository – Technology Platform (IGD-TP), *"IGD-TP – Objectives and medium-term perspectives";*
10:20 – 10:40	**Martin Duda,** Board Member of the Czech Technology Agency, Czech Republic, *"Czech Technology Agency energy projects";*
10:40 – 11:00	**Václava Havlová,** ÚJV Řež, Czech Republic, *"Development of R&D supporting Czech DGR safety assessment in the context of EU cooperation";*
11:00 – 11:30	**Coffee Break**
11:30 – 11:50	**Fionán O´Carroll,** Senior Expert, AINS Group, Nuclear Waste Management Unit, Finland *"Nuclear Waste Management in Finland";*
11:50 – 12:10	**Vladimír Wagner,** Institute of Nuclear Physics, Academy of Sciences of the Czech Republic, *"Various aspects of the nuclear fuel cycle back-end for the general public";*
12:10 – 12:30	**Peter Wikberg,** former Head of Research and Development, SKB, Sweden, *"Site Investigations – A major part of the siting and licencing of a spent nuclear fuel repository";*
12:30 – 13:00	Question and Answer Session
13:00 – 14:10	**Lunch Break**
14:10 – 14:30	**Robin Taylor,** National Nuclear Laboratory, United Kingdom, *"Developing options for the future recycling of spent nuclear fuel in the UK";*
14:30 – 14:50	**Vanessa Vo Van,** Orano Back-End Sales, Vice President, France, *"Back-end operations, Orano capabilities in used fuel and waste management for the benefit of international nuclear operators";*
14:50 – 15:10	**Michel Hugon,** former expert at DG Research and Innovation, *"Partitioning and transmutation as an option for high-level radioactive waste management: opportunities and challenges";*
15:10 – 15:40	Question and Answer Session
15:40 – 16:30	**Conference Conclusions**

Abstracts

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European strategic long-term vision, and Radioactive Waste Management requirements

Massimo Garribba, European Commission,
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In November 2018, the European Commission presented the European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy exploring pathways to achieve greenhouse gas emissions reductions in line with the Paris Agreement's commitments.

Nuclear energy is a well-established large-scale low-carbon technology in power generation. It is expected to play a role at global level in CO2 emissions mitigation scenarios.

According to the Radioactive Waste Directive (Council Directive 2011/70/EURATOM), EU Member States have to ensure that the public is given the necessary opportunities to effectively participate in the decision-making process regarding spent fuel and radioactive waste management.

The development of geological disposal facilities, and in particular the choice of their locations is a complex, long-term process in which transparency and public participation will be of great importance.

Ensuring the long-term operation of ČEZ Ltd's nuclear power plants

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A range of technical-economic studies of the long-term operation of the nuclear power plant units owned by ČEZ Ltd. have confirmed that their operation beyond the original project expectations will be both safe and technically and economically feasible. However, the exploitation of the potential of these plants requires the implementation of a number of measures so as to ensure compliance with the terms of their operation licences. In addition to the continuous modernisation of selected technology, the expansion of the spent nuclear fuel storage facilities at both plants will be a major priority. While a number of options are being considered regarding the expansion of these facilities, the final solution will take into account the future operational and technical requirements of both plants and reflect the progress of the deep geological repository development project. Thus, we will ensure the continuity of the supply of nuclear energy and the sustainability of the potential of the Dukovany and Temelín sites for the construction of new nuclear units.

Development of deep geological repository and research and development in the Czech republic

Lukáš Vondrovic, SÚRAO,
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The high-level radioactive waste management concept in the Czech Republic includes the consideration of the integrated development of the disposal concept itself, the siting process and the fulfilment of preliminary compliance with the relevant atomic legislation. An integrated inter-disciplinary approach to the various requirements concerning safety, technical feasibility and environmental criteria is being applied aimed at reducing the number of potential DGR sites from 9 to 4 during the first half of 2020. The intensive R&D planning for the next project planning stage that will involve a reduced number of sites is currently being addressed in order to be able to proceed with the continuous updating of the DGR safety assessment and the demonstration of technical feasibility. The main principles with concern to R&D include the preparation of site descriptive models for the calculation of the site-specific dose, the update of the reference concept and compilation of alternative disposal and safety concepts, and the consideration of the various repository components and potential construction techniques.

Posiva's journey: from approval to construction of the world's first Deep Geological Repository for spent nuclear fuel

Mika Pohjonen, Posiva Solutions Oy,
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Posiva Oy is the global forerunner in industrial final disposal of spent nuclear fuel. As the first organization in the world it constructs a deep geological repository ONKALO® in Olkiluoto, Finland. Posiva Solutions Oy is fully owned by Posiva and it focuses on the sales of the know-how and technologies Posiva has since 1978 accumulated from its design, research and development activities in final disposal of spent nuclear fuel.

This presentation gives a short overview of the history and success factors of Posiva's project, but the main emphasis is in the present situation and the plans for next few years - what is Posiva doing and going to do to be ready to start final disposal in 2025.

The role of ÚJV Řež in the development of the Czech deep geological repository – research support for the safety case and licencing

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ÚJV Řež (formerly the Řež Nuclear Research Institute) has, for over 60 years, been the Czech Republic's (formerly Czechoslovakia's) leading research and engineering organisation in the field of the support of the use of nuclear energy and ionising radiation. From the outset, support activities included research into issues involving radiochemistry and, subsequently, radioactive waste management systems, technologies and applications. Moreover, ÚJV made a significant contribution to the concept and preparation of the establishment of SÚRAO as the Czech WMO and also provided the first group of experts to advise SÚRAO following its establishment. The uniqueness of ÚJV lies in its combination of multi-disciplinary engineering, research, laboratory, workshop and experimental facilities that are capable of handling radioactive substances and irradiated materials. ÚJV's accumulated knowledge and experience have been further enriched over the past 20 years via its participation in two dozen or so international research projects funded by the European Commission. In addition, ÚJV coordinated the research involved in the compilation of the Czech DGR Reference Project which remains the main source of information on this topic. ÚJV's current role consists of the coordination of research into DGR safety issues including geological structures, geochemistry, hydrology, geotechnics, long-term geological, climatic and tectonic processes, microbial processes, the influences of intrusion and, particularly, the corrosion behaviour, and processes surrounding the interaction and migration of radionuclides through, engineered barrier systems. The research and development of engineered barrier properties and the compilation of radionuclide transport models of the near- and far-fields make up ÚJV's key contributions with respect to the overall demonstration of the safety of the future Czech DGR.

Cigéo update and relationship with hosting communities

Marie-Delphine SALSAC, Andra – International Relations Department – Development, Innovation and International Division,
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The Industrial Centre for Geological Disposal, or Cigéo, is a deep geological disposal facility for radioactive waste to be built in France. It will be used for the disposal of highly radioactive waste produced by France's current fleet of nuclear facilities, including that produced after reprocessing the spent fuel from nuclear power plants.

The reasons for the existence of the Cigéo project – the selection of a reversible disposal facility for radioactive waste in a deep geological formation – were the object of a lengthy process of decision-making, selection and deliberation, which began in 1991, punctuated by public debate followed by laws voted by parliament. The evolution of the history and of the project itself (see picture) will be presented.

Established for over 20 years in the Meuse and Haute-Marne departments, Andra has played a major role in local life, economic development and employment. Andra is committed to an active joint construction process with the region. This approach primarily involves informing and having ongoing dialogue with the centre's neighbours, as well as consultations with the region's stakeholders in the project. One part of the communication strategy relies on the local people's involvement.

The status of the spent fuel and high-level radioactivewaste disposal programme in the USA

William J. Boyle, Deputy Assistant Secretary, Office of Spent Fuel & Waste Disposal,US Department of Energy,
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An overview of the status of the United States' spent nuclear fuel (SNF) and high-level waste (HLW) disposal program is presented. The proposed repository at Yucca Mountain is the only repository for SNY and HLW currently authorized by US law. Although funding for the repository at Yucca Mountain and also funding for an interim storage program has been requested in the President's budget, Congress has not appropriated funding for the repository at Yucca Mountain, nor for the interim storage program. Instead Congress has provided funds to perform research and development of the storage, transportation, and disposal of SNF and HLW.

Research and development for safe radioactive waste management

Daneš Burket, Research Centre Rez as a Research Entity supporting the Czech Radioactive Waste Repository Authority,
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Research Centre Řež plays a very important role of Research Entity for the Czech Radioactive Waste Repository Authority (SÚRAO). A complex research infrastructure and knowledge has been developed to support all important activities related to radioactive waste management from intermediate storage through transport and manipulations to the final disposal. The main activities are focused on research and development related to safety aspects of spent fuel casks – construction and shielding materials testing and long term behaviour of spent fuel (covered all relevant degradation mechanisms – radiation, media, environmental impacts). The second area of research and development is focused on studies supporting planning and construction of deep geological repositories for radioactive waste as inputs for safety assessment of a barrier system of a deep geological repository for radioactive waste. The Research Centre Řež is only organization in the Czech Republic which is able to cover all above mentioned activities thanks to robust experimental facilities and laboratories – research reactor, complex of hot cells, material, microstructural and chemical laboratories, anaerobic boxes, geotechnical laboratory etc.

The German national radioactive waste disposal programme – deep geological repository preparation, construction, operation and closure

Thilo von Berlepsch, Director of Research and New Technologies, BGE (Tech), Germany,
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The BGE is commissioned by the Federal Government with the tasks in the field of disposal of radioactive waste. For this purpose, the state-owned company was founded for this purpose in July 2016. Since April 2017, the BGE has been the operator responsible for the three German repository projects Konrad and Morsleben and the Asse mine. A further task is the site selection process for a repository in particular for high-level radioactive waste.

In March 2017, an amendment to the StandAG is enacted. The StandAG now stipulates a multi-phase search for a location with the best possible safety and comprehensive public participation. On September 5th, 2017, the BGE started the search for a location with a kick-off event in Berlin.

The former Konrad iron ore mine is currently being converted into a repository. Subsequently, up to 303,000 cubic metres of low- and intermediate-level radioactive waste are to be disposed of.

Between 1971 and 1991 and between 1994 and 1998, a total of around 37,000 cubic metres of low- and intermediate-level radioactive waste were disposed of in the Morsleben repository. The repository is to be decommissioned while the waste remains.

From 1967 to 1978, around 47,000 cubic metres of low- and intermediate-level radioactive waste were disposed of in the Asse II mine on behalf of the Federal Government. The long-term safety of the facility cannot be proven by current standards. For this reason, the retrieval has been a legal mandate since 2013.

Summarising, BGE is in the unique situation that even its current tasks cover the site selection for a geological repository, its planning, constructing, operation, closure, and even the retrieval of radioactive waste from such a facility. The presentation will give an insight into all phases of the lifetime of a geological radioactive waste repository.

How to promote a nuclear waste repository – German experience and suggestions

Dagmar Dehmer, Head of the Communications Department, BGE, Germany,
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After around 35 years Germany in 2013 switched the reset button on the site selection process for a repository for high level nucelar waste. Between 1977 and 2011 Gorleben, a salt formation in norther Germany, has been chosen as the site for a repository. But since 1979 it was the place where the dispute about nuclear energy in Germany found it‘s climax.

In 2013 and 2017 a new bill was passed in the Bundestag to restart the site selection process. The so called StandAG defines the rules, criteria and the level of public participation in the new site selection process. The BGE, Federal Company for Radioactive Waste Disposal, since 2017 has the task to find a new site for a repository for high level nuclear waste. The new administration BfE, Federal Office for the Safety of Nuclear Waste Management, is responsible for the public participation process. Both are accompanied by the NBG, National Citizens’ Oversight Committee, which has the task to plea for public participation on all levels and to moderate the public debates wherever possible.

The BGE is authorized to conduct the site selection in practice. the process is done in three phases, right now it is still at the beginning. The StandAG defines a high level of transparency about the work that is done around the site selection process. The BGE is obligated to inform transparently about every step in the process. The BfE runs a public platform to document essential documents. But the BGE informs the public in it‘s own capacity too. How the BGE tries to gain trust in the process, which instruments it uses to reach out to the public, and how this shall help the BfE to organize a participation process will be the main focus of the presentation for the Prague conference on May 14th and 15th 2019.

Update to Slovenian National Strategy for RW and SF

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The Krško NPP, in commercial operation since 1983, was jointly constructed by Slovenia and Croatia and is owned in equal shares by the Slovenian and Croatian utilities. According to Council Directive 2011/70/Euratom establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, each European Union member state shall ensure the implementation of its national programme for the management of spent fuel (SF) and radioactive waste (RW). In April 2016, the Slovenian parliament adopted 2nd national programme, which sets out general activities related to SF and RW management for all radiation and nuclear facilities in Slovenia for the next ten years (2016–2025). This paper presents expert bases for future updates to the national strategy for RW and SF based on preparation of the Third revision of the Krško NPP Decommissioning Program and the Third revision of the Krško NPP RW and SF Disposal Program that is jointly prepared by authorised organisations in both countries and approved by competent bodies in Republic of Slovenia and Republic of Croatia.

Spent Fuel Management in Hungary

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The NPP origin spent nuclear fuel is stored safely for decades in modularly extendable, vault type, dry storage facility at Paks. Currently there is no final decision for the back-end of the nuclear fuel cycle in Hungary. A so called “do and see” policy is applied, with a reference scenario. The reference scenario, which is currently the open fuel cycle (direct disposal of used fuel) serves as a basis for the cost calculations.

The basis of the policy is that, the implementation of any back-end option will result some high-level and long-lived waste, which have to be disposed of in a geological repository. The ‘do’ part of the policy is the implementation of a domestic geological disposal facility (currently the project is in the site selection phase). The ‘see’ part of the policy is the regular review of the services in the field of the back-end and regular reevaluation of the reference scenario. This flexible concept will be summarized in the presentation.

Decommissioning and Radioactive Waste Management Program in the Slovak Republic

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The activities related to the final phase of nuclear energy in Slovakia are provided by Jadrová a vyraďovacia spoločnosť, a.s. (JAVYS). It’s main responsibilities are:
- Decommissioning of Nuclear Facilities;
- Radioactive Waste Management;
- Spent Fuel Management;
- Management of Institutional Radioactive Waste and Radioactive Material of unknown origin;
- Carrying out Shipments of Radioactive Waste, materials and spent nuclear fuel.

JAVYS, a.s carries out all activities in accordance with the National Policy and the National Spent Fuel and Radioactive Waste Management Program in the Slovak Republic according to the principles of EC Directive 2011/70 / Euratom.

All activities of the company JAVYS, a.s are carried out with an emphasis on the safety, quality and environmental protection, in compliance with requirements in the various areas of its protection as well as the conditions of decisions of state and supervisory institutions on the protection of individual part of the environment.

Responsible and safe management of radioactive waste in Romania

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Romania has an established nuclear sector and is active in most aspects of the nuclear fuel cycle, including mining, fuel manufacture and civil nuclear power generation. There are currently two operating CANDU reactor units in Romania, both located on the Cernavoda site. It is planned that a further two CANDU reactor units will be commissioned at the Cernavoda site in the coming years. Romania adopts an open fuel cycle and consequently SNF from the NPP is considered as a waste and is expected to be disposed to a DGR. The LILW-LL from reactor operations and decommissioning will be co-disposed in the same geological repository as the SNF. To dispose of LILW-SL, a new surface repository having a modular cell design is planned to be constructed, subject to regulatory approval. It is anticipated that the first phase of the new repository will be licensed for waste disposals starting in around 2026.

Geological Disposal in Switzerland: Advances in the final Stage of the site selection process

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The Swiss site selection process for geological repositories is a stepwise nominational and participative approach defined by the 'Sectoral Plan for Deep Geological Repositories (SGT)'. The process began with the selection of geological siting regions on the basis of safety and engineering feasibility criteria (Stage 1; completed in 2011). In the next stage, the narrowing-down process focused on the selection of at least two potential siting regions for each type of repository including proposals for the location of the surface facilities (Stage 2; completed in 2018). The latter were derived following an interaction process with more than 200 communities defined in SGT. In the on-going final Stage 3, three sites will be evaluated on the basis of detailed site-specific investigations (seismic campaigns, deep boreholes).

European Joint Programme on Radioactive Waste Management

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For more than 40 years, considerable scientific/technical knowledge has been acquired in Europe in the field of radioactive waste management (RWM). RD&D will continue to be necessary to develop, maintain and consolidate knowledge throughout the stepwise development, operation and closure of disposal facilities, which will be spread over many decades and make this knowledge available to end users. Recently, the EC has promoted a step-change in pan-European research cooperation between EU Member States' national programmes by promoting the setting-up of inclusive research joint programmes in Europe. Based on the positive achievement of the JOPRAD project (2015-2017), the EC confirmed in 2017 its willingness to co-fund such a Joint Programme in the field of RWM. The RWM community therefore pursued the efforts to establish the Founding Documents (Vision, Strategic Research Agenda, Roadmap, Deployment) and a Work Plan for a first implementation phase of 5 years (2019-2024).

ONKALO® – an international underground research facility

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ONKALO® research facility, located in Eurajoki Western Finland, is an underground rock laboratory, where both site characterization studies and final disposal technology development has been conducted, under authority supervision. Construction of the ONKALO® started in 2004 and it was accepted to be part of the final repository in 2015. During the construction, the processes and the technologies for excavation, related investigations and disposal has been developed to meet the coming production needs. To achieve all above stated, ONKALO® has hosted and will continue to host internationally significant research activities and full scale test, like REPRO (a Rock Matrix Retention Properties test) and FISST (a Full-Scale In-Situ Test for installation of the canister, buffer, backfill and plug and to gain pioneering information about the early evolution of the disposal system). R&D work done in ONKALO® will not benefit just Posiva's project but the global final disposal community.

EuradScience: the grouping and vision of European research entities in the first EJP EURAD

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Research entities (RE) are key actors in answering the safety and the implementation needs of nuclear waste management and disposal at European level since the 2nd FWP of the European commission. In the process of setting up the EJP EURAD, an independent, cross-disciplinary network of RE, named EURADScience, has been created. The EURADScience Vision is to develop a clear science-driven perspective in radioactive waste management together with the complementary implementation driven platforms such as IGD-TP of the WMOs and the safety driven SITEX Network of TSOs.

IGD-TP – Objectives and medium-term perspectives

Ingo Blechschmidt & Irina Gaus, National Cooperative for the Disposal of Radioactive Waste (NAGRA),
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The presentation will focus on a short review on the role and activities of the Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD-TP) during the first 10 years since its establishment in 2009 and provide an outlook of its future role.

The IGD-TP was established with support of the European Commission (EC), but is now led and funded by an Executive Group (EG) comprising representatives from 11 European Waste Management Organisations (WMOs) and organisations responsible for implementation-related RD&D programmes. The main aim of the IGD-TP is to coordinate RD&D work which will help to ensure the realisation of the vision that the first geological disposal facilities (GDF) for spent fuel, high-level waste and other long-lived radioactive waste are in operation by 2025.

The IGD-TP has been supporting delivery of this vision by establishing common research needs and developing project scopes that ensure alignment of safety case needs and facilitate stepwise implementation of Geological Disposal Facilities. In addition, IGD-TP has also contributed to build confidence in the concept of geological disposal, to reduce duplicated work and deliver savings and ultimately make better use of existing European competence and research infrastructures.

In the past, much of the extensive underpinning scientific knowledgebase was developed within EURATOM RD&D funded projects and initiatives. Last year the European Commission (EC) called for a 'step change' in RD&D cooperation involving all parties through a European Joint Programme (EJP) on Radioactive Waste Management which agrees on common objectives. The recently

submitted EJP proposal is referred to as EURAD and aims to deliver an ambitious, cohesive and coordinated joint programme with an expected start in June 2019.

The IGD-TP extensively contributed towards realising this step change within the EURAD programme, representing all WMOs in EURAD, together with the participating research entities (RE) and technical support organisations for the regulators (TSO). Typical WMO RD&D programmes have a much wider scope of activities than the commonly agreed EURAD strategic research agenda (SRA) can address. Beside supporting the EURAD initiative actively, the IGD-TP will therefore increasingly work towards developing RD&D initiatives and activities that are unlikely to be integrated into the EURAD scope of activities for various reasons. Also, in the future, the IGD-TP remit will remain focused on geological disposal, with some interest in upstream activities (such as conditioning and treatment) but will also expand to include scope of greater relevance to nations with small programmes, for example disposal of sealed sources and borehole disposal to some extent. (https://igdtp.eu/).

Czech Technology Agency energy projects

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Through its various applied research and innovation programmes, the Technology Agency of the Czech Republic provides support for a range of energy projects, in particular projects concerning nuclear energy. The research results of one such programme known as THETA are proving to be particularly beneficial in terms of the development of nuclear energy. Moreover, a new programme named MIT (Ministry of Industry and Trade) TREND, the first public tender for which will be announced on 15 May 2019, will aim to further advance applied research in the field of energy. It is probable that both programmes will, to some extent, address the back-end of the fuel cycle which, as evidenced by the organisation of this conference, is of particular topical importance worldwide.

Development of R&D supporting Czech DGR safety assessment in the context of EU cooperation

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Wide research and development programme has been launched in Czech Republic since 2014, aiming to obtain the data, models, arguments and other information required so as to be able to evaluate potential sites for the location of such a repository in terms of long-term safety. The presentation will introduce development of R&D supporting DGR safety assessment, presenting specific topics and examples of experiments, methodology development and data mining, being crowned by Kravi hora preliminary safety case.

However, any national R&D cannot exist solitary. It needs to be linked to the international activities in order to follow the latest development, to exploit possibilities of new ideas, inspiration and cooperation and to gain the feedback, received from the scientific audience. Bilateral Czech – German cooperation and new European project EURAD seem to be the best examples.

Nuclear Waste Management in Finland

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The vast majority of nuclear waste in Finland is produced at the country's two operating Nuclear Power Plants. Small amounts are also produced elsewhere, for example from industrial use of radio isotopes, such as agriculture and in health care. Nuclear waste is considered as high level waste (HLW), or low and intermediate level waste (LILW). The Radiation and Nuclear Safety Authority, STUK, regulates the management of nuclear waste and advises the government on decision making. The costs for management and disposal of nuclear waste are borne by the waste producers themselves. LILW produced at the power plants from normal operation are disposed of onsite in special underground facilities managed by the power plant owners. Used fuel assemblies from the reactors are not reprocessed in Finland and the spent fuel is considered as high level waste. The power plant companies have a joint company, Posiva, for managing the spent nuclear fuel.

Various aspects of the nuclear fuel cycle back-end for the general public

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The most important problem of nuclear power acceptance is radioactive waste. Presentation and discussion of nuclear fuel cycle back-end with the general public is very difficult task. There are some successful examples but much more failures. We will discuss possibilities how to present rational scientific methods to present society. The most important is to explain that every power source has negative and positive aspects. The rational and open information about possible solution of their problems is really necessary.

Site Investigations – a major part of the siting and licencing of a spent nuclear fuel repository

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The KBS-3 system is the constructed repository in a hard crystalline (granitic) rock at about 500 metres depth supported by a long-lasting copper container and bentonite clay. Investigations are needed for characterizing the host rock and finding out the suitability of the investigated site(s). During the Site Investigation Stage, Repository Design and Safety Assessment were requesting information either directly from the collected data or through the Site Descriptive Modelling work.

The investigations were organised to deliver data in accordance with the general programme developed before the start of the investigations. A well-structured organisation and a well-planned programme made the work run according to the timeplan.

During the Site Investigation Stage the interaction between the investigation team and the Site Descriptive Model(ling) team was continuous. Feedback from Repository Design and from Safety Assessment was obtained at fixed defined milestones.

Developing options for future recycling of spent nuclear fuel in the UK

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At the industrial scale, UK policy is changing from a nuclear fuel cycle based on reprocessing of spent fuel to an open fuel cycle with spent fuel from current and new build reactors interim stored before disposal in a geological repository around 2080. However, to maintain policy options in the UK for expanded use of low carbon nuclear energy, throughout the 21st century, spent fuel management routes are needed including economic technologies for spent fuel recycling that generate less wastes for geological disposal and enhance proliferation resistance. This talk will provide an overview of the initial phase of a new UK Government funded R&D programme on nuclear fuel recycle. One of the key objectives of the programmes relates to international engagement and this will be discussed with reference to our participation in European Framework projects and other key collaborations.

Back-end operations, Orano capabilities in used fuel and waste management for the benefit of international nuclear operators

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Considering the evolution of international and national regulations, and their request for clarification of used fuel (UF) and radioactive waste management strategy, the identification of sustainable and optimized UF and waste management solutions is one of the major challenges faced today by nuclear stakeholders.

Reprocessing of UF, being performed at industrial scale since decades, allowing to remove fissile material and IAEA safeguards from final waste to be disposed of, allowing also to recycle the reusable materials in form of fresh recycled fuel contributes to implement sustainable UF management. Optimized UF and waste strategy is based on careful implementation of all management steps from characterization to definition of adequate treatment and packaging according to storage and disposal requirements.
The purpose of the paper is to present the demonstrated and customized industrial solutions provided by Orano for the benefit of international nuclear operators regarding global management of UF and waste.

Partitioning and transmutation as an option for high-level radioactive waste management: opportunities and challenges

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Partitioning and Transmutation (P&T) aims to reduce the inventories of long-lived radionuclides (actinides and long-lived fission products) in high-level radioactive waste (HLW) by transmuting them into radionuclides with a shorter lifetime in dedicated burners. P&T has been first investigated in Japan and the USA in the 80ties, then in the European Union since the beginning of the 90ties and later on in Russia, China and South Korea. Partitioning or advanced reprocessing is the chemical separation of the long-lived radionuclides from the high-level waste, which can be done either by aqueous processes (solvent extraction) or by pyrometallurgical processes (electrolysis or metal/salt exchange). Transmutation of these radionuclides could be achieved efficiently in fast neutron reactors or accelerator driven systems. The implementation of P&T to manage HLW will be discussed in terms of feasibility and benefits/drawbacks. Nevertheless, it is a challenging research area, which attracts young researchers in the field of nuclear energy.

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