Seminar 2 – Waste management, decommissioning and disposal – Session 1

Chaired by W. Pfingsten (PSI) / M. Tichauer (IRSN)

10:00 - 10:30 | No. 201

Safety of dry storage of German spent research and test reactor fuels

O. Bartos (GRS), K. Hummel (GRS), P. Kaufholz (GRS) and F. Rowold (GRS)

The Federal Republic of Germany utilized several research reactors for science, engineering and development of the country's nuclear technology. For historical reasons, the reactor-types depict reactors of former Soviet design (WWR), British designs (DIDO) and US-American reactor designs (MTR) as well as own developments (AVR). The majority of the spent fuel originating from the operation of those reactors was repatriated to the country where it is originally enriched. However, fuels of research and test reactors which are still in operation as well as fuels for which a repatriation was not possible, stay within Germany and need to be disposed of in a repository for heat generating radioactive waste. In parallel to the spent fuel from light water reactors (LWR), there will be a need for extended dry storage of these research and test reactor spent fuels beyond the initially licensed storage period of 40 years.

Research reactor fuels show major distinctions in design, material selection, burn-up and operation mode in comparison with LWR fuels. For the research and test reactor fuels to be stored in Germany, potential effects related to cladding corrosion, burn-up behavior and material embrittlement during dry storage are under assessment. Operational strain, wet-storage conditions, fuel-drying process and material behavior were identified to be major factors for the fuel integrity during dry storage. Due to the historical development and the widely varying properties of German spent research and test reactor fuels, several encapsulation concepts and different types of transport and storage casks were utilized.

A participation in a Coordinated Research Project (CRP), "Ageing Management Programmes for Spent Fuel Dry Storage Systems", organized by the IAEA in 2021 is intended. Beside research objectives that cover those under assessment for German research and test reactor fuels, the CRP comprises additional focus on monitoring, inspection and surveillance programmes for spent fuel dry storage systems.

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10:30 - 11:00 | No. 202

Numerical simulation of shock absorber used for safeguard of the spent nuclear fuel casks with spent fuel in case dropping

G. Dundulis (LEI), E. Babilas (LEI), V. Eidukina (KUT) and V. Grigas (KUT)

The Ignalina Nuclear Power Plant (INPP) has two RBMK-1500 graphite moderate boiling water multichannel reactors. INPP Unit 1 was shut down at the end of 2004 and Unit 2 was shut down at the end of 2009. Due to the absence of the possibility of spent nuclear fuel (SNF) transport for recycling, it was decided to store SNF in a dry way using first CASTOR RBMK-1500 and later CONSTOR RBMK-1500 casks at the Interim Spent Fuel Storage Facility, which was built near of INPP. In Interim Spent Fuel Storage Facility is equipped special place where casks can be handled. At this place is equipped shock absorbers which should safeguard structural integrity of the casks during dropping. The CASTOR cask is manufactured of the metal, CONSTOR cask – reinforced concrete. The geometry of these casks is different also, therefore of weight of these casks is different also. The proposed design of shock absorber should fulfill the stopping function in case of dropping of spent nuclear fuel casks with different weight.

The objective of this work is the estimation of the weight limits in which the proposed design of shock absorber can fulfill the stopping function of the spent nuclear fuel casks and is capable to withstand the dynamics load. The dynamic numerical investigations using the finite element code ABAQUS/Explicit were performed. The simulation model was verified by comparing the analytical and numerical simulation results. The obtained results enable to make a statement that the developed FE model can be used for numerical modelling of behavior of the given design of shock absorber in case dynamic loads. It was concluded that the shock absorber is capable to withstand the dynamic load in case dropping of casks. Therefore the proposed design of shock absorber can fulfill the stopping function of the casks, i.e. successful force suppression function in case of dropping of casks.

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11:00 - 11:30 | No. 203

The Pathway Evaluation Process serious game to explore the complexity of a safe long term radioactive waste management: a first experience with Civil Society in Belgium

F. Lemy (Bel V), V. Detilleux (Bel V), F. Bernier (FANC), M. Surkova (FANC) and C. Parotte (ULg)

The Pathway Evaluation Process (PEP) is a serious game provided by SITEX Network, a network gathering notably TSOs and Civil Society Organisations having an interest in the safety of radioactive waste management. This serious game allows structuring dialogues between individuals (not necessarily informed about radioactive waste management) about the complexity of a safe long term radioactive waste management. It is thus an interesting tool for TSOs (or other stakeholders) to interact constructively with the Public/Civil Society about the challenges associated with the safety of radioactive waste management, including those related to their disposal.

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11:30 - 12:00 | No. 204

Predisposal Waste Management and Decommissioning of the Finnish FiR1 Research Reactor

E. Holt (VTT), M. Alirila (VTT), P. Kotiluoto (VTT), A. Leskinen (VTT) and M. Oksa (VTT)

In the last two years VTT has made great progress in the decommissioning steps of our pool-type TRIGA research reactor, FiR1 which was commissioned in 1962 and shut down in 2015. Along with the reactor, the historic adjacent laboratories and hot cells are also under decommissioning. The Radiation and Nuclear Safety Authority of Finland (STUK) gave their safety assessment on decommissioning in 2019, and VTT expects the decommissioning licence to be granted by the Finnish Government during 2021.

Because the reactor is a small, operationally safe nuclear facility designed for educational use, the amounts of spent fuel, decommissioning waste and the associated radioactivity are relatively minor. Recently VTT managed to recycle FiR1 spent nuclear fuel for further use abroad. The reactor at the U.S. Geological Survey (USGS), located in Denver, Colorado, USA received the used fuel in January 2021. Arranging spent fuel management abroad is an exception permitted by the Finnish Nuclear Energy Act. Before sending the fuel, Finland received a report of the US authorities on their commitment to the management of the fuel batch. When the USGS ceases to use its reactor, it will deliver the spent fuel to Idaho National Laboratory, where several countries have previously sent similar batches of nuclear fuel from research reactors.

The low- and intermediate level dismantling wastes (LILW) need another solution, and they will be managed in collaboration with a Finnish NPP. VTT has been active in characterisation of the FiR1 reactor and associated laboratory waste streams as part of our licensing and decommissioning plans. The waste management activities are also complemented by coordination and technical involvement in the Euratom PREDIS project on predisposal radioactive waste management. This 4-year project with a 24 M€ budget between 47 partners aims at improved technical solutions for characterisation and treatment of metallic and organic wastes, as well as improved handling and monitoring of concrete waste packages in interim storage. Fortum will ultimately handle the final disposal of the dismantling waste at their Loviisa final disposal LILW facility.

Safety will be an absolute priority during the planning and execution of the VTT plant's and laboratory's decommissioning. All measures related to the decommissioning will be carried out under the supervision of STUK. This presentation will give an overview of the achievements to-date on decommissioning and pre-disposal waste management.