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Director Clean Planet, DG Research and Innovation
on behalf of Mariya GABRIEL (EC) European Commissioner for Innovation, Research, Culture, Education and Youth

Awards ceremony for the Euratom Nuclear Innovation Prize

1. STEERING BRIEF

Scene Setter

You will be awarding the winners of the Nuclear Innovation Prize. The European Commission is the organizer of the Nuclear Innovation Prize.

The Nuclear Innovation Prize is being offered to highlight and reward the excellence in nuclear innovation that can be found in this field of research as well as the quality of the talented researchers and companies involved. This is the first edition of the Prize. We have received 28 proposals and will be awarding 7 winners.

Objective(s)

- Award the Nuclear Innovation Prize winners

Line to take

- EU supports and encourages cutting-edge innovation to maintain a high level of competences, underpinned by sound and advanced research. Nuclear researchers and engineers are constantly challenging state-of-the-art in the field and improving evolving technologies towards a more dynamic and competitive European industry for the benefit of every citizen and the whole of society.

2. SPEAKING POINTS

Award of the Prize

1. Introduction

- I am delighted to open the award ceremony for the Nuclear Innovation Prize.
- Before announcing the winners, I would like to share a few thoughts on the prize.
- This prize rewards outstanding researchers or industries who try to find innovative ideas or new solutions, possibly with wider applications.
- Nuclear research has pushed advances in disciplines ranging from medical technology, environment to astrophysics and material sciences.
- Today, we are not only rewarding the best candidates and their work, but we are also rewarding the institutions which they are representing.
- We are giving seven Prizes to particularly successful projects in the field safety of reactor systems or radioactive waste management. I can assure you that the selection process was not an easy task.
- We have received 28 proposals that were all assessed based on originality and replicability, technical excellence, and economic impact and exploitation of the innovation
- The decision was made by an independent jury composed of experts in the nuclear area from business and academia.
- Finally, I would like to thank all those who participated in the first edition of the Nuclear Innovation Prize, and I would like to strongly encourage others to participate in the second edition that will be launched in 2024.
- On that note, I would like to proceed with awarding of the Nuclear Innovation Prizes.

2. Awards

- Let’s start with the category of safety of reactor systems. In this category, the experts have decided that the Third Prize will be shared between two excellent proposals.

- I am pleased to announce that the **Third Prize in safety of reactor systems** is awarded to **Professor Jaakko Leppänen from VTT** Technical Research Centre of Finland. Congratulations *(give diploma & Karolina give out the trophy).*
- **Dr. David Legrady from Budapest University of Technology** and Economics is also receiving the Third Prize in safety of reactor systems. Congratulations *(give diploma & Karolina will be giving out the trophy).*

- The **Second Prize goes to Mr. Luis Lopez from Iberdola,** he will receive the Prize on behalf of the two research teams: **Iberdola and Innomerics**. *Congratulations (give 2 diplomas & Karolina will give out the trophy).*

- I am pleased to announce that the **First Prize** goes to **Dr. Martin Sevecek from the Czech technical university in Prague.** *Congratulations (give diploma & Karolina will give out the trophy).*

Now let’s continue with the category of radioactive waste management.

- The **Third Prize** goes to **Mrs. Gabriele Strehalu from RWE and Mr. Pedro Santos from Fraunhofer**. *Congratulations (give 2 diplomas & Karolina will give out the trophy).*

- I am pleased to award the **Second Prize** to **Dr. Laurent Coquard and Mr. Alexandre Felt from Framatome** who will be receiving the Prize on behalf of the research teams including among others **Aachen Institut for Nuclear Training**. *Congratulations (give 3 diploma & Karolina give out the trophy).*

- The **First Prize** goes to **Prof. Bo Wilhelm Cederwall from KTH Royal Institute of Technology in Stockholm**. *Congratulations (give 2 diplomas & Karolina give out the trophy).*

- I would like to invite all of you to join me in participating to the Nuclear Innovation Prizes pitches today at 16:30.

- To close this ceremony, I would like to wish all seven Nuclear Innovation Prize winners success in their careers and further development of their innovations.

3. ABSTRACTS OF THE PRIZES:

Nuclear Innovation Prize in safety of reactor systems

First Prize – MultiProtectFuel

Accident Tolerant or Advanced Technology Fuels (ATF) are one of the hottest research topics in the nuclear engineering research and development area since the Fukushima-Daiichi events with the first concepts inserted into commercial nuclear power plants in 2019. The most advanced ATF concept is Cr-coated Zr-based alloy which was chosen as the near-term ATF solution by fuel vendors operating on the EU nuclear fuel market - Framatome, Westinghouse Electric Company, and TVEL. The research group at CTU in Prague identified several new degradation phenomena linked to this concept such as material interdiffusion, Cr enhanced embrittlement, and Zr-Cr eutectic formation. The optimization of advanced coating techniques and fuel cladding design led the team to develop and qualify innovative multicomponent Cr/CrN coated Zr alloy cladding that limits the degradation effects such as Cr enhanced embrittlement and delays the eutectic reaction to much higher temperature making the cladding more resistant and accident tolerant in comparison with both traditional Zr-based alloys as well as pure Cr coated Zr alloys. This innovative solution was qualified out-of-pile and is now under in-pile investigation in the LVR-15 reactor. In the next phase, this innovative nuclear fuel cladding will be inserted into a commercial reactor as a non-fueled material, the fabrication process will be qualified for industrial production, and the complete solution will be offered to fuel vendors as an advanced near-term nuclear fuel cladding for the current generation of light water reactors. Currently, there are ongoing discussions about future joint ventures or license transfers from CTU to one of the commercial fuel vendors operating on the EU market.

Second Prize – MitMAT

Targeting ultimate fidelity coupled reactor physics and thermal-hydraulics calculations has recently entered the forefronts of reactor safety analysis research enabled by the vast forward leap of High Performance Computing (HPC). Our project has achieved a breakthrough by introducing Graphics Processing Units (GPU’s) to the prodigiously progressive Dynamic Monte Carlo (DMC) method where time dependence is handled explicitly rather than by a series of static calculations, achieving simulations very faithful to nature. Algorithms were devised such that they both optimally fulfill DMC requirements and adapt to GPU specificities, moreover attention was paid to keeping statistical variance of the population low. In 2016 the GUARDYAN (GPU Assisted Reactor Dynamic Analysis) code development started and recently reached the capabilities to accomplish full core VVER-440/V213 calculations with meaningful detector reading simulation results. This indicates that with the inventions conceived and implemented into GUARDYAN, the DMC method was promoted from proof-of-concept to real application to power plants. The code has been verified and validated against 30 ICSBEP benchmark scenarios by comparison to MCNP6.1 for approximately 440 000 data points; further by performing experiments using the Budapest University of Technology and Economics (BME) Training Reactor of a Cd sample insertion and rod drop experiments, and even further by replicating a recent safety rod drop experiment results of the Paks Nuclear Power Plant for a VVER-440/V213 unit with realistic burnup values, each comparison was concluded with complete success. The code GUARDYAN fused existing and novel Monte Carlo techniques with GPU based high performance computing advocating DMC to be the gold standard of reactor physics, a calculation tool devoid of obscure approximations. A high fidelity simulation tool enables a more optimal use of design safety margins and creates room for efficiency improvement of NPPs.

Third Prize – GUARDYAN

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Third Prize – DH-LDR

This invention is related to the passive decay heat removal function of the LDR-50 low-temperature decay heat reactor developed at VTT Technical Research Centre of Finland. The invention enables passive cooling of the reactor core without any mechanical moving parts. The application describes the technology and operating principle behind the invention, and presents results of computational simulations demonstrating its applicability. The economical and environmental impact of the invention results from the fact that inherent safety is considered a necessary requirement for district heating reactors, since the heating plant must be constructed close to urban areas. The background on heating reactors and the significance of decarbonization of heating systems is discussed, and the market potential of the LDR-50 reactor briefly evaluated.

Nuclear Innovation Prize in radioactive waste management

First Prize – ARCTERIX

The proposal concerns a newly developed technology for non-destructive assay (NDA) of radioactive waste that we call ARCTERIX. ARCTERIX stands for AdvancThe proposal concerns a newly developed technology for non-destructive assay (NDA) of radioactive waste that we call ARCTERIX. ARCTERIX stands for Advanced radwaste characterization based on tomographically enhanced radiation imaging without X-rays. The concept is based on the novel 3D radiation imaging modality for special nuclear materials (SNM) - neutron-gamma emission tomography (NGET) - invented by the PI. The purpose of the present application is to demonstrate how the invention establishes a new ground-breaking modality for passive NDA interrogation of mixed long-lived radioactive waste, so called legacy waste, with special security and safeguards concerns due to the presence of SNM. A detection system featuring the NGET imaging modality can also be applied to radioactive waste characterization in general, including verification of spent nuclear fuel and other high-level waste. ARCTERIX provides rapid imaging of nuclear materials and characterization of radioactive waste with a high degree of automation. In the future, we believe the technique can also be adapted for use with active interrogation measures based on pulsed and continuous neutron sources and high-energy photon sources. The ARCTERIX prototype system has demonstrated a high technological readiness to implement the technique in a commercial stand-alone system for rapid assessment of radioactive waste drums or in a system operating in conjunction with established techniques. By enabling rapid, high-spatial-resolution imaging of SNM the ARCTERIX concept has the potential to take routine radioactive waste characterization to an entirely new technological performance level. Its high throughput capabilities make it possible to quickly scan large radioactive waste inventories for the presence of special nuclear materials with minimal manual intervention.

Second Prize – QUANTOM

During the last decades, the nuclear and non-nuclear industry has produced a considerable amount of low (LLW) and intermediate level (ILW) radioactive waste. Though the waste form and streams might be different, such radioactive waste must be safely disposed in a final repository under the same strict waste acceptance requirements (e.g. the radiological and material characterization) defined by national licensing and supervisory authorities. Material characterization remains an indispensable criterion to prevent pollution of the ground water with toxic materials. Nowadays material description stays very challenging for waste producers, especially for legacy waste. It can be performed on the basis of existing documentation or, if the documentation is insufficient (e.g. legacy waste), on further destructive or non-destructive analysis. Destructive analysis is not favored as operating personal is exposed to radiation, the waste volume is increased, it is very time-consuming and generates high costs. Therefore non-destructive methods are to be preferred. This R&D project presents an innovative non-destructive technology called QUANTOM® based on Prompt and Delayed Gamma Neutron Activation Analysis (P&DGNAA). This technology is able to identify, verify and quantify the amount of hazardous and non-hazardous substances in waste packages such as 200-l radioactive drums. The QUANTOM® measurement device will be integrated in a transportable container in order to perform measurement campaigns directly on site. The main benefits of QUANTOM® are summarized below:

- Non-destructive multi-element analysis with high sensitivity (ppm-range) of the entire matrix
- Fast measurement process (2h-4h per waste drum) with high measurement precision
- No repackaging and no increase of waste volume

- Reduction of costs (min. 50% per waste drum) compared to destructive analysis processes
- Minimizing the transportation of radioactive waste packages and radiation exposure

Third Prize – ROBBE

For a successful dismantling of a nuclear power plant, correct and controlled processing of all components is necessary, whereby a large part of the work relates to coated (mainly painted) steel components, which make up a significant proportion of the total inventory of the power plant to be processed. The contamination of these components will be reduced by removing the surface coating using the UHD water jet technology in such a way that the decontaminated material will be released after it has been released in accordance with Chap. 3 StrlSchV (German Federal Law Gazette 2018 No. 41: StrlSchV, 2018) can be recycled conventionally. The manual processing of these individual parts is cost-intensive, so that an autonomous, automated solution is more economical when increasing throughput and ensuring consistently high quality. In addition, almost all processes, especially UHD water jet technology, require personal protective equipment and the work is very physically demanding for employees and poses a potential risk. The aspects of radiation protection should not be neglected either. In the case of manual processing, the staff is exposed to radiation that is not applicable to the autonomous variant. This corresponds to the ALARA principle. The aim of the project is to implement, for the first time, an automated and autonomous removal of the coating from component groups using UHD water jet technology when dismantling core technical systems and to use it in the German Biblis NPP on an industrial, productive scale. The acronym “ROBBE” (ROBOT-assisted processing of assemblies during the dismantling of nuclear power plants) is derived from this project objective. The core of the technology to be developed is the autonomous real-time acquisition of the 3D geometry of various components with multiple coatings, as well as the path planning derived from this for robot-assisted stripping using UHD water jet technology.