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Nuclear Energy for New Europe

11th -14th September 2023
Portorož, Slovenia

32nd International Conference
Nuclear Energy for New Europe

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Previous Meetings Organized by the Nuclear Society of Slovenia

- First Meeting of Nuclear Society of Slovenia, Bovec, Slovenia, June 1992
- Regional Meeting: Nuclear Energy in Central Europe, Present and Perspectives, Portorož, Slovenia, June 1993
- PSA/PRA and Severe Accidents '94, Ljubljana, Slovenia, April 1994
- Annual Meeting of NSS '94, Rogaška Slatina, Slovenia, September 1994
- 2nd Regional Meeting: Nuclear Energy in Central Europe, Portorož, Slovenia, September 1995
- 3rd Regional Meeting: Nuclear Energy in Central Europe, Portorož, Slovenia, September 1996
- 4th Regional Meeting: Nuclear Energy in Central Europe, Bled, Slovenia, September 1997
- Nuclear Energy in Central Europe `98, Čatež, Slovenia, September 1998
- Nuclear Energy in Central Europe `99 with Embedded Meeting Neutron Imaging Methods to Detect Defects in Materials, Portorož, Slovenia, September 1999
- 20th International Conference on Nuclear Tracks in Solids, Portorož, Slovenia, August 2000
- Nuclear Energy in Central Europe 2000, Bled, Slovenia, September 2000
- Nuclear Energy in Central Europe 2001, Portorož, Slovenia, September 2001
- Nuclear Energy for New Europe 2002, Kranjska Gora, Slovenia, September 2002
- Nuclear Energy for New Europe 2003, Portorož, Slovenia, September 2003
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- Nuclear Energy for New Europe 2022, Portorož, Slovenia, September 2022

Welcome

Dear participants,

Welcome to the 32nd conference Nuclear Energy for New Europe. Traditionally organised by the Nuclear Society of Slovenia, this conference is an international meeting of nuclear experts dealing with different aspects of nuclear energy. The primary objective of the meeting is to foster international cooperation amongst professionals from nuclear utilities, nuclear research organisations, educational institutions, industrial companies, and regulatory bodies.

Nuclear. The surest path to a brighter future. With this conference slogan, we emphasise the importance of nuclear energy as a key clean energy source, enabling countries to achieve ambitious international and national climate and energy goals effectively and efficiently. But not only climate and energy goals. Nuclear energy is furthering all seventeen United Nations sustainable development goals, including healthcare, food security, access to clean water, industry, and economic growth.

The conference program begins with lectures on nuclear energy's role in national energy and decarbonisation strategies of France and the United Kingdom, two countries with very serious climate and energy independence goals. For nuclear energy to achieve its full potential globally, nuclear knowledge and expertise growth will be needed in several parallel development pillars. The conference program features distinguished speakers who will delve into key topics addressing these development pillars: long-term operation of existing large reactors, activities related to planning and construction of new reactors, and development of future generation reactors for even more versatile applications. A systematic approach to human capacity building across all those pillars will be required to reach sustainable growth and stability in nuclear organisations.

Additionally, contributed papers will offer valuable insights into the latest scientific research and technological advancements in energy and decarbonisation policies, nuclear power plant operations, outage management, lifetime extensions, nuclear regulation, reactor physic and research reactors, thermal hydraulics, probabilistic safety analyses, nuclear materials, fuel cycle and radioactive waste, nuclear education, training, and nuclear leadership. The conference will emphasise and discuss the opportunities and challenges associated with all aspects of peaceful uses of nuclear energy and nuclear power generation.

All these topics are timely and relevant for Slovenia, with the recent final approval of a lifetime extension for NPP Krško, with active planning of new reactors in Slovenia and intensive development of future generations of nuclear experts. The record-breaking number of participants in the young authors contest at this conference also shows how the young generation of experts believes in nuclear power as a secure path to a clean, bright energy future.

We look forward to your attendance at the conference.

Melita Lenošek Kavčič
Organizing committee chair

Dr. Tomaž Žagar
Program committee chair
Nuclear Society of Slovenia President

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Licensing fusion facilities based on the ITER and DEMO paradigms

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The safety assessment for an authorized facility is performed in order to evaluate its compliance with the set of safety requirements and provide the evidence of achieving the safety objectives. It is prepared by the licensee as a structured document – safety case whose content depends on the national legislation and the nature, purpose and development phase of the facility. With regard to the DEMOnstration Power Plant (DEMO) and ITER facilities, the objective of the safety case documentation is to demonstrate the achievement of six, top-level safety objectives. [1]

To this end, three questions were posed – within the HARMONISE [2] project – while reviewing the available safety case documentation of the ITER and DEMO facilities from the point-of-view of the licensing process:
What are the important outcomes that ought to be considered in the future licensing process of fusion power plants?

What improvements could be introduced in the future licensing process of fusion power plants?

What R&D tasks are required to support the future licensing process of fusion power plants?

The review performed has taken as a basis the IAEA GSR Part 4 [3] requirements with the intention to identify constituents that will contribute towards the licensing harmonization of fusion power plants in the future. As such, the facilities under consideration – an experimental and a demonstration infrastructures – represent successive implementations towards a fully operational fusion power plant. Because of their radioactive contents both ITER and DEMO are characterized as facilities in need of an authorization from a regulatory body. While the first has received it from the French nuclear safety regulator ASN (Autorité de sûreté nucléaire), the latter being in the conceptualization phase has yet to be submitted to the licensing process that will be formulated in accordance with the regulatory framework of the hosting State.

In agreement with IAEA GSR Part 4 that dictates: “A graded approach shall be used in determining the scope and level of detail of the safety assessment carried out …” the safety cases were assessed for the two facilities at the principle level considered during designing the safety architecture of each facility with a level of detail that depends upon the information available. The different maturity levels of the two facilities provided a higher level of detail for ITER than that of DEMO.

The findings of the assessment that are based on specific designs using deuterium-tritium plasmas shaped and confined by magnetic forces will be presented and discussed outlining also the gaps that are to be filled in harmonizing the licensing process of fusion power plants in the future.

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[1] Neill Taylor et al., Safety and environment studies for a European DEMO design concept, Fusion Engineering and Design, Volume 146, Part A, 2019, pp. 111-114
[2] https://harmonise-project.eu/, retrieved on 29 May 2023
[3] IAEA, Safety Assessment for Facilities and Activities, IAEA Safety Standards Series No. GSR Part 4 (Rev. 1), IAEA, Vienna (2016)

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Experimental simulation of fusion-relevant radiation environments in bulk samples

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In radiation environments of some advanced nuclear facilities such as fission, fusion, and accelerator-driven, radiation-tolerant materials may suffer from radiation embrittlement, including volumetric cavity swelling. From the material engineering point of view, it is critical to know when the microstructure of irradiated material gets to the stage where it may pose a safety hazard. Predicting the transition from safe to unsafe conditions requires understanding the early stage of the radiation ageing processes, including sinking point defects and transmutation products such as hydrogen and helium. Positron annihilation spectroscopy (PAS) is a technique known for its unique sensitivity to point defects and early-stage open-volume. However, in its most common setup, it probes a bulk of tens of micrometres. At the same time, conventional ion beam irradiation experiments used in research on nuclear materials provide displacement damage of only a few microns.

This contribution reports our recent high-energy (up to 17MeV) high-fluence (5.42 x 10^19 cm-2) helium implantation experiment, which has been used to obtain a quasi-homogenous displacement damage profile up to 70 micrometres in various samples of ferritic/martensitic steels for nuclear applications. These samples