Nuclear Science for Sustainable Environment and Security

JRC and INRNE Joint Activities Recent Results

Excellence, Sustainability, Integration



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Mission



INRNE is nuclear research institution and the biggest leading complex centre in Bulgaria for scientific investigations and applications of the nuclear science

Vision

INRNE has to satisfy the needs of the society for support and development of the nuclear science and knowledge towards to perform investigations and applications on the field of nuclear technologies, medicine, industry and environment

Integrated Quality management system since 2003/2004 ISO 9001:2000 ISO 14000:1996

IRMM - INRNE Neutron Investigations



towards to access safe operation of nuclear reactors, model the ageing of operating NPP, development of new reactor concepts, various technological applications

Neutron cross sections investigations

The thorium – uranium fuel cycle is very attractive because it limits the build up of highly radioactive trans uranium nuclides.

Gelina facility Accelerator Driven Systems based on Th– U – fuel cycle → to increate the waste of NPP

¹⁰B(n,α) standard reaction investigations: 10B(n, α_0)/10B(n, $\alpha_1 \gamma$) branching ratio up to 2MeV



Cross section measurements of Activation neutron – induced reactions

towards to determine activity levels induced during the reactors operation and for low activation material development



IE - INRNE

NET - Neutron Techniques Standardization for Structural Integrity

The main objective of the NET European <u>Network</u> is performance and safety enhancement of European Nuclear Power production by supporting the structural integrity and the safe operation of ageing reactors.

<u>The Network aims</u> at the development and standardization of novel experimental (e.g., neutron diffraction, Small Angle Neutron Scattering) techniques and advanced numerical modelling methods for the investigation of residual stress and defects in welded structural components.



SAFELIFE Project – 1 Post Doc work

Methods:

 <u>Neutron Diffraction</u> towards micro-structural characterisation, residual stress analysis, defects analyses; Evaluation of the effects of thermal and irradiation exposure
<u>Small Angle Neutron Scattering</u> towards nanoscale characterization of thermal ageing effects

IE - INRNE Neutron Fluence for Reactor Vessel Embrittlement

REDOS

towards to assess the fast neutron fluence onto the RPV is therefore required for evaluation of vessel steel degradation



Calculated (curves) and measured (signs) induced activities of the scraps and ex-vessel detectors, Unit 1, Kozloduy NPP, 18th cycle. **REDOS** (Reactor Dosimetry: Accurate determination and benchmarking of radiation field parameters, relevant for reactor pressure vessel monitoring) is being carried out during 2001-2004 in joint works of Tecnatom (Madrid), JRC-IE (Petten), INR (Prague), INRNE (Sofia), Skoda (Plzen), KFKI (Budapest), INR (Rossendorf), Framatome (Erlangen).

INRNE responcibilities are:

- Neutron and gamma transport calculations of VVER440 and VVER1000 RPV benchmarks.
- Data and analyses of ex-vessel detectors measurements in Kozloduy NPP.
- Calculations of neutron and gamma fluxes and radiation damages on VVER1000 and VVER440 RPVs.

IE - INRNE NPP Safety Analysis

SARNET FR6 NoE

Network of Excellence for Sustainable Integration of European Research on Severe Accident Phenomenology

Basis:

Kozloduy VVER-1000 Reactor and Pressurizer RELAP5 Model

Aims:

- Analytical Code Validation
- Analytical validation of Emergency Operating Procedures
- Severe Accident Analysis





IE - INRNE FP6 COVERS project



Improvement of professional and communication environment important for ensuring a continuing safe and efficient operation of nuclear power plants with VVER-440 and VVER-1000 reactors



Problems to be solved:

Field content Spent field casks Storage facility design

ITU - INRNE Research and Development for Licensing Fuel in Bulgaria

The TRANSURANUS code, proved to be promising for assessing the fuel performance in WWER's operated in the East **European countries**

Main results of TRANSURANUS-VVER calculations

- the burn up calculations are in excellent agreement:
- the fission gas release calculations are in very good agreement;
- the size changes of the cladding are reproduced satisfactorily;
- the gas pressure is reproduced very well.

The obtained results serve the national needs in the field of the radiation safety, safe operation of the NPP and the reactor physics science







JRC - INRNE Future Nuclear Energy Systems – Generation IV



Generation IV is an international initiative aimed at developing nuclear energy systems that can supply future worldwide need for electricity, hydrogen and other energy products



JRC - INRNE IP EUROTRANS – Transmutation of High Level Nuclear Waste in Accelerator driven Stystem

Improvement of the simulation tools for ADS transmuters and its associated advanced fuels







ITU - INRNE Combating Illicit Trafficking of Nuclear Materials GAMDETEC Project



Objectives

Further improvement the capacities for gamma analysis of nuclear samples in Bulgaria - transfer of equipment (Supply of ORTEC Detective system with a Stirling-cooled HPGe detector)

Exchange of technical experience related to the treatment and analysis of vagabonding materials

ITU - INRNE Environmental Radiation Monitoring



ITU Project " Harmonization of techniques and methodologies for sampling and measuring radioactivity in the environment"

Checking of sampling procedures and analytical methods towards to reach the EU - wide harmonization of analytical procedures and the development of a common quality assurance/quality control programme.

The environmental monitoring covers the areas of INRNE (including the area of IRT-2000), the area of the National Radioactive Waste Repository Site in Novi Han and 2 referent sites (Vitosha mountain and BEO Moussala).

More than 40 years this monitoring is carried out at the same sites with the use of same or compatible techniques, leading to the accumulation of a significant data base, including the period of atmospheric nuclear tests and the Chernobyl accident.





2.7 2.10 2.13 2.16

months

INRNE - JRC FP6 BEOBAL Project BEO Centre of Excellence Research Capacity Improvement for Sustainable Environment and Advanced Integration into ERA

Main goals

Networking, International Collaboration & Integration and Reinforced Research Infrastructure

Improvement of Human Resources

Advanced Science – Society Interactions

Advanced Management



NUSES Work Programme

Main goal – Integration between INRNE and JRC

Recent results

- 5 new joint EURATOM projects
- I FP6 project BEOBAL
- 1 JRC INRNE project GAMDETEC
- Generation IV initiative joining
- Extreme intensive personal exchange and training INRNE – JRC institutes: ITU, IRMM, IE

Good joint practices

- JRC INRNE leadership coordination meetings
- Development of joint project proposals
- Regular estimation of the work programme progress by express survey questionnaires

New Ideas

Safety Analysis for Spent Fuel Facilities

Calculatonal analyses of the spent fuel storage and transportation facilities are needed for substantiation of their nuclear and radiation safety

Application of SCALE modular code system is proposed

The further VVER SCALE applicability aspects discussion is planed to be performed in the frames of WP3 "Operational safety" of the project COVERS (NUCTECH-2004-3.4.3.1-2 VVER Safety Research) of FP6 Euratom

Radioecotoxicological studies

Impact assessment of environmental global changes on the living organisms and water

Where is a will where is a will is a way

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