National Centre for Nuclear Research

Nuclear Energy Division

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The European programmes supporting the development of nuclear energy in Europe, with particular reference to nuclear cogeneration and the role of Poland in these programmes

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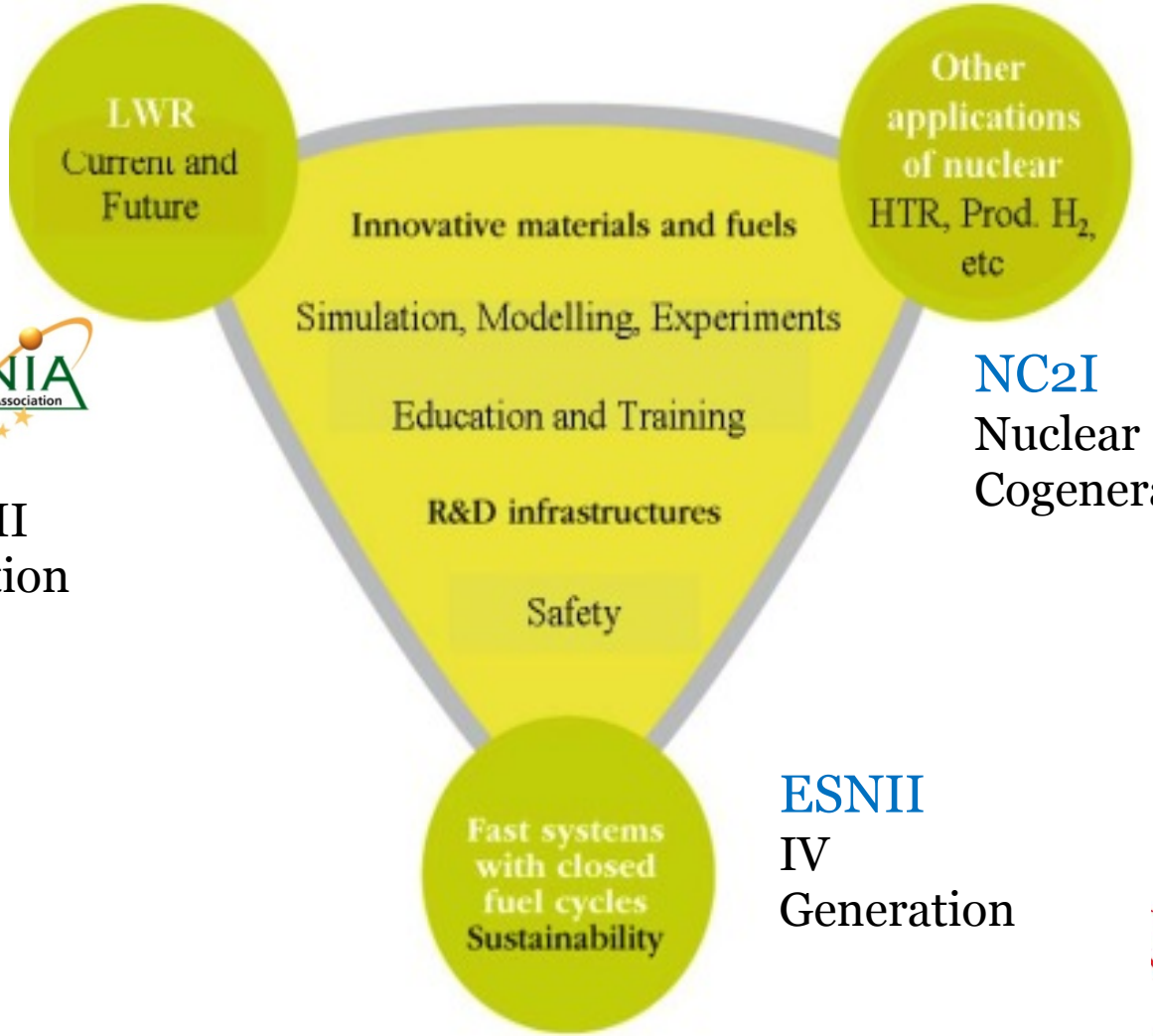
Outline:

- SNETP – SustainableNuclear Energy Technology Platform
- European programmes:
  - EUROATOM FP7
    - PRE-XFEL
    - IPPA
    - **NC2IR- Nuclear Cogeneration Industrial Initiative – Research**
    - ASAMPSA_E: Advanced Safety Assessment Methodologies: Extended PSA
    - ESNII+ European Sustainable Nuclear Industrial Initiative
    - ALLIANCE part of the Allegro programme
    - NURESAFE
  - Starting projects:
    - BRILIANT- nuclear energy for Baltic Regon
    - ARKADIA
    - VINCO
- Polish programmes
  - Świerk Computing Centre (CIŚ)
  - **HTR-PL**
  - 4LABy
  - Science & Technology Park in Świerk

SNETP



NUGENIA
NUclear GENeration II & III Association

II and III
Generation

NC2I
Nuclear
Cogeneration

ESNII
IV
Generation

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SNETP

- Aim of the organisation:

Coordination of european R&D in nuclear field

- Activities include projects in the frame of three SNETP pillars:
  - NUGENIA: Light-water reactors;
  - ESNII: Fast reactors with associated plants of the closed fuel cycle, and
  - NC2I: (Very-)high-temperature reactors

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NUGENIA

- NUGENIA is an association dedicated to the research and development of nuclear fission technologies, with a focus on Generation II and III nuclear plants.
- It gathers stakeholders from industry, research, safety organizations and academia, committed to develop joint R&D projects in the field.
- NUGENIA builds on the past success of a European Commission-supported network called NULIFE, and integrates a working group from SNETP, it also targets to include the SARNET network.
- The work of NUGENIA is organized in seven technical areas, within a general scope defined by the Strategic Research Agenda published by SNETP, the European stakeholder forum for nuclear technology.

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Projects in NUGENIA

- *Fast-running simulator* (**FASTQUICK**)- RSE Milano
- *In Vessel Melt Retention Severe Accident Strategy for existing and future NPPs* (**IVMR**) – IRSN
- *Integrated Deterministic – Probabilistic Safety Analysis* (**IDPSA**) – KTH, GRS
- *Nugenia Water Hammer* (**NEW**)
- *Multi-scale Approach to address Fuel and Fission Products safety issues during any abnormal situation* (**FUEL**)

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PRE-XFEL

Preparatory activities for the implementation of the European X-ray Free-Electron Laser Facility

- Programme: FP7
- Phase: Grant Management
- Role: Beneficiary

The objectives of the PRE-XFEL are:

1. to provide the technical, legal and financial documents which are necessary for the foundation of this new research infrastructure in Europe.
2. to advance as far as possible in the specification, research and development, prototyping and industrialization of buildings, technical infrastructure, technical components, in order to start the construction phase with maximum probability to conclude it successfully on time and budget.
3. to mobilize the potential users community, which is multidisciplinary and possibly composed by scientists experienced with synchrotron light sources, with ultrafast lasers, and ultrafast electron diffraction.

- **FP7-EURATOM –IPPA 2011-2013 Implementing Public Participation Approaches in Radioactive Waste Disposal**

The new approach to public participation in environmental decision-making methods was the reason of Poland participation in IPPA EP7 project where the methods of communication with society and transparency of decision-making actions are developed. The main goal of IPPA project in Poland was to build the safe base and space for dialogue between interested parties involved in decision process related to radioactive waste management in Poland.

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Implementing Public Participation Approaches in Radioactive Waste Disposal (IPPA) - finished

- The focus of IPPA is on the establishment of areas where different stakeholders can move forward together to increase their understanding of the issues involved in radioactive waste disposal and of their respective views.
- The focus is on implementation in some central and eastern European countries.
- The overall structure is in one end to take stock of existing research results and other experiences for implementation, and in the other end to evaluate to provide feedback to knowledge and research.
- The framework of the “Implementing Geological Disposal of Radioactive Waste Technology Platform” (IGD-TP) can be a suitable forum in which to investigate these issues further, therefore emphasis is given to linking IPPA results to the development of the platform.
- IPPA consists of six Work Packages.

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NURESAFE
Nuclear Reactor Safety Simulation Platform

- Disaster in Japan as a start point for improvement of nuclear safety – the paramount condition for nuclear industry further development.
- The NURESAFE project addresses engineering aspects of nuclear safety, especially those relative to design basis accidents (DBA) as an answer for the recently occurred need
- Despite the fact that Japanese event was a severe accident, it is clear that control of DBA with defense-in-depth and prevention is a strategic way for safety improvement
- In this respect, the best simulation and best estimate software are needed to justify the design of reactor protection systems and measures taken to prevent and control accidents.

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NURESAFE

- Main goals of NURESAFE:
  - To deliver a reliable software for safety analysis
  - Develop high level of expertise in usege of above mentioned software
- To-be-delivered software will be based on NURESIM platform created during NURESIM project (developed during NURISP project)
- NURESAFE assumes to extend the expertise of the NURESIM applications' usage for safety analysis, operation and design.
- The main outcome of NURESAFE will be the delivery of multiphysics, multiscale applications fully integrated within.

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Project: Alliance

Title: Preparation of ALLegro - Implementing Advanced Nuclear Fuel Cycle in Central Europe

- Program: FP7;
- Phase: Ongoing;
- Role: Beneficiary;
- Total budget (in €): 1 396 860.00, 36 600.00 (NCBJ)

- Focuses on the preparatory phase for developing the ALLEGRO demonstrator.
- Based on the Gas Fast Reactor (GFR) concept expected to be built in Central Europe.
- Covers a number of preliminary studies:
  - fuel management,
  - R&D roadmap & infrastructures needs,
  - siting,
  - licensing roadmap,
  - preliminary design,
  - safety analysis.

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Project: ASAMPSA_E

Title: Advanced Safety Assessment : Extended PSA

- Program: FP7;
- Phase: Ongoing;
- Role: Beneficiary;

- If the performance of a Level 1-Level 2 PSA concludes that a low probability event can lead to extreme consequences, the industry (system suppliers and utilities) or the Safety Authorities may take appropriate decisions to reinforce the defence in depth of the plant;
- The project ASAMPSA_E aims at identifying good practices for the identification of such situations with the help of Level 1-Level 2 PSA and for the definition of appropriate criteria for decision making in the European context;
- It offers a new framework to discuss:
  - how extended PSA can be developed efficiently and be used to verify the sufficient of robustness of NPPs in their environment.;
- It will allow exchanges on the feasibility of “extended PSAs” able to quantify risks induced by NPPs site (multi-units reactors and spent fuel pools, modeling impact of internal initiating events, internal and external hazards on equipment and human recovery actions);

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NC2I-R

Nuclear Cogeneration Industrial Initiative - Research and Development Coordination

- Call: FP7-Fission-2013
- Programme: FP7
- Phase: Ongoing
- Role: Coordiantor
- Total budget (in €): 2 478 705.00, 107 880.00 (NCBJ)

Objective of NC2I-R is to structure the European public and private R&D capabilities for delivering a nuclear cogeneration demonstrator fully meeting the market needs.

Action on the base of: EUROPAIRS project and in close collaboration with the on going ARCHER project, national projects (e.g. Polish HTRPL, German SYNKOPE), non-EU HTR programs (US, China, South Korea, South Africa) and Generation IV International Forum

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NC2I-R

NC2I-R will:

1. Structure the European public and private R&D capacities towards nuclear cogeneration demonstration and identify clearly the status of Europe's public and private R&D infrastructures and competences.
2. Define the safety requirements to prepare for the future licensing process for a cogeneration demonstrator and limit the associated risk.
3. Define clear and consensual specifications for the demonstrator, ensuring its economic viability, its market fit, its future reliability and its safety, in particular of the coupling scheme, and limiting all construction project risks.

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NC2I-R

1. Manage the knowledge from past projects on HTR and nuclear cogeneration with a comprehensive experience feedback in order to identify potential points of attention and success factors.
2. Prepare on a joint roadmap paving the way for today's European R&D capacities towards the commissioning of the specified demonstrator and identify potential gaps.
3. Prepare for and organize the cooperation with non-European similar programs to possibly share the demonstrator risk in line with the European interest and to secure EU's leadership position in the global competition for HTR.
4. Prepare a smooth and inclusive governance for the future NC2I, engaging all stakeholders including civil society into a wide.

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ESNII PLUS
Preparing ESNII for HORIZON 2020

- Call: FP7-Fission-2013
- Programme: FP7
- Phase: Ongoing
- Role: Beneficiary
- Total budget (in €): 10 339 372.00, 100 000.00 (NCBJ)

The aim of this cross-cutting project is to develop a broad strategic approach to advanced fission systems in Europe in support of the European Sustainable Industrial Initiative (ESNII) within the SET-Plan.

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ESNII PLUS

The project aims to:

1. prepare ESNII structuration and deployment strategy,
2. to ensure efficient European coordinated research on Reactor Safety for the next generation of nuclear installations, linked with SNETP SRA priorities,
3. define strategic orientations for the Horizon 2020 period, with a vision to 2050.

Project will coordinate and support the preparatory phase of legal, administrative, financial and governance structuration, and ensure the review of the different advanced reactor solutions. The project will involve private and public stakeholders, including industry, research and academic communities, with opened door to international collaboration, involving TSO.

FP: 605116 – ARCADIA

Assessment of Regional Capabilities for new reactors Development through an Integrated Approach

11.2011 – 12.2015

27 participants

The **ARCADIA** project has been conceived so as to provide a twofold support to the further development of nuclear research programs in the NMS, targeting two major areas included in the Strategic Research and Innovation Agenda of SNETP: ESNII, trough the support of the ALFRED project towards its realization in Romania and NUGENIA, approaching remaining safety aspects of Gen III/III+ that could be built in Lithuania, Poland, Czech Republic and Slovenia.

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BRILLIANT

- Countries involved:
  - Estonia,
  - Latvia,
  - Lithuania,
  - Poland,
  - Sweden

- Goal:

  Identify bariers in developing nuclear power, specific to the Baltic region.

  Find regional solutions for local problems

BRILLIANT

Baltic Region Initiative for Long Lasting InnovAtive Nuclear Technologies

- **Countries involved in the project:**
  - Lithuania,
  - Poland,
  - Latvia,
  - Estonia,
  - Sweden;

Identified problems:

-Relatively small power systems & no justification for autonomous handling of nuclear wastes

-Basic technical level of heavy industry & diminishing number of qualified workers

-Poor nuclear research infrastructure & competence gap between old and new nuclear programs

Solutions:

- Analysis of electric power systems
- Regional cooperation on nuclear waste and fuel cycle
- Macroeconomic impact of nuclear programs
- Nuclear Research Capacity building

BRILLIANT

Baltic Region Initiative for Long Lasting InnovAtive Nuclear Technologies

- **The Project consists of 6 work packages, which are coordinated by organizations from different Baltic countries:**

WP1 – ***Nuclear Research Capacity building*** (coordinator - National Center for Nuclear Research, Poland),

WP2 – ***Regional cooperation on nuclear waste and fuel cycle*** (coordinator - University of Tartu, Estonia),

WP3 – ***Role of nuclear energy in long-term energy supply in the Baltic region*** (coordinator - Lithuanian Energy Institute),

WP4 – ***Macroeconomic impact of nuclear programs*** (coordinator - Latvia University),

WP5 – ***Public Communication and results dissemination*** (coordinator - KTH Royal Institute of Technology, Sweden).

WP6 – *Project management* (coordinator - Lithuanian Energy Institute).

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VINCO: Visegrad Initiative for Nuclear Coperation

Type: Coordination & Support project *(in preparation)*.

Coordinator: NCBJ Poland

Partners: V4G4 Association (PL, CZ, SLO, H) and CEA France.

Aims: Coordination of research, Education & Training, Capacity Building and Structural Funds acquisition in Visegrad countries.

Focus: Nuclear technologies with a special emphasis on Gas Cooled Reactors (GFR, HTR)

Timeframes: 2015 - 2017

A new proposal in the HTGR field

- Responding to: NFRP - 01 – 2014: Improved safety design and operation of fission reactors
- Goals:
  - To specify the shape of the future european demonstrator plant
  - To solve several remaining technology issues

WP1: Reactor design

- Past EUROPAIRS and ongoing NC2I-R programmes should give us solutions for the main issue of optimum reactor size.
- This WP should give us picture of the future plant.
- Specifications of components should follow

WP3: Graphite

- Graphite undergoes various changes under irradiation. Most notably, it shrinks and swells.
- Creep is another problem.
- Some irradiation in order to investigate this phenomenon has been performed in NGNP programme, but no PIE and data analysis due to lack of funds.
- Very good knowledge on graphite is in UK due to their Magnox and AGR experience.
- Univ. of Manchester and AMEC identified as partners for this WP.
- **Target: Increased knowledge about graphite performance under irradiation. This is important for lifetime of the plant.**

Other possible topics

- Issues with other materials (than fuel and graphite).
- Management of the business group (i.e. energy intensive industry – possible future users of the HTGRs)
- Licensing
- Supply chain analysis.

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Polish programmes

The National Centre for Research and Development

- Programmes cofounded by National Centre for Research and Development
  - Świerk Computing Centre (CIŚ)
  - HTR-PL
  - 4LABy
  - Science & Technology Park in Świerk
  - …

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Świerk Computing Centre

- Świerk Computing Centre (CIŚ) is an answer to dynamically growing demand for IT solutions needed by the power industry sector, both conventional and nuclear. Especially the latter is developing in Poland at a fast pace. The sector needs modern, intelligent and effective IT solutions to quickly and securely compute large amounts of data.
- In nuclear power industry efficient computer clusters may find plenty of applications in such fields as monitoring and simulating radiation hazards, crisis management, design & optimization of power plant equipment, planning of power distribution grids etc.

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High performance computer in CIŚ.

- **Calculations for polish science and deployment of Polish Nuclear Power Program**
  - 1920 cores,
  - 7680 GB RAM purposely **130TB** RAM,
  - 560 TB harddrive, purposely **3200 TB**
  - Theoretycial efficiency present configuration 17,25 TFLOPS
  - Almost **500TFLOPS** in 2015.

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HTR-PL

- Technologies Supporting Development of Safe Nuclear Power Engineeringg
  - **Development of high temperature reactors for industrial purposes**
- Aims:
  - Creating and implementing numerical package for HTR simulations
  - Performing safety calculations for HTR's
  - Review of licensing methodologies for industrial HTR's

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Science & Technology Park in Świerk

- Science and Technology Park in Świerk (Świerk STP) will be a base of resources helping to quickly transform scientific research results into practical applications.
- It will be a base for growth of innovative Hi-Tech businesses that will draw on know-how and experience accumulated in the NCBJ
- It is also envisaged that in the future it will become a local center of knowledge-based economy in the Otwock county area. Scope of its activities will be flexibly adopted to future circumstances, nevertheless its primary functions should basically reflect development of various nuclear technologies and their applications in industry, medicine, power industry, environment protection, biology, and material engineering.

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4 LABy

- **Acceleration Structure Laboratory**
- **Ionic- plasma Beam Laboratory**
- **Radiographical Laboratory**
- **Environmental Measurments Laboratory**

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Other programmes in NCBJ

- **BayesFITS**
  - **Bayesian approach to multi-parameter problems in physics and beyond involving parallel computing and large data-sets** founded by FNP Foundation for Poilsh Science in WELCOME frame
- **HOMING PLUS**
  - **Programme** founded by FNP to encourage young polish scientists to come back to Poland

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Good example of the Polish – Swedish collaboration

- European spallation source

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Euratom – National Structural Funds

- No national financing without European International Collaboration
- No European financing without national suport and national programmes

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Thank you for your attention

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