



Nuclear energy research and development: perspective of the company, the Czech Republic and the European Union

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A **Research and development of CEZ**

B Czech Republic

C European Union

research and development of CEZ is pragmatically oriented



- **Applied and industrial R&D, demonstration of technologies,..**
- **Primary role: support of business**
(improvement of operation of assets + new business opportunities)
- Additional roles: knowledge management, human resources development, support of R&D organisations and HEI, creation of knowledge networks
- **Project-focused system - externally executed (role of CEZ – initiation and management)**
Cooperation: Research institutes, engineering organizations, universities,...
UJV (NRI) + Research Center Rez
- **Various forms of projects (complexity, duration, financing modes,..)**
- **Strengthening of international collaboration (EU, OECD, IAEA, VGB, EPRI)**

Nuclear energy research is the most important area among all topics



Nuclear energy

Safety and risk analysis, support of reliable and efficient operation of NPPs; R&D for Gen III and Gen IV (trends); fuel cycles and radioactive waste management,...

Fossil fuel energy

Efficiency increasing; reducing of environmental pollution (emissions); decarbonisation (CCS),.....

Renewable energy

Low-potential hydro-energy; geothermal energy (HDR); exploitation of innovative solar systems,....

Heating and cooling

Efficiency; centralised and decentralised systems (heat pumps, micro-generation, solar thermal)

Alternative fuels – biomass, waste

Biomass (sources and production, efficient use); waste-to-energy concepts,...

Energy storage

Overview – current, innovative and „breakthrough“ concepts; pilot – stationary application; role of hydrogen,.....

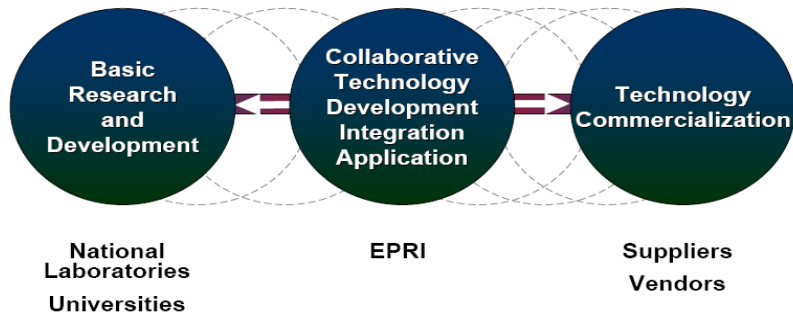
Electricity supply infrastructure (Smart Grids)

System integration, model development, component testing,..

Diagnostics and monitoring; new materials in energy

Implementation of modern approaches (stochastic methods for lifetime assessment), databases,....

CEZ is full member of nuclear sector of EPRI



165 mil. USD/y

			
Generation	Nuclear Power	Power Delivery & Utilization	Environment
<ul style="list-style-type: none"> Environmental Controls Major Component Reliability Combustion Turbines Operations and Maintenance Advanced Coal Plant Portfolio Renewables and Hydropower Generation Planning 	<ul style="list-style-type: none"> Material Degradation/Aging Fuel Reliability High-Level Waste and Spent Fuel Management NDE and Material Characterization Equipment Reliability Instrumentation & Control Nuclear Asset-Risk Management Safety Risk Technology and Application Advanced Nuclear Plant Technology Low-Level Waste and Radiation Management 	<ul style="list-style-type: none"> Transmission and Increased Power Flow Substations and Asset Life Cycle Management Grid Operations, Planning, and Markets Distribution Infrastructure Energy Utilization 	<ul style="list-style-type: none"> Air Quality Global Climate Change Land and Groundwater Water and Ecosystems T&D Environmental Issues Occupational Health & Safety

Example of R&D project: Dissimilar metal welds (steam generators – VVER 440)



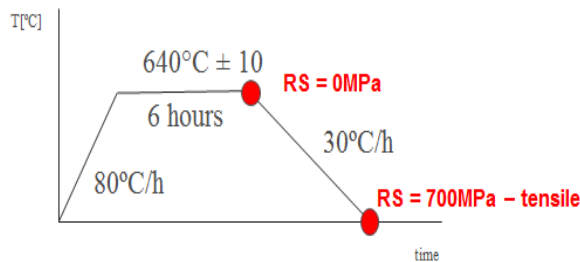
Reliable detection and risk assessment

NDE (ultrasonic) method qualification
Risk assessment methodology

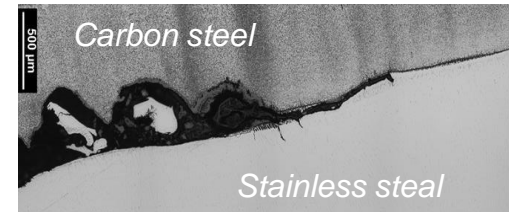
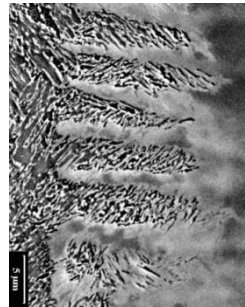
Material research – SCC factors

1) Design and manufacturing deficiencies

Post welding heat treatment



Carbon diffusion

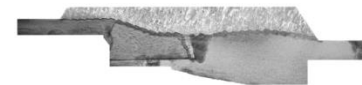


2) Aspects of operation

- Strain loading due to thermal expansion differences (app. 33%)
- Stress concentration factors on the crack tip
- Non-standard corrosion medium (beneath corrosion deposits) and medium contact with material sensitive to SCC

⇒ Development of DMW repair by WOL procedure

⇒ Operation measures (both EDU and ETE)



Example of R&D project: Severe accidents (VVER 1000)

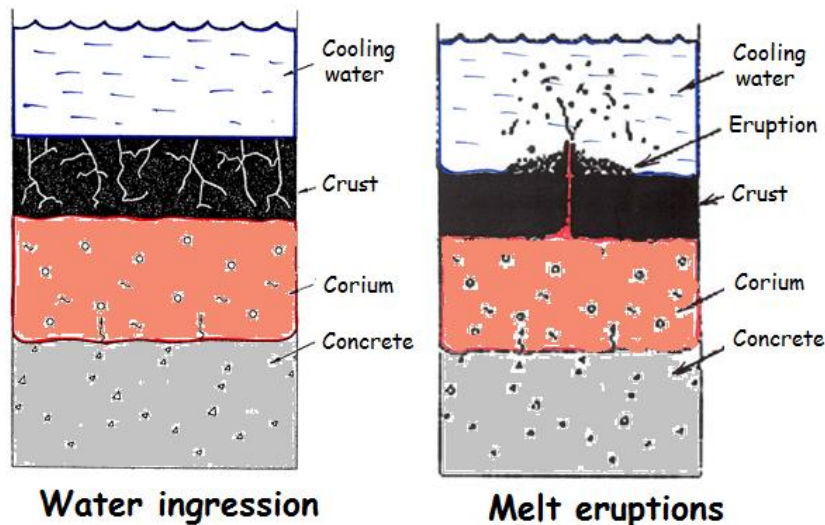


Research in areas of corium localization strategies

Corium coolability during MCCI

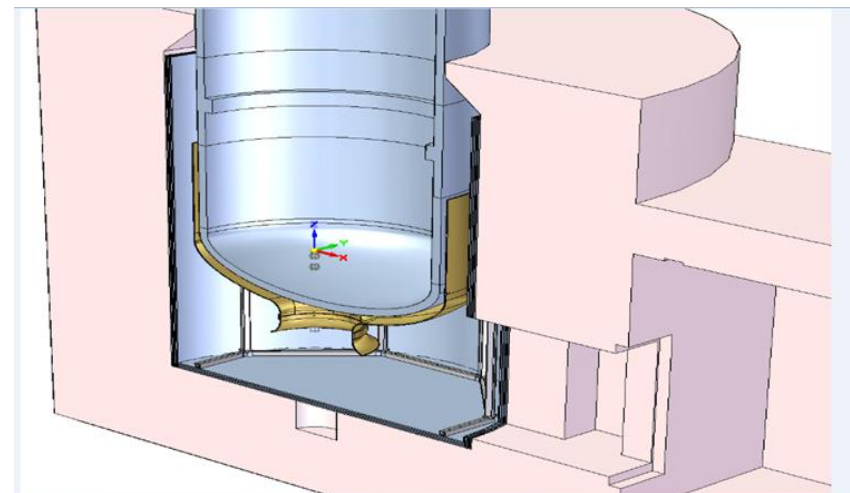
- Transfer of experimental knowledge to plant applications

Intensification of heat removal from corium via melt eruptions and water ingress



In-Vessel Retention Strategy

- Corium composition and heat flux to vessel wall distribution
- Coolant behavior in cavity
- Intensification of heat transfer with
 - Deflector
 - Coating of vessel wall



Example of R&D project: Radioactive waste management



Researcher: UJV, public support: MTI ČR, industrial partner: ČEZ

Very low level waste

Improvement of waste conditioning and matrices and development of innovative approaches

- ❑ Bitumenation
- ❑ Geoconcrete (geopolymers), polysiloxanes, application of nanoparticles,....

Improvement of decontamination methods and technologies

Improvement of analytical methods



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Nuclear energy R&D in the Czech Republic past and current period



Public support of industrial research (including energy research):

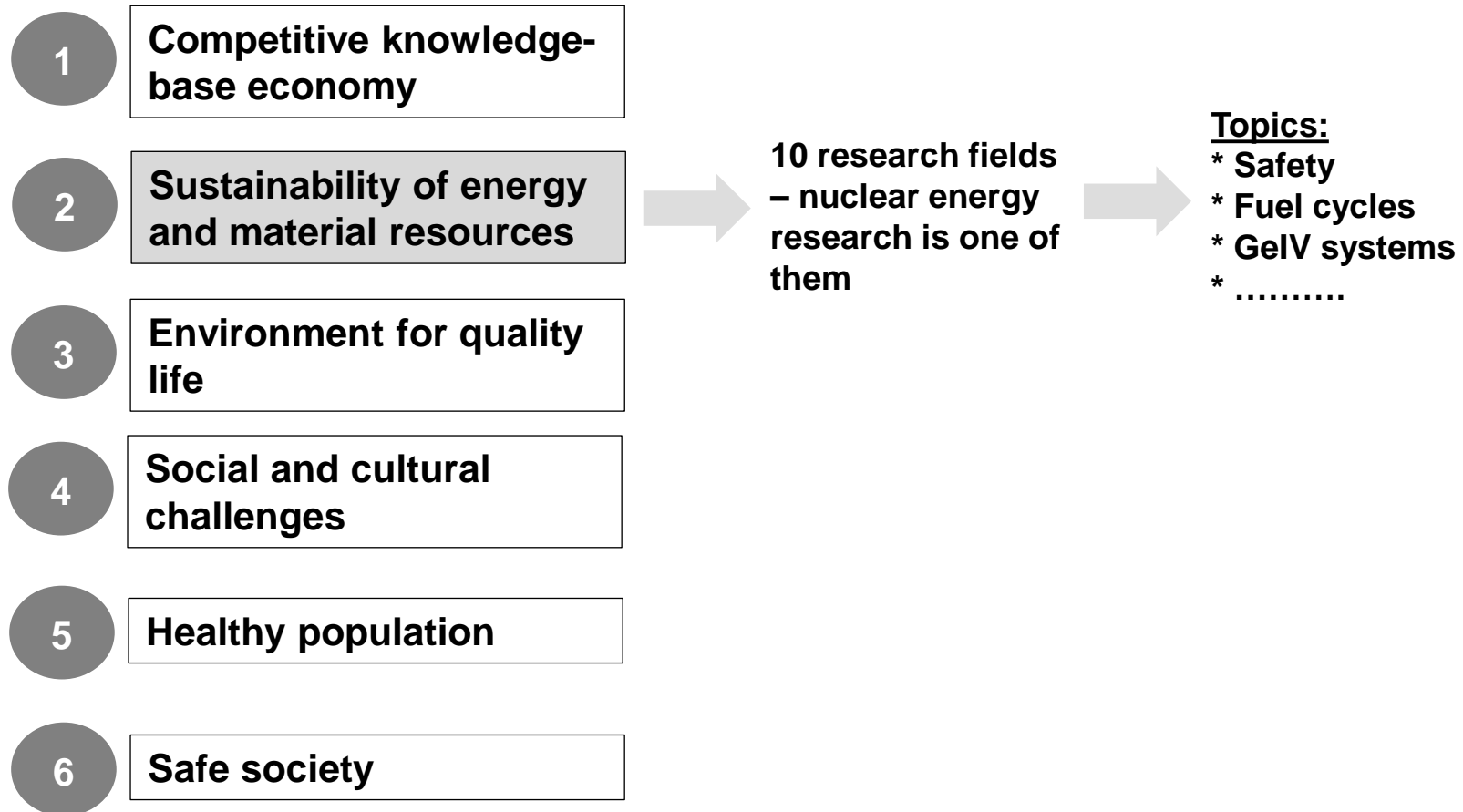
- ❑ **Ministry of Trade and Industry** – various programmes in the past

- ❑ **Technology Agency of the Czech Republic**
 - Programmes: ALFA
 - Competence Centres

- ❑ **Ministry of Education** – special field and support of international research
 - Large research infrastructures
 - Czech participation in the Jules Horowitz reactor project

Specialized R&D support programme of energy research is critically needed !!

National priorities of applied research and development



Good coherency with the Horizon 2020



The government of the Czech Republic should:

- Develop a comprehensive, long-term energy R&D strategy, building on the country's technical strengths and taking account of energy and climate policy priorities.*
- Review the energy R&D strategy and institutional structure on a regular basis to ensure it is clearly defined and operates in a manner that allows for co-ordination, information sharing, decision making and evaluation.*
- Continue to increase public energy R&D funding and ensure that plans to evaluate cost-effectiveness and other outputs are put into place to guide the allocation of this funding.*
- Continue to increase efforts in energy-related educational programmes in order to renew the ageing R&D personnel pool and to maintain technical expertise.*
- Expand national energy R&D capacities through international collaboration, for example through the IEA Implementing Agreements.*

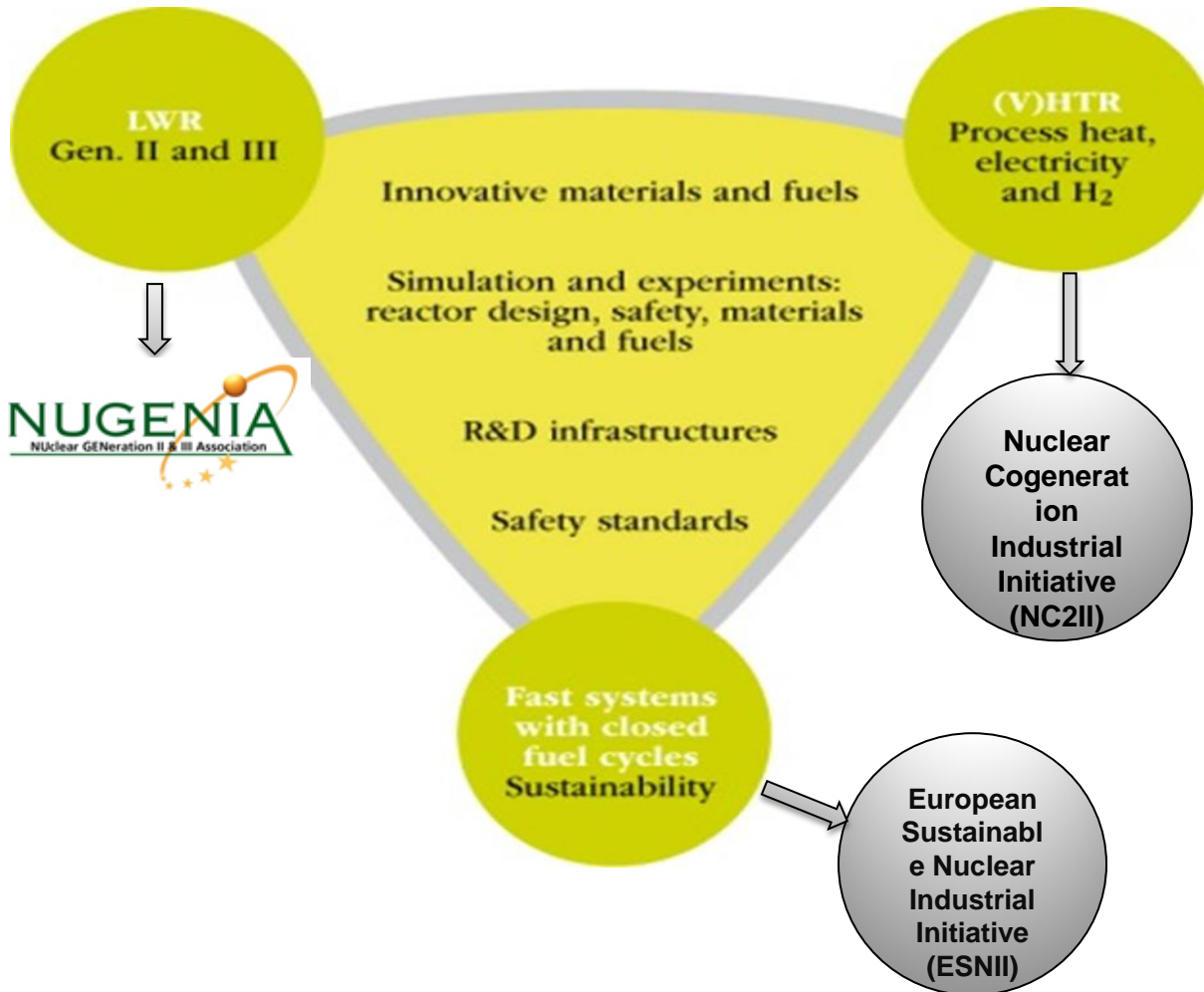


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Sustainable Nuclear Energy Technology Platform (SNETP) and European Industrial Initiatives (EII)



Members

(October 2013)

RTOs 33

Industry & Services 46

Academia 23

NGOs 4

TSOs 4

Networks / Others 6

Total 116

from 21 countries

And more applying continuously

NUGENIA



NUGENIA is an **international non-profit association** founded under Belgian legislation in November 2011, and launched in March 2012



NUGENIA:

- * off-spring of the SNETP Gen II/Gen III TF
- * successor of the network projects: NULIFE, SARNET, ENIQ,..

NUGENIA:

- * to be Integrator of the Gen II/ Gen III R&D in Europe
- * to be the joint project initiation vehicle

Members: major nuclear stakeholders

- Approx. 70 members from 20 countries (*as of August 2013*)
- Industry, utilities, research institutions, SMEs and technical safety organisations



The environment of NUGENIA



- **NUGENIA foresees to interact with:**



EUROPEAN
TECHNICAL SAFETY
ORGANISATIONS
NETWORK



And the public authorities in European MS



- R&D roadmapping with strategic prioritisation
- Online marketplace for seekers and solvers (Open Innovation Platform)
- Facilitation the dissemination and valorisation of R&D projects results

Example of running project – ACCEPPT (3 year project) Aging of concrete and civil structures in nuclear power plants

OBJECTIVES

- To assess the behaviour and aging of pre-stressed concrete containment of NPP including steel liner and tendons. This will lead to increased safety and lifetime of NPPs.
- Determination of reliable material properties, initial and boundary conditions, on which the reliability of the integrity assessment strongly depends, is one of the major challenges of this project.

SCIENTIFIC APPROACH

- Carry out an European state-of-the-art on reactor containments and liners (dimensions, materials, encountered damages, feedback experiences, leak tightness criteria etc.).
- Experiments on liner behaviour under LOCA conditions.
- Find and experiment new NDE techniques (global & local) for detecting flaws on the liner.
- Numerical simulation of reactor containments (loss of pre-stress, evolution of moisture, temperature conditions etc.).





- Launched in September 2013 with 3-years duration
- EUR 6 millions contribution from the FP7 Euratom programme

Main objectives

- Optimize and strengthen the synergy within the NUGENIA Association, its members and with national and European authorities,
- Map traditional and new R&D projects funding sources and channels,
- Encourage public-public and public-private co-programming
- Valorise the R&D results
- Launch pilots calls for R&D projects



Thank you for your attention

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