



Nuclear Research Institute Rez plc

Ústav jaderného výzkumu Řež a.s.

# Nuclear Research Institute Rez plc

## and its mission and role in the Czech nuclear energy programme

**Miroslav Hrehor, NRI Rez plc**



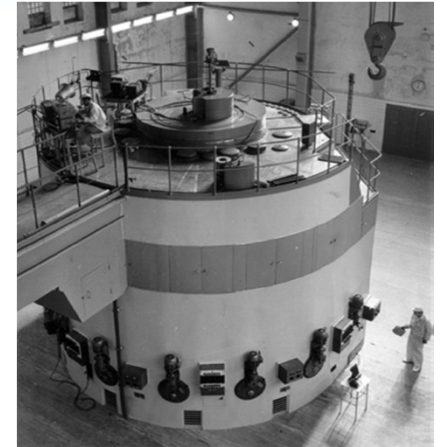
# Content

- Nuclear history in CR
- Snapshot of the nuclear power in CR
- Nuclear power as part of energy mix
- Future energy needs
- Next build – what?
- Nuclear infrastructure (key players) to continue in nuclear programme
- NRI Rez plc as the key technical support and R&D organization for nuclear power - examples of activities
- Conclusions



# Nuclear history of the Czech Republic (1)

- 1955 Nuclear Research Institut (NRI) Rez
- 1956 Faculty of Nuclear Physics Prague
- 1957 Research Reactor at NRI Rez
- 1960 Czechoslovak R&D project on development of HWGCR
- 1960's Industrial development towards nuclear (Škoda, Vítkovice...)
- 1972 NPP A1 (HWGCR) (Slovakia)
- 1978 NPP V1 (VVER – 2x 440 MWe) (Slovakia)





# Nuclear history of the Czech Republic (2)

- 1984 NPP V2  
(VVER – 2x440 MWe) (Slovakia)
- 1985 NPP Dukovany  
(VVER – 4x440 MWe) (Czech Republic)
- 2002 NPP Temelin  
(VVER – 2x 1000 MWe)







# Czech Energy Mix

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2 Nuclear Plants



32 Hydro Plants  
including  
3 pumping stations

+

1 solar  
1 wind plants

15 Coal Plants



# Power Plants (CEZ Group)

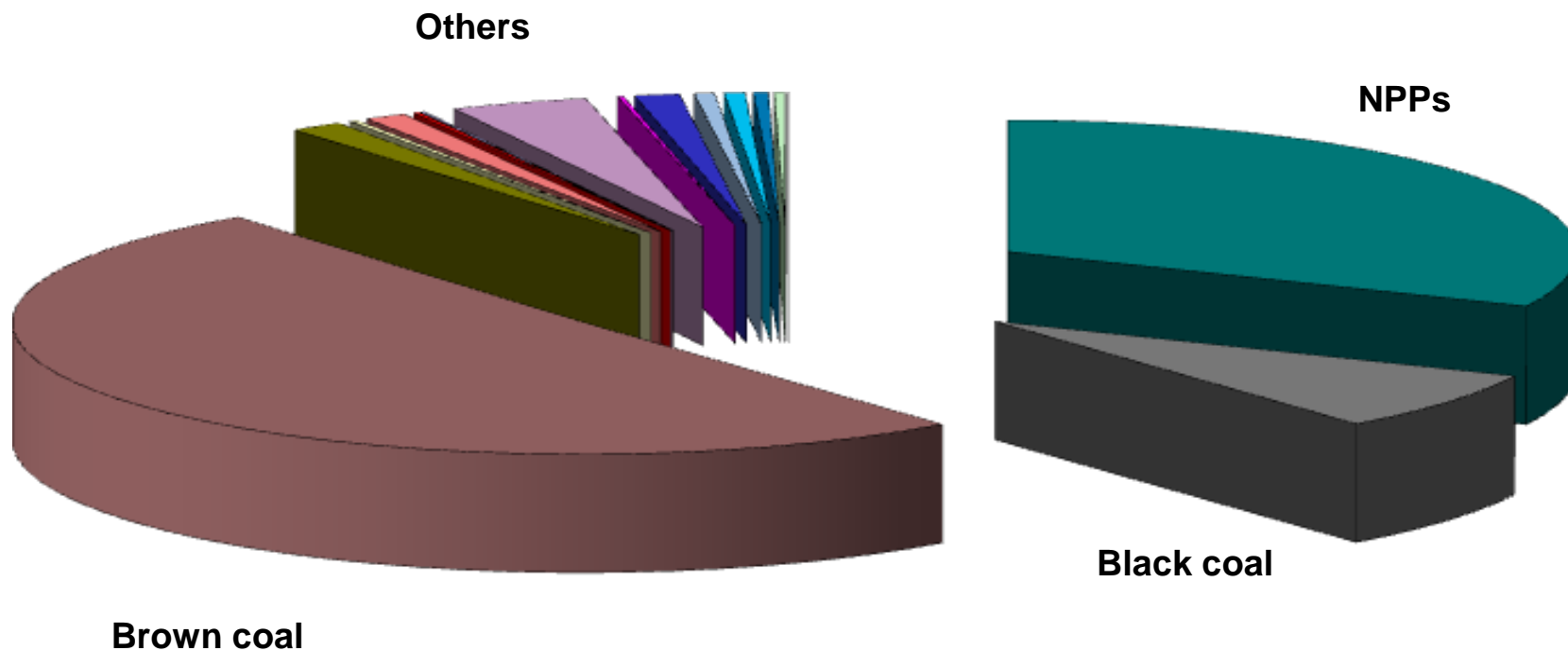
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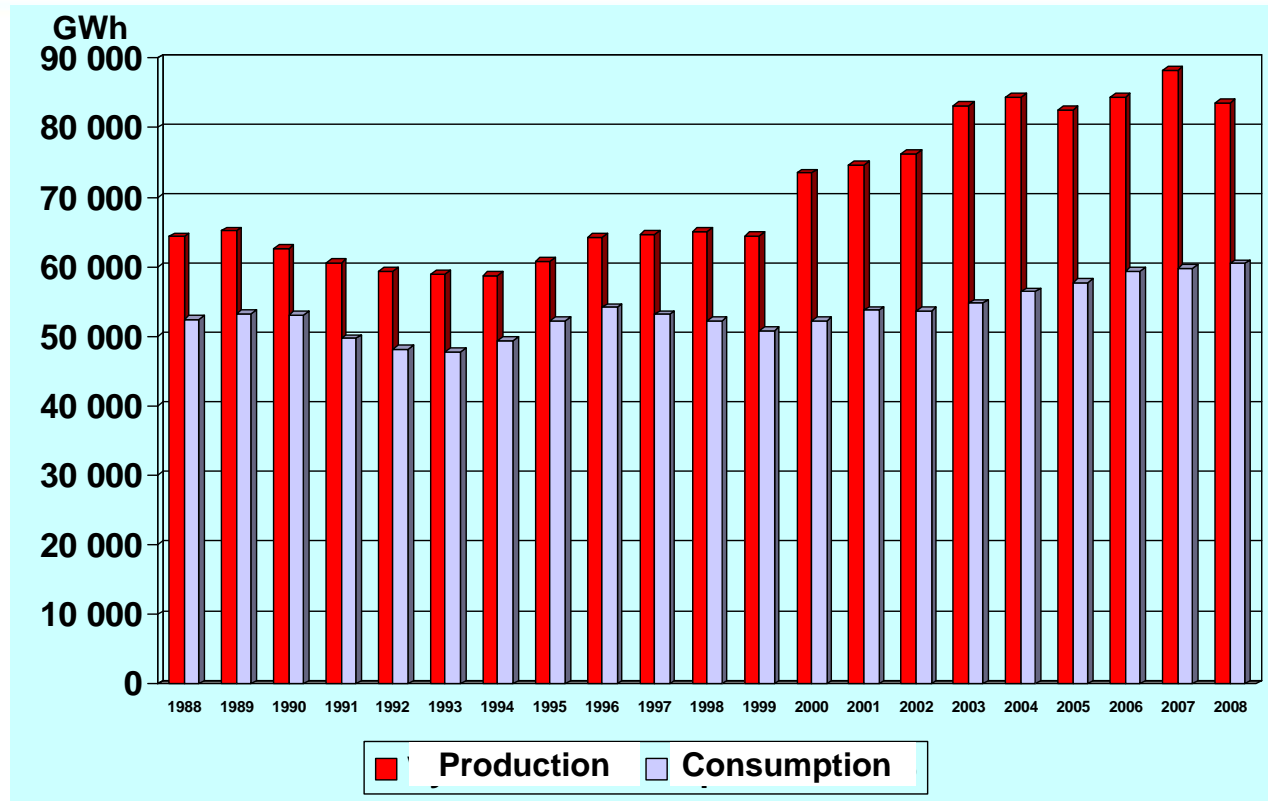
# Energy production in 2008

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# Challenge No.1



- Currently CR is an exporter of electricity in Europe
- Prediction: starting from 2012 CR will have to start importing electricity
- **Challenge No.1: to remain self-sufficient in electricity consumption construction of new nuclear unit(s) is a must (the sooner, the better)**





# Future energy needs - limited options

- Hydro – minimum possibilities
- Coal plant – limited possibilities to extend mining capacity
- Gas (?) - price, availability, guaranteed supply (?)
- Renewables – not voluminous effect
- Nuclear – the only realistic option in large scale



# New tender opened by CEZ

PWR (2 units):

- 1000 - 1500 MWe
- Turn key project
- 3 qualified potential suppliers:
- AREVA (EPR)
- Atomstroyexport (MIR 1200)
- Westinghouse (AP 1000)



# Sufficient “nuclear” infrastructure still exist

- **Energy provider:** CEZ plc (intelligent customer)
- **System suppliers:** SKODA JS, SKODA Praha, VITKOVICE, SIGMA, .....
- **Regulatory body:** State Office for Nuclear Safety (SÚJB)
- **Education and training institutions:** Technical Universities in Prague, Brno, Pilsen, Ostrava
- **Research organisation:** NRI plc (ÚJV Řež a.s.)



# List of NPP Units manufactured by SKODA JS

Nuclear Power Plant	Units	Year	Prime Contractor for Plant Technological Part	Main Supplier of Primary Circuit and Fuel Handling Systems					Current Status
				Detailed Design	Equipment Manufacture	Procurement	On-site Installation	Start-up	
Bohunice A1, Slovakia	1 x HWGCR (150MWe)	1965-72	✓	✓	✓	✓	✓	✓	Under decommissioning
Paks, Hungary	4 x VVER 440 / V-213	1980-87			✓*		✓*		Operable
Bohunice V2, Slovakia	2 x VVER 440 / V-213	1982-85		✓	✓	✓	✓	✓	Operable (Unit 1 - 1984, Unit 2 - 1985)
Dukovany, Czech Republic	4 x VVER 440 / V-213	1982-87		✓	✓	✓	✓	✓	Operable ( Unit 1-1985,Unit 2 -1986, Unit 3 -1987, Unit 4 -1988)
Nord, Germany	3 x VVER 440 / V-213	1982-88			✓*		✓*		Under decommissioning
Zarnowiec, Poland	4 x VVER 440 / V-213	1986-88			✓*		✓*		Project cancelled
Mochovce, Slovakia	4 x VVER 440 / V-213	1987-1999		✓	✓	✓	✓	✓	Units 1,2 in operation (1998-1999) Units 3,4 - project stayed proceedings
Belene, Bulgaria	1 x VVER 1000 / V-320	1988-			✓*				The equipment will be used for the completion of Kalinin 4 NPP in Russia
Temelín, Czech Republic	2 x VVER 1000 / V-320	1991-2003		✓	✓	✓	✓	✓	Operable ( Unit 1-2002, Unit 2 -2003)

\* Reactor manufacture + supervision of the on-site installation

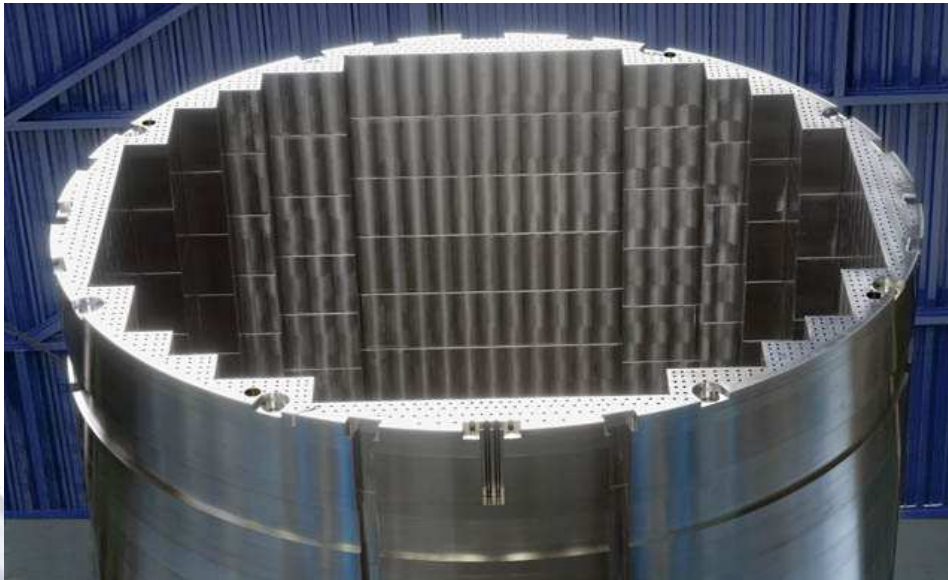




# Nuclear Equipment for Ongoing Projects

## EPR reactor components for Olkiluoto NPP/Unit 3 (in progress)

- Reactor internal parts
- Customer: Areva NP
- End-user: TVO, Finland
- Contract award – 03/2005
- To be supplied in 2009-2010





# NRI Rez plc

## Mission - why we are here?

- NRI is a professional authority and promoter of the use of nuclear power and ionizing radiation
- NRI offers in national and international scale scientific, analytical, engineering and design support to both NPPs in operation and under construction as well as to other power plants
- NRI provides comprehensive and system R&D, in particular in the field of use of nuclear power and ionizing radiation sources



## NRI Rez plc

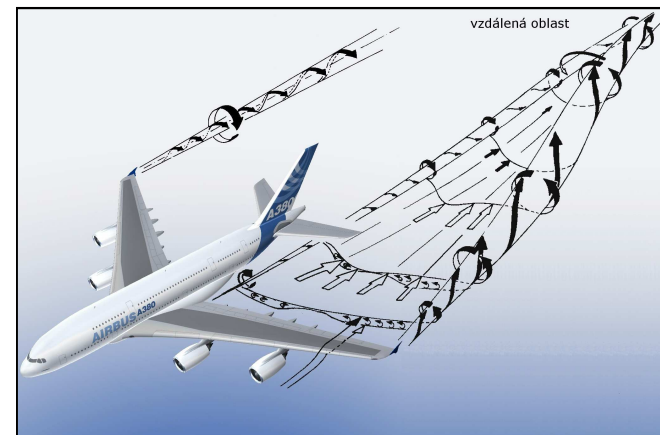
### - Nuclear Energy:



- Safety of NPPs
- Structural integrity/Material testing
- NPP Lifetime management
- Innovative reactors
- Waste management and Fuel Cycle

### - other areas:

- Fossil power plants
- Hydrogen economy
- Radiopharmaceuticals
- Aerospace industry
- Chemical industry
- Defense



Turbulences behind A380, the Institute participated in the far area analysis





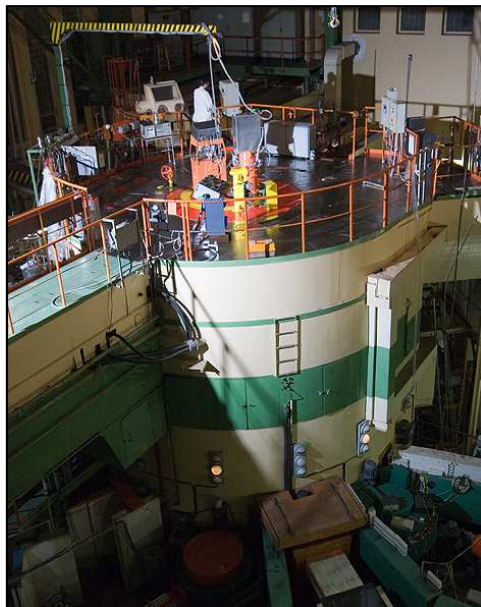
# Research infrastructure

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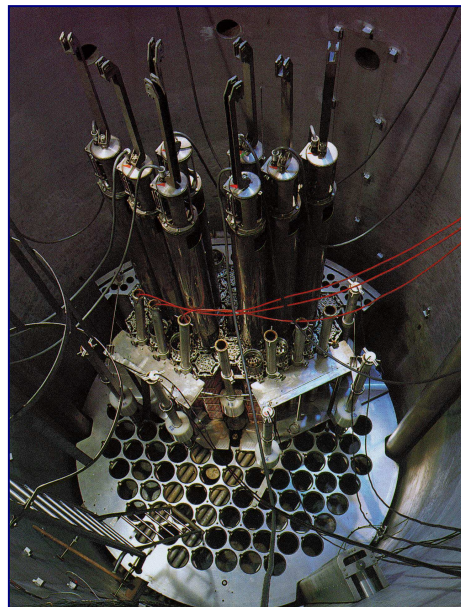
**Institute operates large infrastructure both for R&D and engineering services**

- 10 MW<sub>t</sub> research reactor
- Critical assembly
- Hot and semi hot cells
- Cyclotron
- Different Laboratories

Critical assembly LR-0



Research reactor LVR-15



Cyclotron

Hot cells







# NRI Rez plc Owners

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ČEZ, a. s.: 52,4 %

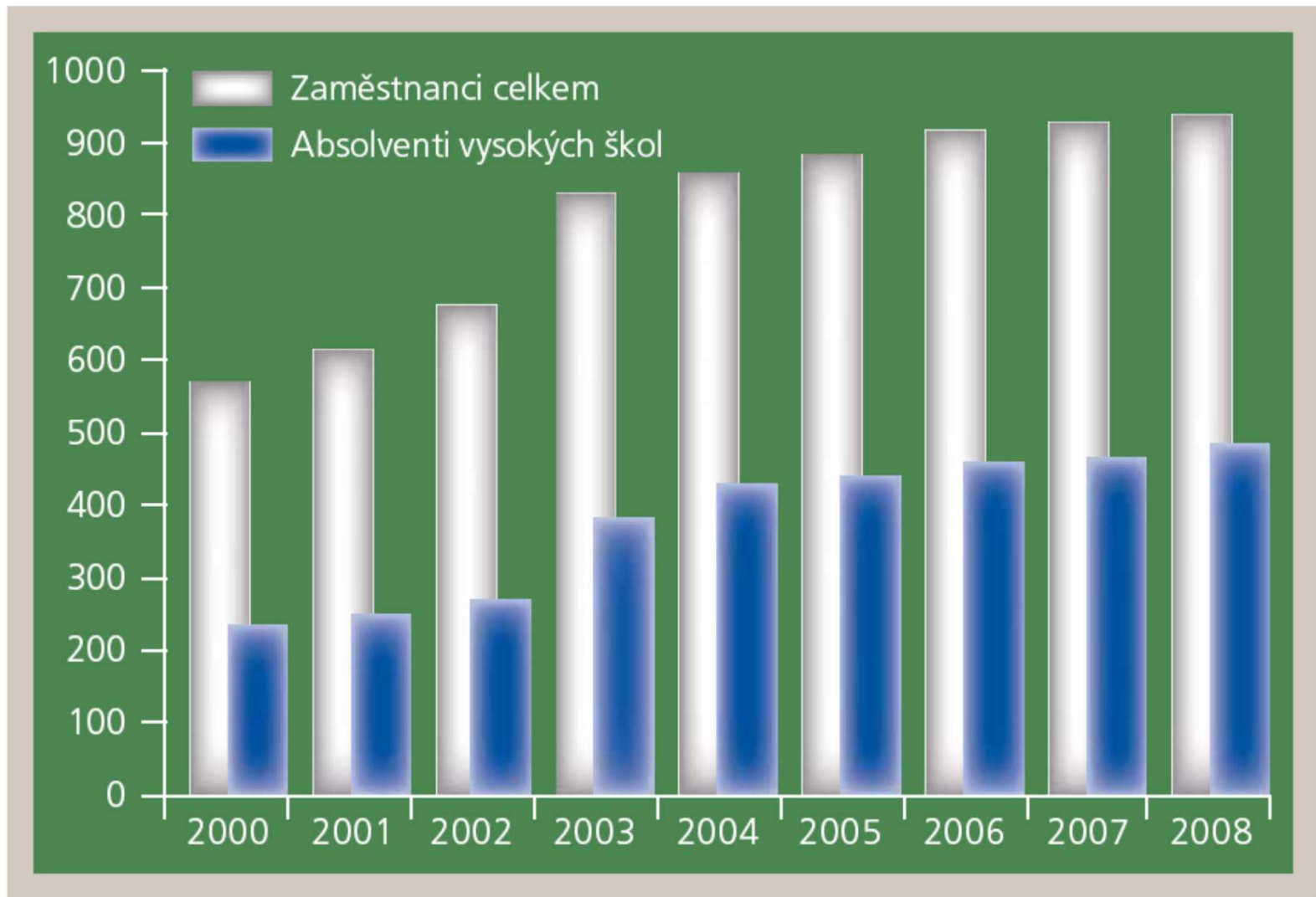
SE, a.s.: 27,8 %

Škoda JS a.s.: 17,4 %

obec Husinec: 2,4 %

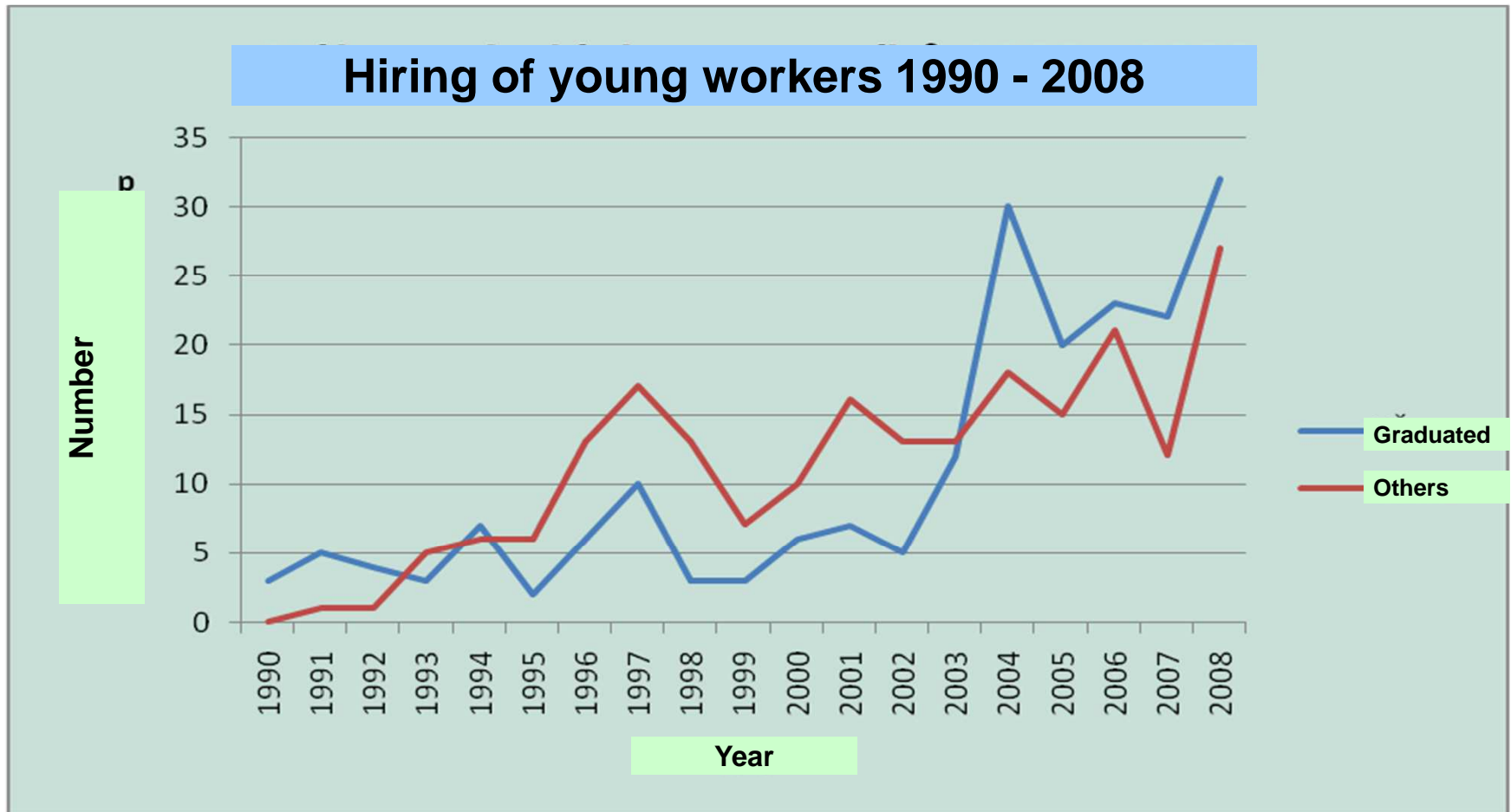


## NRI Personnel





# NRI Strategy of Controlled Rejuvenation

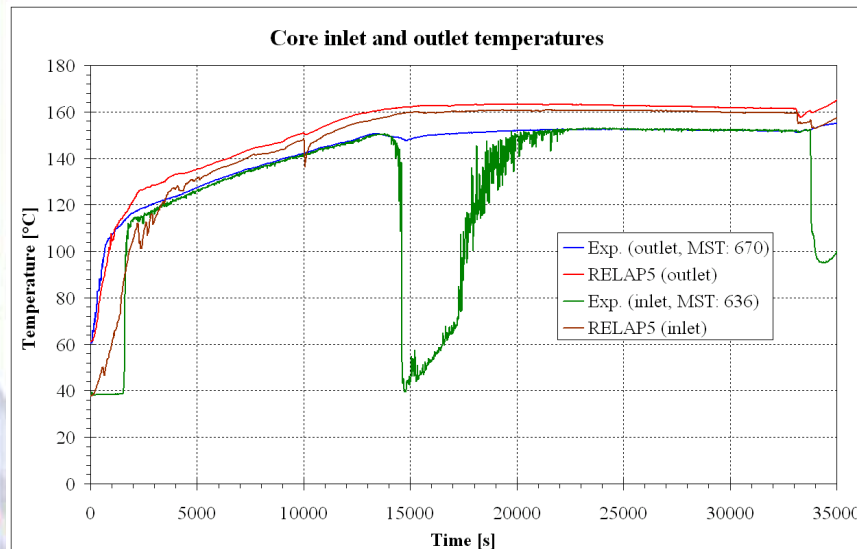




# Examples of activities

## Safety of NPPs

- Safety analyses (Thermal-hydraulics)
- Severe accident analysis
- Analyses of fuel behaviour
- Reliability and risk analyses
- Fuel cycle and core reload optimization
- Core monitoring system SCORPIO-VVER
- On-line radiation monitoring







## Examples of activities Support of safety authority (SUJB)

- Review of safety analyses reports
- Development of TH reactor models and their validation
- Development of best estimate & uncertainty assessment methodology

### Specific examples:

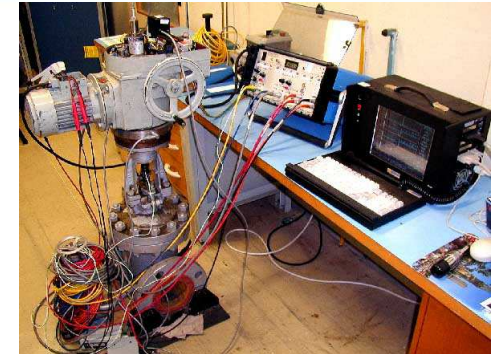
- Support in Review of Safety Documentation for Licensing of Advanced Fuel (Gd-2+) for NPP Dukovany
- Support in Review of Safety Documentation for NPP Dukovany Refurbishment
- Review of Best Estimate Methods for SAR of NPP Temelin



# Examples of activities

## Structural integrity, material testing

- Components diagnostics
- Components qualification
- Material testing
- Steam generators maintenance and repair



Diagnostic of valves



Preparation of manipulator for SG heat-exchanging tubes inspection by eddy currents



In-service inspection

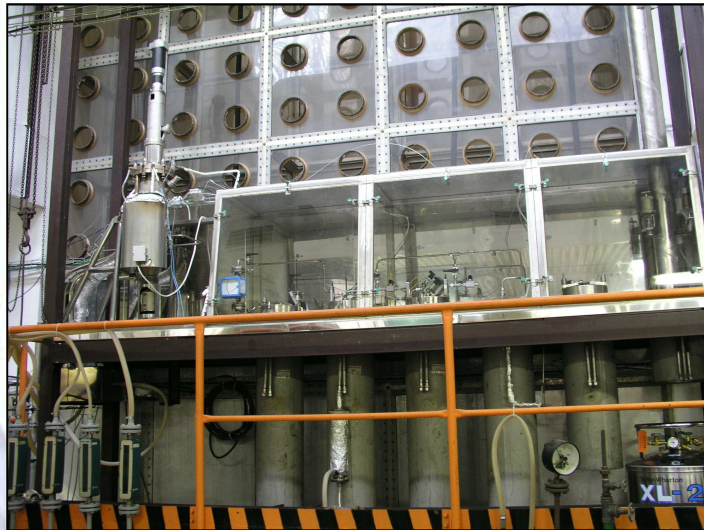




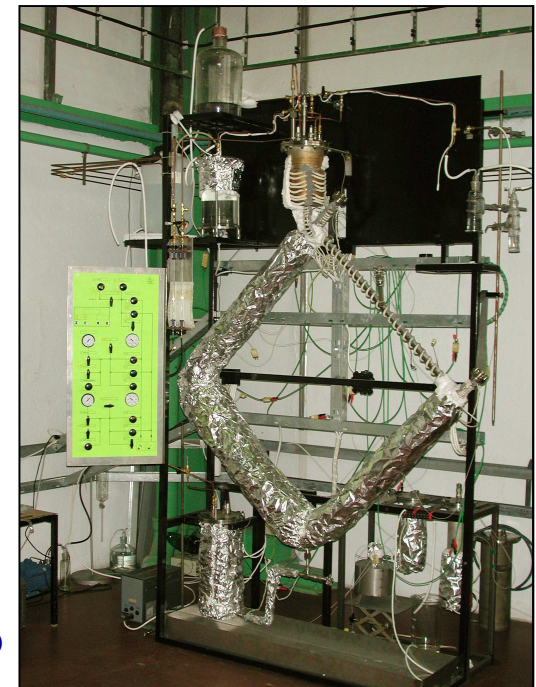
# Examples of activities Innovative reactors (Generation IV)

## Participation in GIF through EURATOM:

- SCWR (construction of reactor water loop)
- VHTR (construction of He reactor loop)
- LFR (operation of Pb-Bi out of pile material test loop)
- MSR (demonstration of fluoride technology)
- SFR (cooperation with CEA - France)



Demonstration of Fluoride technology



Operation of Pb-Bi loop



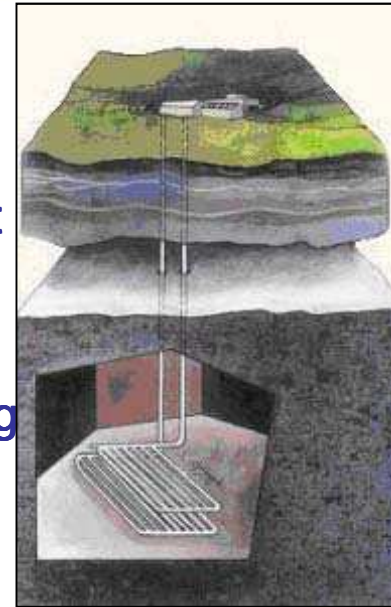
# Examples of activities R&D for waste and fuel cycle

## R&D Waste

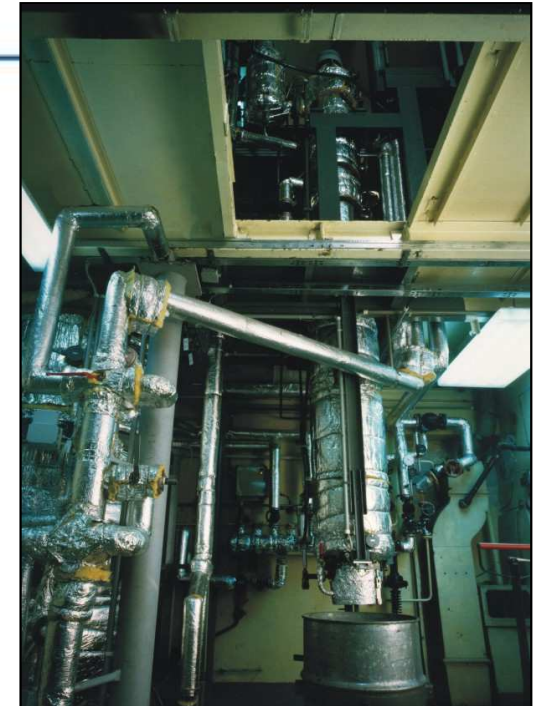
- Demonstration Bitumenation unit
- Vitrification – R&D
- Operation of RAD Waste Management Centre
- R&D for Deep Geological repository
- Decontamination and decommissioning services



FREGAT-2 unit in hot cell of the Dimitrovgrad Research Institute of Atomic Reactors



Lay-out of a deep geological repository



Demonstration bitumenation unit - FROBIT

## Fuel Cycle

- Development of Spent Fuel Reprocessing Technology
- R&D - Partitioning and transmutation





# Examples of activities

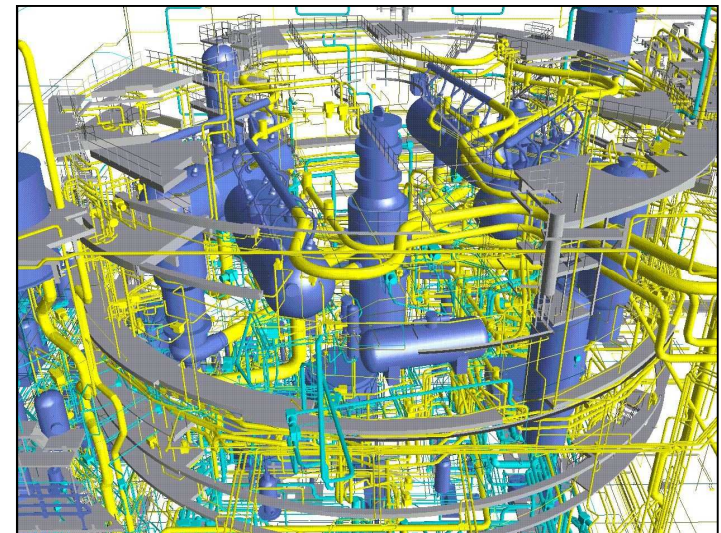
## Design and Engineering Services - References

Division **ENERGOPROJEKT Praha** 

- Basic Design of all fossil and nuclear power plants in former Czechoslovakia
- Basic Design NPP Mochovce, 2x440 MW - Slovakia
- Temelín 2x1000 MW - Czech Republic Basic Design NPP NPP
- Temelín - Spent fuel storage
- Power plant Prunerov II – Technical parameters optimization
- Combined Cycle Plant - Balloki (Pakistan)



**Temelín - Spent fuel storage**



**Digitalised as-built NPP Temelín**



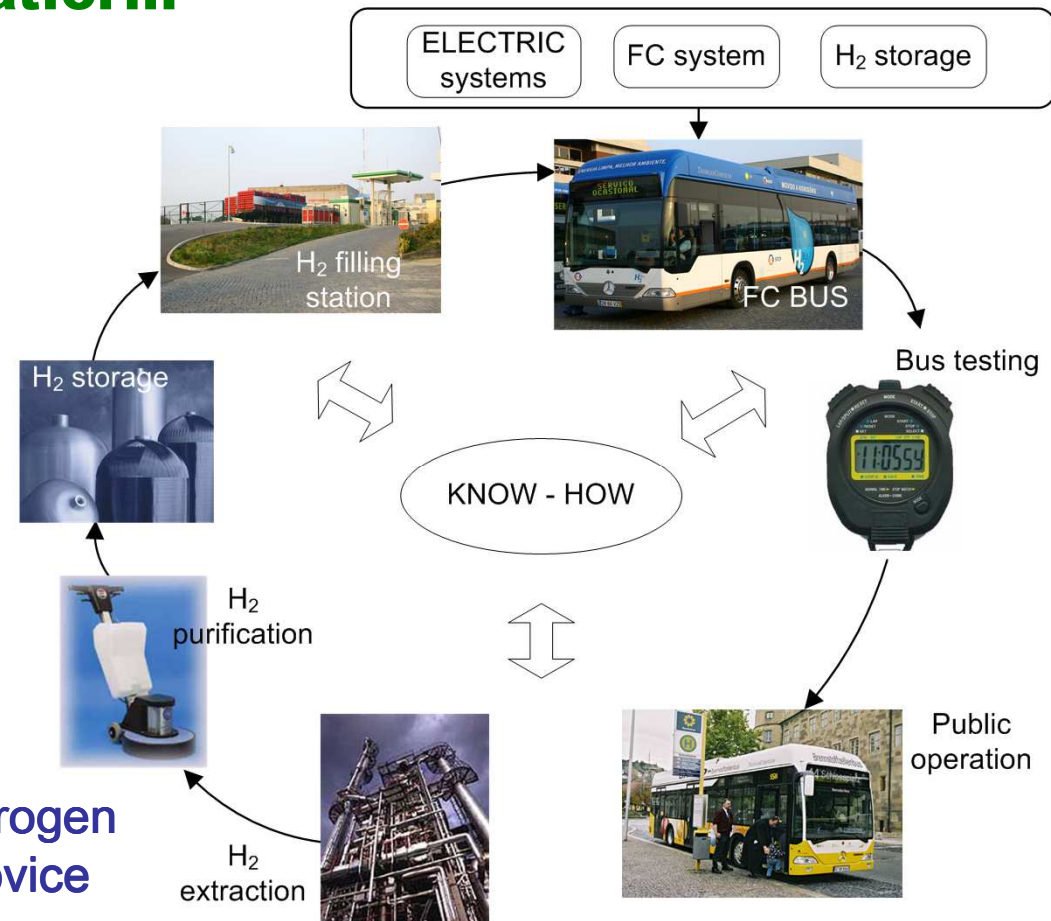
# Examples of activities Hydrogen economy

## Participation in European Hydrogen & Fuel Cell Technology Platform

### FCZ – H<sub>2</sub> BUS

Demonstration of hydrogen application for public transport:

- Operation of bus with hydrogen fuel cells in 2008
- Construction and operation of hydrogen filling station
- Production and purification of hydrogen as byproduct in SPOLANA Neratovice





# Examples of activities Radiopharmaceuticals

Routinely produced:

- Sodium iodohippuricum ( $^{131}\text{I}$ ) (monitoring of renal functions)
- Sodium iodide ( $^{131}\text{I}$ ) (thyroid therapy)
- THALLOUS CHLORIDE ( $^{201}\text{Tl}$ ) (heart perfusion scintigraphy)
- GALLIUM CITRICUM ( $^{67}\text{Ga}$ ) (imaging of tumours and abscesses)
- $^{153}\text{Sm}$ -EDTMP (palliative treatment of bone metastases)
- PET – Fludeoxyglucose ( $^{18}\text{F}$ )



Newly constructed PET Centre in Brno



Production semi-hot cells





# International Cooperation

## ■ IAEA

Regional TC projects, Coordinated Research Projects, INPRO

## ■ OECD/NEA

Participation in OECD NEA Joint Research Projects

## ■ EU

The Institute participated in 32 Projects of 6<sup>th</sup> FP  
Actively involved in proposals for 7<sup>th</sup> FP

## ■ Bilateral cooperation:

- CEA, France
- GRS, Germany
- ROSATOM, Russia
- and others



# Conclusions

- **There is a deep historical experience with nuclear power in the CR**
- **CR energy policy follows the strategy of balanced “energy mix”**
- **Energy consumption forecast indicates that there will be a significant electricity deficit in 2020 if there is no decision on a new power plants**
- **Options for new energy sources are rather limited**
- **Nuclear option is very realistic**
- **There is still sufficient infrastructure and competence to continue in nuclear programme**
- **NRI Rez plc is the key technical support and R&D organization for nuclear power – assisting to existing plants and ready to support construction of the new plant**





**THANK YOU!**

**QUESTIONS?**