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
- Snapshoot 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

2 Nuclear Plants

32 Hydro Plants including
3 pumping stations
+
1 solar
1 wind plants

15 Coal Plants
Power Plants (CEZ Group)

Total 13,086 MW
Energy production in 2008

- Brown coal
- Black coal
- NPPs
- Others
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

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy provider:</td>
<td>CEZ plc (intelligent customer)</td>
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<tr>
<td>System suppliers:</td>
<td>SKODA JS, SKODA Praha, VITKOVICE, SIGMA, …….</td>
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<tr>
<td>Regulatory body:</td>
<td>State Office for Nuclear Safety (SÚJB)</td>
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<td>Education and training institutions:</td>
<td>Technical Universities in Prague, Brno, Pilsen, Ostrava</td>
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<tr>
<td>Research organisation:</td>
<td>NRI plc (ÚJV Řež a.s.)</td>
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# List of NPP Units manufactured by SKODA JS

<table>
<thead>
<tr>
<th>Nuclear Power Plant</th>
<th>Units</th>
<th>Year</th>
<th>Main Supplier of Primary Circuit and Fuel Handling Systems</th>
<th>Current Status</th>
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<tbody>
<tr>
<td></td>
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<td></td>
<td>Prime Contractor for Plant Technology</td>
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<td>Detailed Design</td>
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<td></td>
<td>Equipment Manufacture</td>
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<td>Procurement</td>
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<td>On-site Installation</td>
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<td>Start-up</td>
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<tr>
<td>Bohunice A1, Slovakia</td>
<td>1 x HWGCR (150MW)</td>
<td>1965-72</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Paks, Hungary</td>
<td>4 x VVER 440 / V-213</td>
<td>1980-87</td>
<td>✓</td>
<td>✓*</td>
</tr>
<tr>
<td>Bohunice V2, Slovakia</td>
<td>2 x VVER 440 / V-213</td>
<td>1982-85</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Dukovany, Czech Republic</td>
<td>4 x VVER 440 / V-213</td>
<td>1982-87</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Nord, Germany</td>
<td>3 x VVER 440 / V-213</td>
<td>1982-88</td>
<td>✓</td>
<td>✓*</td>
</tr>
<tr>
<td>Zarnowiec, Poland</td>
<td>4 x VVER 440 / V-213</td>
<td>1986-88</td>
<td>✓</td>
<td>✓*</td>
</tr>
<tr>
<td>Mochovce, Slovakia</td>
<td>4 x VVER 440 / V-213</td>
<td>1987-1999</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Belene, Bulgaria</td>
<td>1 x VVER 1000 / V-320</td>
<td>1988-</td>
<td>✓</td>
<td>✓*</td>
</tr>
</tbody>
</table>

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

- 10 MW$_t$ research reactor
- Critical assembly
- Hot and semi hot cells
- Cyclotron
- Different Laboratories
NRI Rez plc Owners

- 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

Hiring of young workers 1990 - 2008

- Graduated
- Others
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

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

Diagnostic of valves

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

Fuel Cycle
- Development of Spent Fuel Reprocessing Technology
- R&D - Partitioning and transmutation
Examples of activities
Design and Engineering Services - References

- 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)
Examples of activities
Hydrogen economy

- Participation in European Hydrogen & Fuel Cell Technology Platform

- FCZ – H₂ 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 (131I) (monitoring of renal functions)
- Sodium iodide (131I) (thyroid therapy)
- THALLOUS CHLORIDE (201Tl) (heart perfusion scintigraphy)
- GALLIUM CITRICUM (67Ga) (imaging of tumours and abscesses)
- 153Sm-EDTMP (palliative treatment of bone metastases)
- PET – Fludeoxyglucose (18F)
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 6th FP
  Actively involved in proposals for 7th 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?