Rosatom Capabilities in Research Reactor Construction

Rosatom Seminar on Russian Nuclear Energy Technologies and Solutions

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NUKEM Technologies is provider of back-end and nuclear engineering solutions

Role of NUKEM Technologies in Rosatom’s Key Activities

- Mining
- Gas centrifuges manufacturing
- Fuel fabrication
- Conversion and enrichment
- Spent nuclear fuel treatment
- Power Generation
- NPPs engineering & construction
- Power equipment and services
- Research and development

NUKEM Technologies
NUKEM Technologies Leading the International Research Reactor Activities of ROSATOM

- NUKEM Technologies being part of State Cooperation ROSATOM since 2009
- Long range track record and past performance experiences in Research Reactor Fuel Manufacturing and in the overall Fuel Cycle Industries
- Assigned as leading entity within ROSATOM regarding the world wide business for Research Reactor Technology due to:
  - International experience
  - Highly committed to Quality, Time, and Budget
  - Extensive experience in Management of large Turn Key Projects
### ROSATOM’s Selected Team for Research Reactor Technology

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<th>Company</th>
<th>Description</th>
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| **NUKEM Technologies GmbH**                 | - NUKEM Technologies GmbH - is a 100% subsidiary of JSC Atomstroyexport  
- Experienced project management company for complex nuclear turnkey projects.                                                                                         |
| **JSC NIKIET**                               | - key design entity for research reactors within Rosatom  
- reactor designer of the 1st NPP in the world (Obninsk)  
- extensive experience in research reactor design and operation  
- involved in a number of thermonuclear fusion research projects (including ITER).                                                                                           |
| **JSC NIAEP**                                | - leading design and engineering institute of Rosatom  
- currently involved in more than 10 NPP construction projects in Russia and abroad as general contractor, general designer and design work manager.                                                   |

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Russian research and engineering enterprises have all the necessary competences to design and
construct up-to-date research reactors and Centers of nuclear research according to the requirements of
Customers.

All research reactors were integrated in Centers of Nuclear Research. These centers are equipped by an
appropriate civil engineering and scientific infrastructure for safe and effective operation of research
reactors and have high-quality operating and research staff.

Over 100 research reactors were built in Russia, 49 of them are still being operated – about 20% of the world number of RR!

- Material Testing
- Radioisotope Production
- Fundamental and Applied Research
- Education

Over 20 research reactors were built upon Russian design in 18 countries!
Russian Experience in Design and Construction of Research Reactors in Foreign Countries

- **Ukraine**: IR-100, 0.2MW; VVR-M, 10MW
- **Belarus**: IRT-M, 4MW
- **Uzbekistan**: VVR-SM, 10MW
- **Georgia**: IRT-M, 8MW
- **Iraq**: IRT-5000, 5MW
- **Poland**: EVA, 10MW; MARIA, 30MW
- **Latvia**: IRT-M, 5MW
- **Czech Republic**: LVR-15, 10MW
- **Germany**: RFR-10, 10MW
- **Serbia**: RA, 6.5MW
- **Bulgaria**: IRT-2000, 2MW
- **Egypt**: ETRR-1, 2MW
- **Romania**: VVR-S, 2MW
- **Libya**: IRT-1, 10MW
- **North Korea**: IRT, 8MW
- **China**: RFR-10, 10MW
- **Vietnam**: DRR, 0.5MW
- **Ukraine**: IR, 100, 0.2MW
- **Latvia**: IRT-M, 5MW
- **Poland**: EVA, 10MW; MARIA, 30MW

**Reactor Type:**
- **Tank**
- **Heavy Water**
- **Pool**
- **Pulse**
- **Channel in Pool**
Products and Competences
Material Test Reactor: MIR (Main Material Testing Reactor)

- Located: Dimitrovgrad
- Power: up to 100 MWth
- Number of loop channels: up to 11
- Maximum thermal neutron flux: $4.5 \times 10^{14}$ n/cm²/s
- Incore and core border loops for fuel and material testing of different types of power reactors: VVER, PWR, BWR, liquid metal reactors and Generation IV concepts
- In operation since 1966

Source: NIKIET
Location: Gatchina, near St. Petersburg

Power: 18 MWth

Maximum thermal neutron flux: $4.5 \times 10^{14}$ n/cm²/s

Numerous neutron beams for basic and applied research

In operation since 1959
Products and Competences
Radioisotope Production Reactor SM

- Location: Dimitrovgrad
- Power: 100 MWth High-Flux RR
- Maximum thermal neutron flux inside flux trap: 5×10^15 n/cm²/s
- In operation since 1961
Location: Gatchina, near St. Petersburg

Power: 100 MW\text{th}

Tank-type, heavy water reflected

Thermal neutron flux:
inside flux trap: very high $5 \times 10^{15} \text{n/cm}^2/\text{s}$
inside reflector: very high $1.2 \times 10^{15} \text{n/cm}^2/\text{s}$

Commissioning ongoing
Great efforts of Russian engineers were focused on modernization and refurbishment of operating research reactors.

Many reconstructions were made; i.e. reactors SM-2, IBR-2, IR-8 were modernized and new research installations were implemented at these reactors.

The physical start-up of the reactor IBR-2 at the end of 2010 demonstrated that Russian specialists are ready to solve complex problems regarding the design of up-to-date research reactors.

IR-8
Power increase from 1 to 8 MW (1981)

IBR-2
New experimental capabilities
Products and Competences
Fuel Assemblies

- Fuel: UO$_2$+Al
- Uranium enrichment: 19.7%
- Fuel height: 600 mm
- U-235 weight per fuel assembly: 50 g
- Uranium density in fuel meat: 2.5 g/cm$^3$

- The fuel assemblies VVR-M2 have already been used at foreign research reactors, e.g.:
  - BRR (Hungary)
  - DRR (Vietnam)
  - VVR-M (Ukraine)

Three-element VVR-M2
Single-element VVR-M2
Offered Solution for South Africa - NECSA/NTP
Dedicated Isotope Production Reactor DIPR

- Elaboration of consistent design features and safety concept of NECSA’s planned DIPR
- Preparation of comprehensive proposal of the technical concept for DIPR
- Team of ROSATOM’s subsidiaries to provide best competences and capabilities
  - JSC NIKIET for reactor design
  - JSC NIAEP for balance of plant
  - NUKEM Technologies for project management and implementation
- Project award originally scheduled for beginning of 2013, currently frozen due to re-evaluation of concept and project funding
Offered Solution for South Africa - NECSA/NTP
Dedicated Isotope Production Reactor DIPR

- Examples representing architectural ideas for DIPR based on the technical concept as provided by the ROSATOM team
Conclusion

- ROSATOM’s team under the leadership of NUKEM responsible for the world wide Research Reactor business has a long and successful experience in engineering and experimental use of research reactors and has all the necessary competences in the field of Research Reactor Technology.

- On this basis ROSATOM is ready to cooperate in the development, construction and experimental use of research reactors and in particularly in isotope reactors and can provide all necessary services.

- ROSATOM’s team is also ready to provide the required training for research reactor’s personnel and staff.
Thank You for Attention!

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