Prospects and aspects of deployment of transportable small modular reactors on the example of SHELF-M

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Grounds for the development of an SMR project based on the SHELF-M

- Strategy for the development of the Arctic zone of the Russian Federation and ensuring national security for the period up to 2035
- Federal project "New Nuclear Power, Including Small Nuclear Reactors for Remote Areas"
- Seventh Sustainable Development Goal - Affordable and clean energy
SHELF-M Power capsule
The main provisions of the SMR project on the basis of the SHELF-M

- Proven reactor technology with a two-circuit cooling system
- Integrated pressurized water reactor
- Passive safety systems
- Physical barrier system
- Digital design
- Digital twin technology
- Compact placement of primary circuit equipment
- Factory production and testing of the reactor module
## Main technical characteristics of SHELF-M

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Valuation</th>
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<tbody>
<tr>
<td>Thermal power, MW</td>
<td>35</td>
</tr>
<tr>
<td>Electric power, MW</td>
<td>10</td>
</tr>
<tr>
<td>Reactor type</td>
<td>Integral PWR</td>
</tr>
<tr>
<td>Coolant/moderator</td>
<td>Light water</td>
</tr>
<tr>
<td>Primary circulation</td>
<td>Natural (for 20% of rated power) / forced</td>
</tr>
<tr>
<td>Fuel type</td>
<td>Cermet (UO$_2$ in silumin matrix)</td>
</tr>
<tr>
<td>Fuel enrichment</td>
<td>Up to 20%</td>
</tr>
<tr>
<td>Fuel cycle, years</td>
<td>8</td>
</tr>
<tr>
<td>Height/diameter of the power capsule, m</td>
<td>11/8</td>
</tr>
<tr>
<td>Weight of the power capsule together with the reactor, t</td>
<td>370</td>
</tr>
<tr>
<td>Service life of non-replaceable equipment, years</td>
<td>60</td>
</tr>
</tbody>
</table>
Calculation justification of reliability and operability

In order to confirm the reliability and operability, neutron-physical, thermal-hydraulic, strength and radiation variant calculations were carried out, which showed:

- fuel cycle 80000 eff. hours
- radiation resistance of all construction materials during the entire service life of the reactor plant
- biological shielding ensures that radiation levels in all rooms of the NPP comply with radiation safety standards
- compliance of the core and reactor structural elements with the safety requirements
Aspects of the placement of SHELF-M

Transportation by various modes of transport

Exclusion of uncontrolled access to nuclear materials during transportation and operation of reactor unit

NPP site placement close to the consumer

No need for a cooling pond

Wide operating temperature range

Multi-purpose use

High level of autonomy

Possibility to increase the capacity of NPP
Prospects for the placement of SMRs on the basis of the SHELF-M

➢ Providing electricity to decentralized regions
➢ Support for industrial enterprises
➢ The cost of a kilowatt hour of electricity about $0.16 - $0.25*
➢ The project is on engineering design stage
➢ The FOAK power unit site will be near Sovinoe gold deposit in Chukotka Autonomous Okrug
➢ The commissioning of the first of a kind power unit is scheduled for 2030
➢ Serial power unit production will start in 2032

*Based on July 2023 dollar exchange rate
Regulation and licensing

➢ Licensing of a first of a kind power unit in accordance with the requirements for nuclear power plants
➢ Adjustment of existing rules and regulations in the field of nuclear energy use
➢ Lack of a regulatory framework for transportable nuclear power plants
➢ Regulation of transport safety
Thank you for your attention!

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