ROSATOM

SMR

SOLUTIONS

RITM SERIES

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CONTENTS

Revised in August 2019.

ROSATOM's EXPERIENCE in SMR

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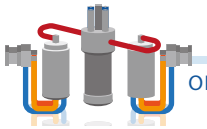
Aside from the vast experience in design, manufacturing, construction and operation for large-scale NPPs, ROSATOM also boasts an impressive record of small reactor technology development for the icebreaker fleet –

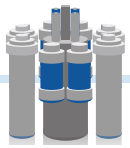
ABOUT **400 REACTOR-YEARS**!

EVOLUTION OF REACTORS FOR NUCLEAR ICEBREAKERS



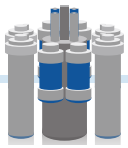
OK-150

Shaft power, MW	Displacement, tons	Thermal power, MW(t)	Design life, hours	Reactor type	Design life, years	Time to maintenance, hours
32	17 810	3×90	12 000	—	Loop type	8 000



OK-900

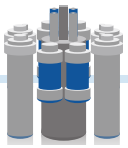
Shaft power, MW	Displacement, tons	Thermal power, MW(t)	Design life, hours	Reactor type	Design life, years	Time to maintenance, hours
32	19 240	2×159	25 000 – 30 000	—	Compact loop type	8 000



OK-900A

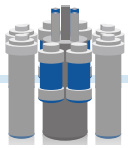
Shaft power, MW	Displacement, tons	Thermal power, MW(t)	Design life, hours	Reactor type	Design life, years	Time to maintenance, hours
54	23 460	2×171	50 000 – 100 000	25	Compact loop type	8 000

RITM-200 REACTORS HAVE ALREADY BEEN MANUFACTURED AND INSTALLED ON **"ARKTIKA"**, **"SIBIR"** AND **"URAL"** NUCLEAR ICEBREAKERS!



KLT-40

Shaft power, MW	Displacement, tons	Thermal power, MW(t)	Design life, hours	Reactor type	Design life, years	Time to maintenance, hours
32,5	61 800	135	50 000 – 100 000	25	Compact loop type	8 000



KLT-40M

Shaft power, MW	Displacement, tons	Thermal power, MW(t)	Design life, hours	Reactor type	Design life, years	Time to maintenance, hours
35	20 000	171	50 000 – 100 000	—	Compact loop type	8 000

RITM-200

Shaft power, MW	Displacement, tons	Thermal power, MW(t)	Design life, hours	Reactor type	Design life, years	Time to maintenance, hours
60	33 540	2×175	320 000	40	Integral type	26 000

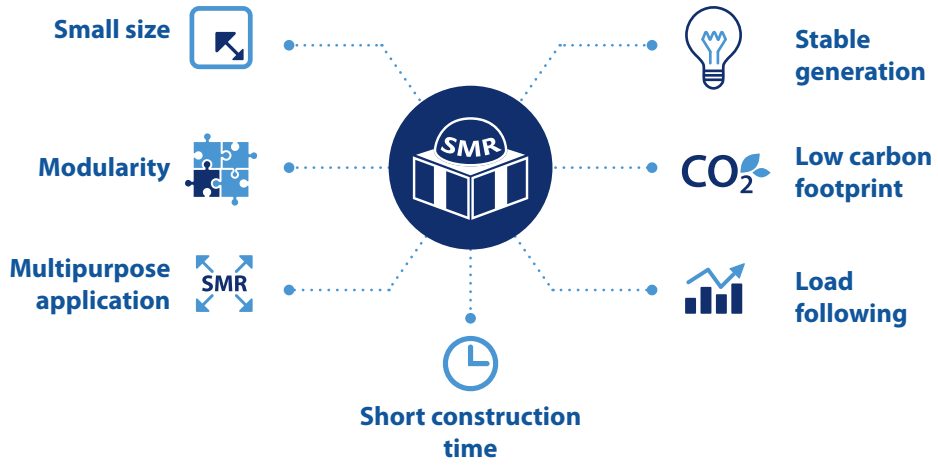
SMR ADVANTAGES

WHAT
ARE THE **KEY ADVANTAGES** OF SMR
TECHNOLOGIES FOR THE COUNTRIES
THAT DECIDE TO IMPLEMENT THEM?

ROSATOM

WHY GO INTO **SMRs**?

SMR SMALL SIZE OPENS UP NUMEROUS OPPORTUNITIES FOR ITS DEPLOYMENT FOR REMOTE AREAS AND LIMITED SITE CONDITIONS



- SMRs can be considered for a wide range of potential sites, including those situated in **EXTREME CLIMATE ZONES** or **LACKING ACCESS TO GRID INFRASTRUCTURE**.
- In addition to onshore based solutions, **FLOATING SMR POWER PLANTS** provide ultimate flexibility in terms of supplying power to remote offshore or coastal sites.
- SMR units can provide synergy with a renewable-based energy system, due to their ability to operate in a **LOAD-FOLLOWING MODE**.
- **MODULARITY** is what makes SMR-based energy solutions so attractive for remote areas. It allows to **ADJUST PLANT CAPACITY** to actual power demand by adding **NEW MODULES**.
- All **MODULES** are prefabricated, which significantly **REDUCES THE COST AND CONSTRUCTION TIME**.
- **MULTI-PURPOSE APPLICATION:** electrical power generation, district heating and water desalination.

ONSHORE

ROSATOM

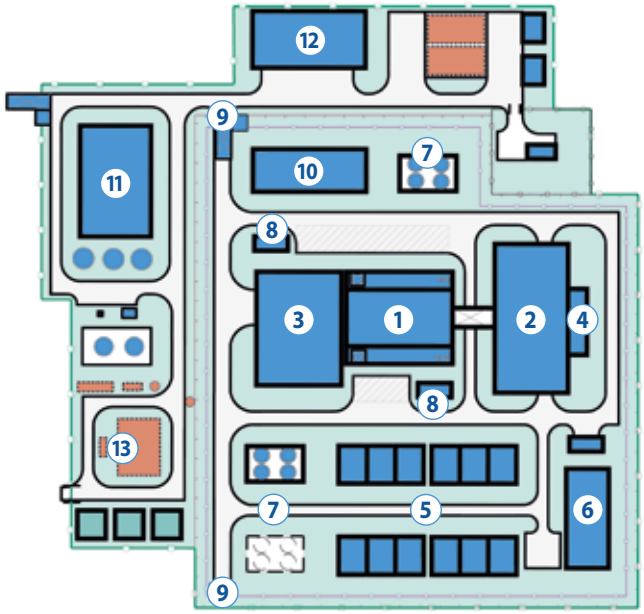
Rosatom is prepared to offer a flexible, tailor-made SMR solution, which is designed to address most peculiar customer demands. **TWO SMR DEPLOYMENT OPTIONS** – **OFFSHORE AND ONSHORE** – were devised to account for all climate, regional and geographic specifics.

SUITABLE FOR SUPPLYING ELECTRICITY, HEAT AND DESALINATED WATER TO:

- LOCAL MUNICIPALITIES
- INDUSTRIAL SITES
- ISOLATED AREAS

TOTAL AREA:

15 ACRES



MAIN BUILDING

1. Reactor building
2. Turbine building
3. Radwaste building
4. Indoor switchgear
5. Cooling towers
6. Cooling water pumps
7. Safety cooling towers
8. Backup generators
9. Security gates
10. Administration building
11. Water treatment building
12. Fire station
13. Sewage works

OFFSHORE

ROSATOM

SUITABLE FOR SUPPLYING ELECTRICITY, HEAT AND DESALINATED WATER TO:

- COASTAL AREAS
- OFFSHORE FACILITIES
- ISLANDS AND ARCHIPELAGOES

1 2 FNPP construction and first fueling in the country of origin *

3 4 Transportation to operation site through the territorial sea of transit countries

5 Power and heat production at operation site in host country (up to 10 years before refueling)

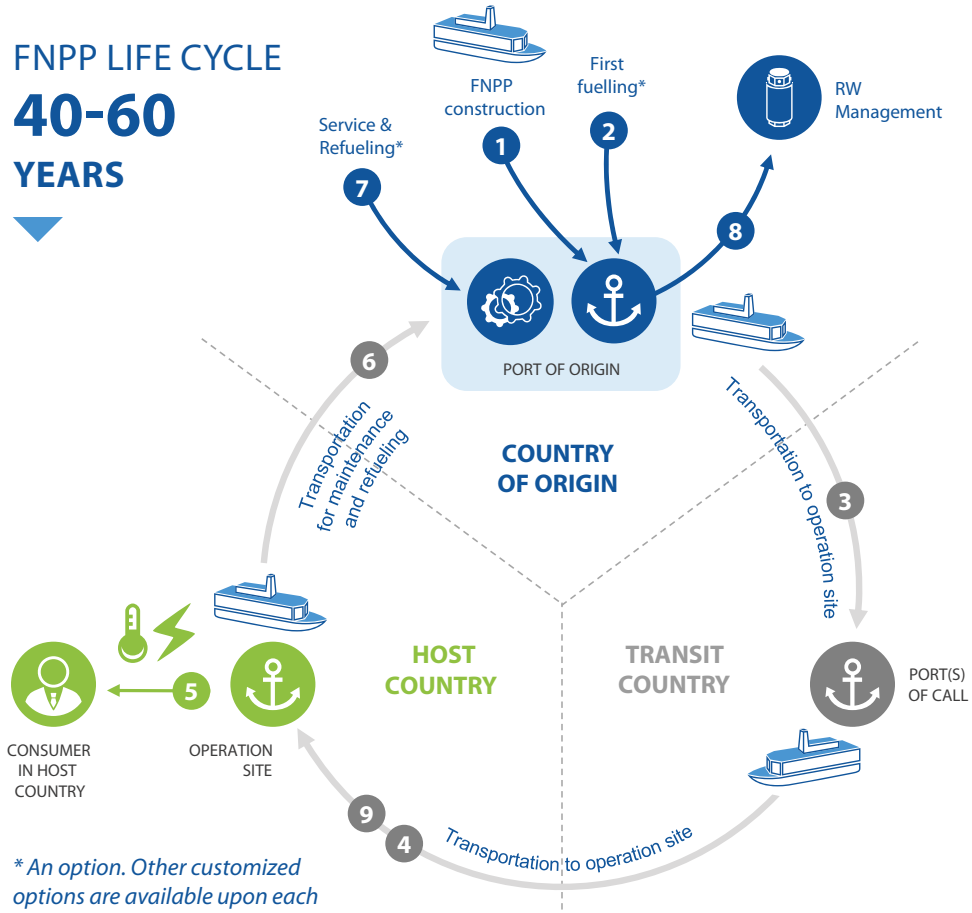
6 Return to the country of origin for maintenance and refueling

7 Maintenance and refueling in the country of origin*

8 Radwaste management in the country of origin

9 Return to operation site

FNPP LIFE CYCLE
40-60
YEARS



** An option. Other customized options are available upon each Project conditions.*

RITM SOLUTION

ROSATOM

RITM SERIES – is the **LATEST DEVELOPMENT** in Rosatom's new generation SMR line and has incorporated all the best features from its predecessors.

Initially **RITM** series was developed for nuclear icebreaker ships powered by two reactor modules.

Later it was adapted for **NUCLEAR POWER PLANT** design. Now RITM series is the flagship Rosatom SMR solution for onshore and floating small power plants.

ROSATOM RITM SERIES IS AN INTEGRAL PRESSURISED WATER REACTOR (PWR) WITH THE CAPACITY OF 57 MW(e)

RITM SERIES CAN BE ALSO UTILIZED TO PRODUCE HEAT FOR DESALINATION PLANTS AND VARIOUS INDUSTRIAL APPLICATIONS

Reactor type	Integral PWR
Electrical capacity	57 MW
Thermal capacity	165 MW
Evaporation capacity	248 t/h
Steam temperature	295 °C
Steam pressure	3.82 MPa
Design life	60 years
Refueling cycle	
RITM-200	6 years
RITM-200M (offshore solution)	10 years
Capacity factor	90%
Fuel enrichment	< 20%

Chief designer:
Afrikantov OKBM (ROSATOM)

OKBM AFRIKANTOV

atomenergomash

SAFETY

ROSATOM

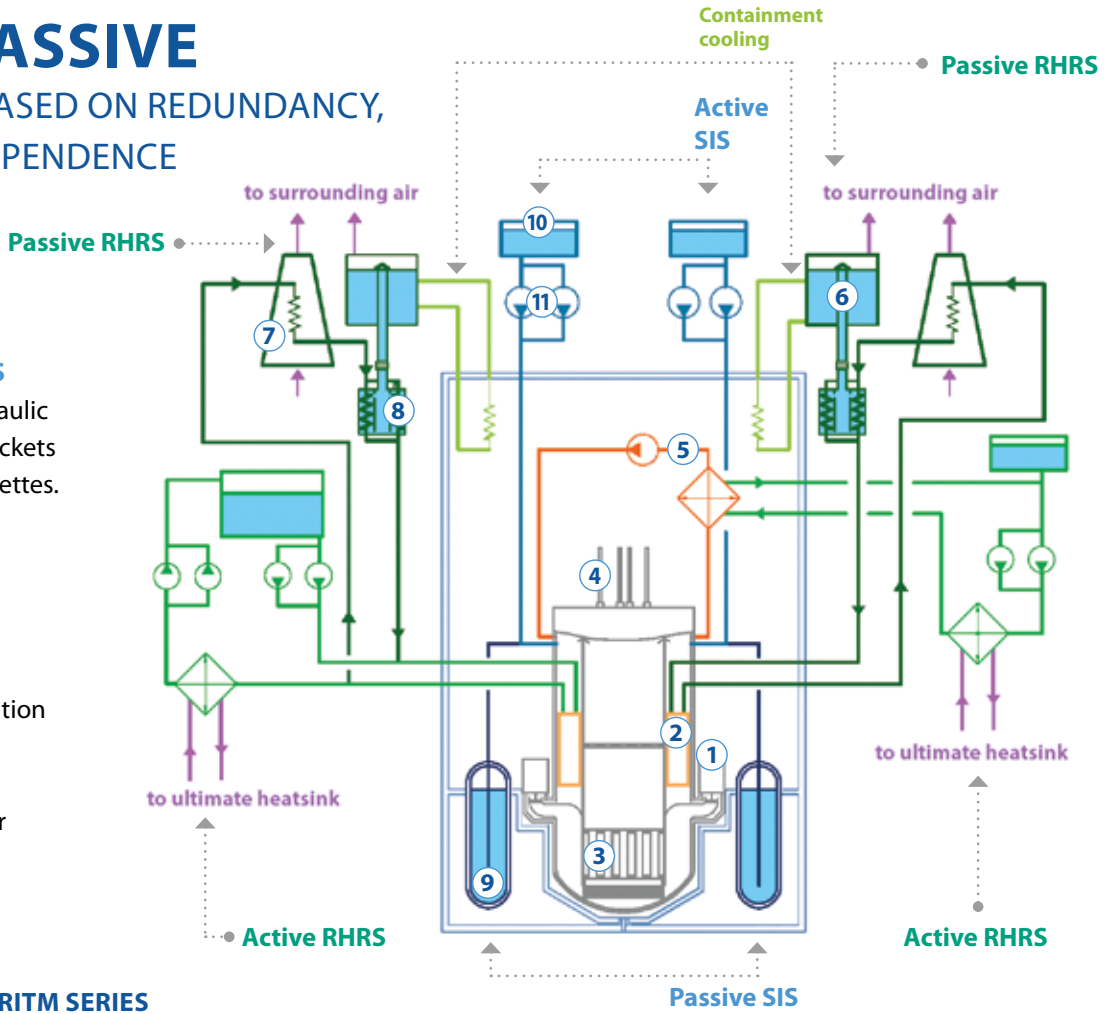
- DEFENCE-IN-DEPTH PRINCIPLE
- INHERENT SAFETY FEATURES
- **ACTIVE & PASSIVE**

SAFETY SYSTEMS BASED ON REDUNDANCY, DIVERSITY AND INDEPENDENCE

The reactor is designed as an integral vessel with the ① **MAIN CIRCULATION PUMPS** located in separate external hydraulic chambers with side horizontal sockets for ② **STEAM GENERATOR** cassettes.

RITM-200 adopts a referenced ③ **LOW ENRICHED URANIUM CORE** that ensures long time operation without refuelling and meets international non-proliferation requirements.

④ **CONTROL ROD DRIVE MECHANISM (CRDM)** is used for reactivity control.



RESIDUAL HEAT REMOVAL SYSTEM (RHRS)

is designed to remove residual heat from the core after the reactor shutdown. Active trains remove heat from the core through a steam generator and the heat exchanger of primary circuit ⑤ **COOLANT PURIFICATION LOOP**. Two passive safety loops with natural coolant circulation from ⑥ **WATER TANKS** through steam generators, ⑦ **AIR-TO-WATER HEAT EXCHANGERS**, and ⑧ **WATER HEAT EXCHANGERS**.

SAFETY INJECTION SYSTEM (SIS)

is designed for water injection in primary circuit to mitigate the consequences of a loss-of-coolant accident (LOCA). The system is based on two passive pressurized ⑨ **HYDRAULIC ACCUMULATORS** and two active channels with ⑩ **WATER TANKS** and two ⑪ **MAKE-UP PUMPS** in each channel for redundancy.

MULTIPURPOSE APPLICATION

ROSATOM

Nuclear power plants with **RITM** series reactors can be utilized for multiple purposes, including desalination and heat production.

POWER GENERATION

High availability factor values provide sustainable power generation

DESALINATION

Hybrid desalination technology based on multiple-effect distillation (MED) and reverse osmosis (RO)

DISTRICT HEATING

RITM series is suitable for district heating application

UP TO **200 000 M³/DAY** IN A FULL DESALINATION MODE PER SMR UNIT

THE PLANT CAN BE SCALED UP FOR MORE CAPACITY IF REQUIRED

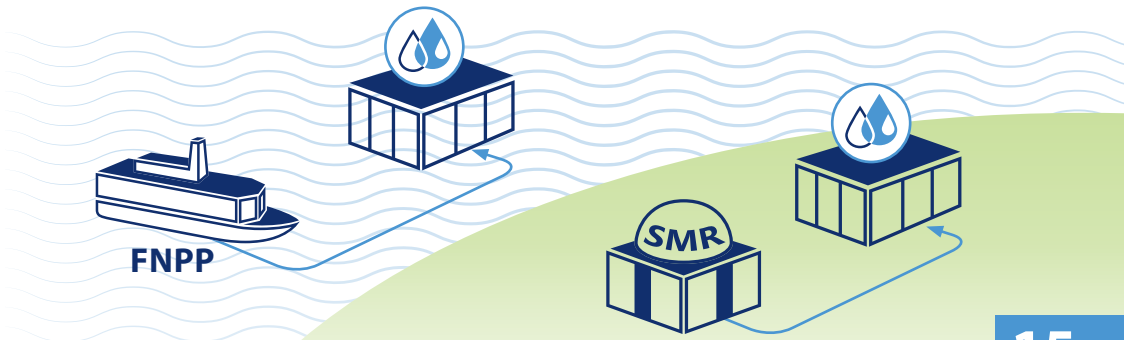
HYBRID TECHNOLOGY – REVERSE OSMOSIS AND MULTIPLE-EFFECT DISTILLATION

OFFSHORE DESALINATION (FLOATING NPP)

- Floating NPP + Offshore desalination plant
- Transportable to a different location

ONSHORE DESALINATION MODULES (SMR)

- Onshore SMR power plant project + Onshore modular desalination units



AKADEMIK LOMONOSOV FNPP

ROSATOM

Rosatom is the **WORLD'S PIONEER** in developing **FLOATING NUCLEAR POWER PLANTS**.

"AKADEMIK LOMONOSOV" FNPP – IS THE FIRST-OF-A-KIND FLOATING NUCLEAR POWER PLANT PROJECT IN THE WORLD.

IT WAS CONNECTED TO THE GRID IN **2019**.

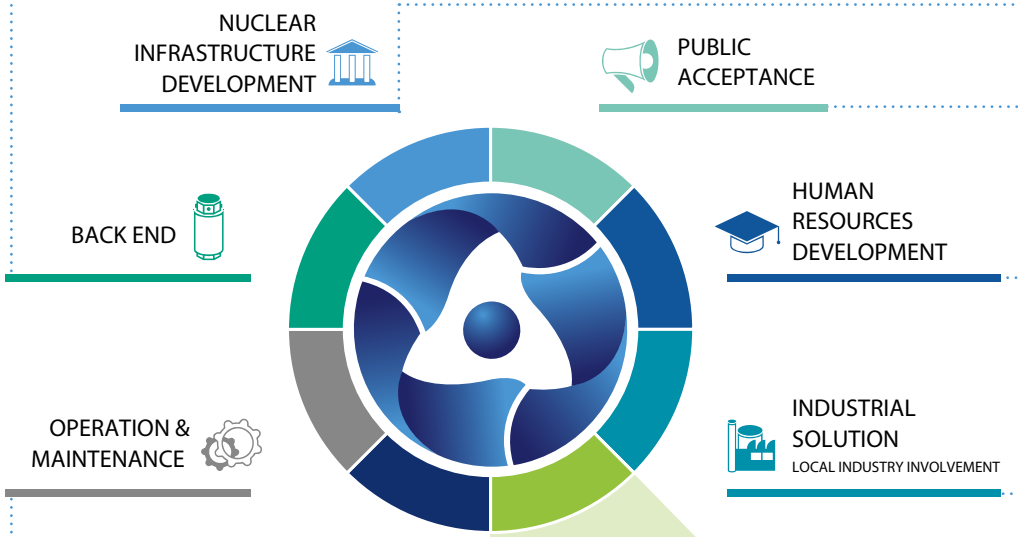
"AKADEMIK LOMONOSOV" FNPP WILL BE THE **FIRST REFERENCE** FOR FLOATING NUCLEAR POWER PLANTS IN THE WORLD, PAVING THE WAY FOR FUTURE FNPP PROJECTS!

Reactor	2 × KLT-40S
Electrical capacity	up to 77 MW (2 × 38.5)
District heating	up to 146 Gcal/h
Thermal capacity	300 MW (2 × 150)
Length	140 m
Beam	30 m
Draught	5.6 m
Displacement	21 000 t
Refueling cycle	up to 3 years
Design life	40 years
Mobility	Towed

ROSATOM INTEGRATED OFFER

ROSATOM SUPPORTS ITS CUSTOMERS THROUGHOUT THE CIVIL NUCLEAR PROGRAM: FROM THE VERY INTRODUCTION OF A NUCLEAR OPTION INTO THE ENERGY STRATEGY TO DECOMMISSIONING OF THE LAST NUCLEAR FACILITY.

ROSATOM



BACK END
providing eco-friendly solutions for spent nuclear fuel and radwaste treatment and decommissioning nuclear facilities

NUCLEAR INFRASTRUCTURE DEVELOPMENT
preparing the customer country to host a nuclear facility in accordance with the world's best practices, as well as IAEA requirements

PUBLIC ACCEPTANCE
raising public awareness of the benefits, that nuclear energy provides and disseminating positive information about its effects among the population

HUMAN RESOURCES DEVELOPMENT
training the qualified professionals to manage a national nuclear program and to operate nuclear facilities safely and efficiently

INDUSTRIAL SOLUTION
enabling local suppliers to contribute to the national nuclear program and giving a boost to the local economy

ENERGY SOLUTION
design, construction, and commissioning of large-scale NPPs, featuring the state-of-the-art VVER-1200 and SMR technologies designed to be a reliable source of power

FUEL SUPPLY
uninterrupted fuel supply throughout the NPP operation cycle to ensure continuous power flow in the national grid

OPERATION & MAINTENANCE
managing safe operation and cost-effective power generation at NPPs

SMR

OTHER ROSATOM ENERGY SOLUTIONS

SHELF

Micro SMR Solution,
<10 MWe

VVER-600

Medium Power
Solution,
600 MWe

SVBR-100

Generation IV SMR,
100 MWe

HTGR

For heat and hydrogen
production

BN-TYPE REACTORS

Sodium Cooled Fast Reactor

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