

THE STATE ATOMIC ENERGY CORPORATION ROSATOM

Rosatom SMR Approach for Brazil: Onshore and Offshore solution





DEMAND GROWTH, CURRENT INSTALLED CAPACITY STRUCTURE & ECONOMY MODEL REQUIRE ADDITION OF **UP TO 4.4 GW OF BASELOAD**

Installed capacity structure, 2017



HPP
NPP
Oil
Gas
Coal
Biomass
Wind

- HPP dominates in the energymix strong dependence on seasonal variations and drought risks
- Strong dependence on energy import 5 GW a year
- · Power demand growth 2% a year under the Base scenario
- Industry as a main consumer requires stable baseload generation
- · Potential deficit up to 4.4 GW by the year 2030



Consumption by sectors, 2017





SMR-based NPP & FNPP – market capacity and grid integration





NOW IS COVERED BY IN-COUNTRY ENERGY TRANSITS





Stable Generation and Sustainable **ENERGY** Mix



SPECIFIC CONDITIIONS BRING DEMAND FOR... TRANSPORTABILITY **GEOGRAPHIC** & FLEXIBLE **CONDITIONS:** Remote areas **PLACEMENT** Limited territories **INFRASTRUCTURE PLUG-AND-PLAY CONDITIONS:** GRID • Undeveloped power grids **CONNECTION** • Energy storage is onerously expensive ARE THE BEST MARKET COSTS SOLUTION CONDITIONS: PREDICTABILITY Energy price volatility Fuel dependency **EXCESSIVE FOCUS ON** STABLE RENEWABLES **GENERATION** Climate conditions Energy intensive industries

SMR: a Truly Innovative ENERGY Solution





SMR FLEXIBLE ENERGY SOLUTION

Rosatom Offers Referenced ENERGY Solutions



ASIDE FROM THE VAST EXPERIENCE IN DESIGN, MANUFACTURING, CONSTRUCTION AND OPERATION FOR LARGE-SCALE NPPS, ROSATOM OPERATES A UNIQUE NUCLEAR ICEBREAKER FLEET.



9 NUCLEAR ICEBREAKERS AND 1 NUCLEAR ICEBREAKING LASH-CARRIER "SEVMORPUT"

ROSATOM HAVE MANUFACTURED
 20 NUCLEAR REACTORS FOR ICEBREAKERS

TOTAL EXPERIENCE – ABOUT 400 REACTOR-YEARS

RITM Series Reactors – The Latest Development Incorporates All The Best Features From Its Predecessors



Six RITM-200's installed into "Arktika", "Sibir", and "Ural" icebreakers

"Arktika" and "Sibir" expected in service in 2020

RITM-200M reactor is the further RITM series development with **increased refueling cycle**

RITM-200 installation to "Arktika" icebreaker









Land-based NPP Concept Design Based on RITM Series SMR Layout





2×50 MW(e) – 100 MW(e) 2 x RITM-200 Reactors

Rosatom is prepared to offer a flexible, tailor-made small NPP solution, based on **RITM series SMR**, which is designed to address most peculiar customer demands

TECHNICAL PARAMETRS:						
Electric capacity	100 MWe (2 x 50)					
Thermal capacity	350 MWt (2 x 170)					
Refueling cycle	up to 6 years					
Design life	60 years					
Capacity factor	90%					
Plant area	5.6 hectares (13 acres)					
Construction period	3 - 4 years					



Land-based NPP Concept Design Based on RITM Series SMR Main Building



SMALL NPP MAIN BUILDING CONSISTS OF

- two RITM-200 reactors,
- two steam turbine generators,
- · rooms for radioactive waste management



MAIN BUILDING LAYOUT



Land-based NPP Concept Design Based on RITM Series SMR Modularity



100 MW(e) 5.6 hectares



Modular approach allows easier plant electrical capacity growth by additional reactor and turbine building construction and shared use of auxiliary buildings

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200 MW(e) 8.6 hectares



Reactor building 1) (2) Turbine building (3) Radwaste building 4 Administrative building (5) Cooling tower pumps (6) Cooling towers (7)Water treatment building (8) Fire station (9) Security gates

10 Backup generators







KEY COMPETITIVE ADVANTAGES – OFF-GRID DEPLOYMENT, AND MODULARITY!

Combined with a stable base load output for 60 years and low operation costs are a perfect fit for isolated and remote areas with limited or no access to the power grid.

	TARIFF DETERMINATION PERIOD	ENVIRONMENTAL FRIENDLINESS	BASE LOAD AND UNINTERRUPTED GENERATION	INDEPENDENCE FROM FUEL SUPPLIES	MODULARITY	CONNECTION SPEED	LOAD FOLLOWING	LOW PRICE FOR ELECTRIC POWER FOR THE FINAL CONSUMER
					Q ≋			\$
SMALL NPP	No risks of significant accumulated price increase of electric power	No CO2 emissions to the atmosphere	Stable electric power supply	Fuel supply infrastructure is not required	Wide range of locations possible to be selected	Short period to start power supply	Capable to ensure basic and peak generation	Ceteris paribus, the most important parameter for the consumer
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GAS	\otimes	\otimes	\odot	\otimes	\odot	\odot	\odot	\odot
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World's First Floating Nuclear Power Plant Reference FNPP AKADEMIK LOMONOSOV





FNPP will be commissioned in 2019 (Pevek, RUSSIA)

After commissioning FNPP will replace aging power generating capacities providing electrical power to the city of Pevek, one of the major Arctic ports in the North-East of Russia

FNPP: Optimized Mobile Solution for Coastal Areas Power Supply





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Optimized FNPP is a solution for coastal areas power supply



A CONTINUOUS BASE-LOAD POWER SUPPLY WITHIN A 60-YEAR LIFE

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EFFECTIVE COST MANAGEMENT DUE TO FIXED TOTAL ELECTRICITY COST THROUGHOUT A 60-YEAR LIFE

SYNERGY WITH THE RENEWABLE ENERGY PROJECTS WHICH FACE PRESSING ISSUES OF SEASONAL FLUCTUATIONS

MULTIPURPOSE APPLICATION INCLUDING HEATING



Key Principles of the FNPP Safety





Site Selection Criteria for FNPP and Requirements for Deployment









Brazilian-Russian cooperation in SMR projects





Potential models of cooperation for SMR based (F) NPPs in Brazil



ROSATOM PROPOSES FOLLOWING CONTRACTING MODELS WITHIN FOREIGN PROJECTS IMPLEMENTATION: **EPC:** ENGINEERING, PROCUREMENT, CONSTRUCTION **BOO:** BUILD, OWN, OPERATE NPP vendor and other parties become EPC turnkey design and construction shareholders of the JV Small The constructed object is handled to the JV attracts investments for the project implementation customer for operation NPP ROI is realized by a PPA mechanism with the business Financing is arranged by the customer government or a major generation/ transmission / models (project financing) consumer company The customer is responsible for licensing, NPP vendor shares operational and project management site and infrastructure & completion risks with the local investors

Rosatom is **FLEXIBLE** In the project implementation models

Rosatom EPC projects portfolio: Belarus, Egypt, India, Hungary, Bangladesh, etc.

Rosatom BOO projects portfolio: Turkey, Finland



