



POCATOM

JOINT-STOCK COMPANY «RUSATOM ENERGO INTERNATIONAL»



Small module reactors (SMR) – New product offer of SC «Rosatom»

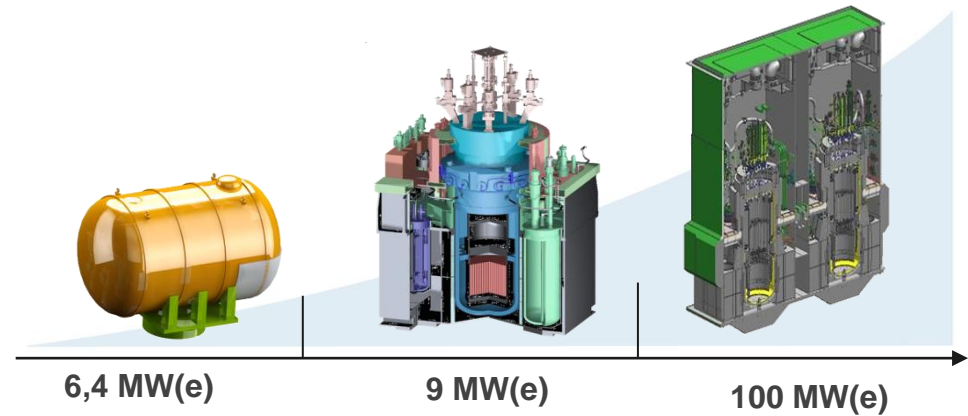
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Deputy Director of Engineering
JSC “Rosatom Energo International”

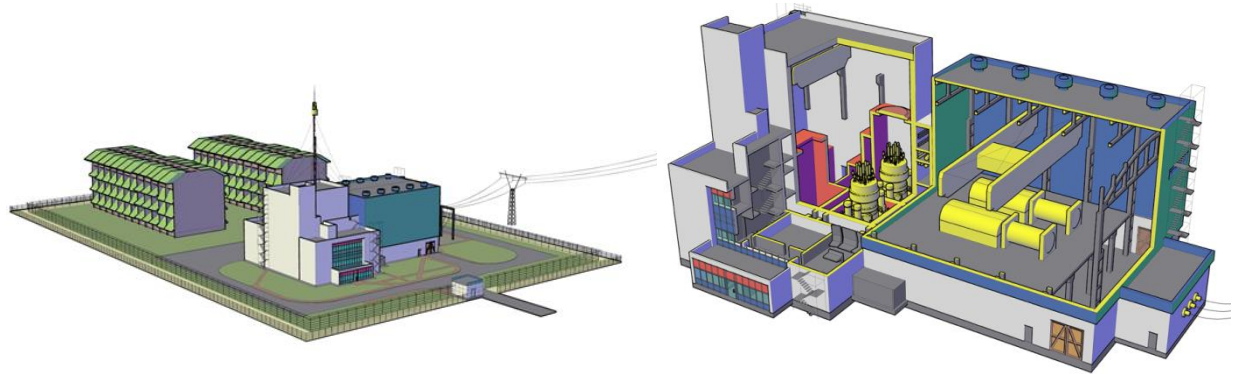
SMR

***April 7, 2016
Saint Petersburg***

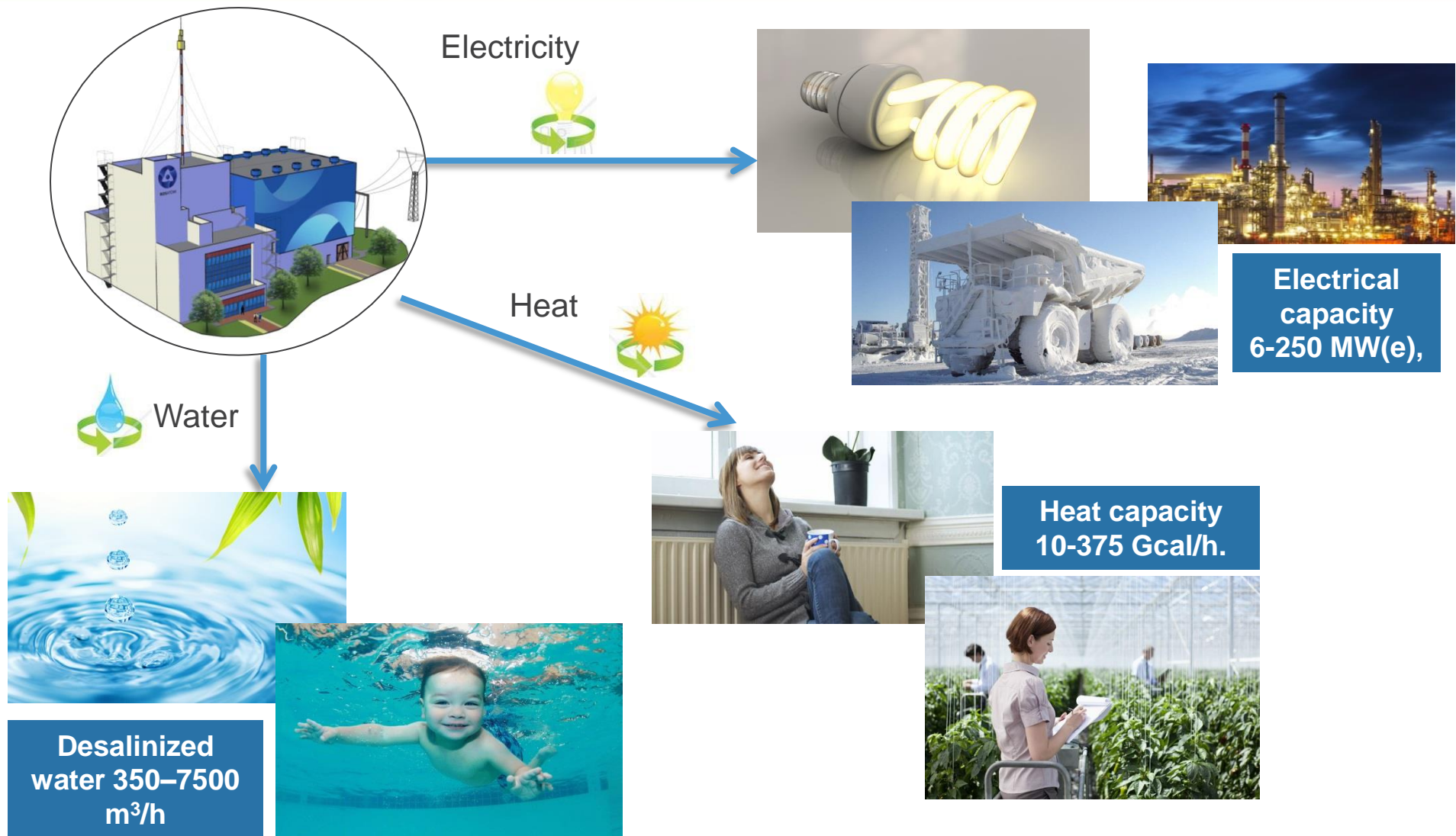
Real solution for SMR market



SMRs of Russian design are based on time and safe operation proven reactors of PWR type



Abilities/useful products of SMR



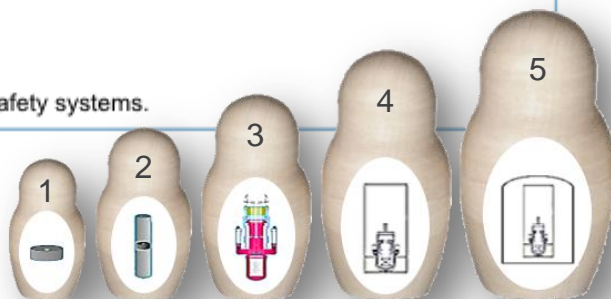
High safety rate

DEFENCE-IN-DEPTH PRINCIPLE

This principle anticipates application of barrier system on the way of ionizing emission and radioactive matter to the environment and system of technical and organizational measures of the barrier protection and preserving their efficiency and protection of inhabitants.

The barrier system includes:

- 1) fuel matrix
- 2) fuel element cover
- 3) reactor core
- 4) border of reactor coolant contour
- 5) hermetical enclosure of localizing safety systems.



TECHNICAL AND ORGANIZATIONAL MEASURES SYSTEM

First level:

- conservative project based on application of modern norms;
- quality assurance on all NPP construction stages;
- operational safety barriers condition control;
- safety culture.

Second level:

- control and failure detection (protection and blocking, reserve mechanisms of normal operation) in case of operation failure.

Third level:

- protective, control, localizing and supply safety systems, preventing failure expansion to design basis accidents and further to beyond design basis accidents.

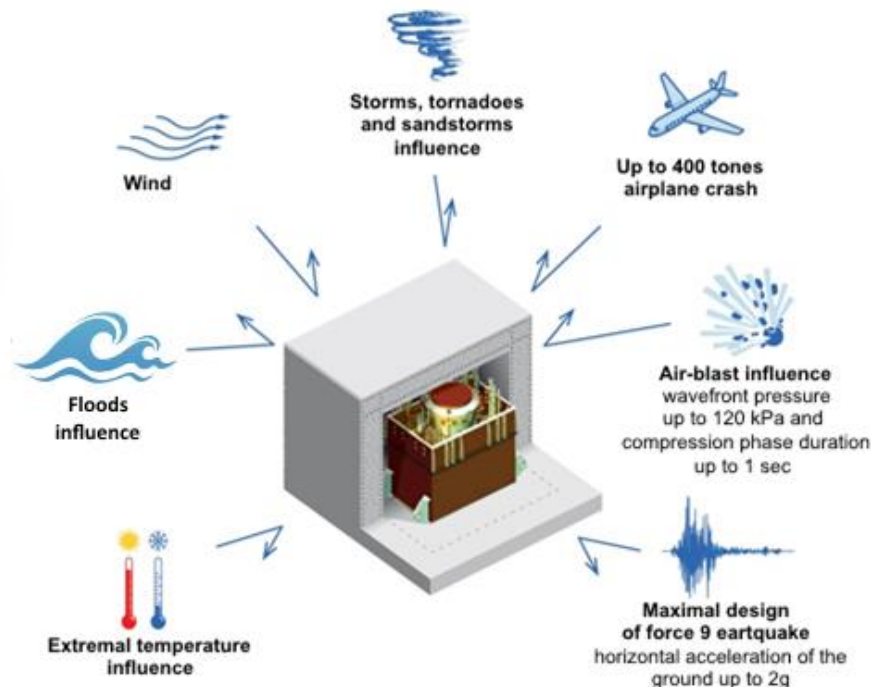
Fourth level:

- accident control including localizing functions protection.

Fifth level:

- accident-prevention measures out of site to reduce consequences of radioactive media emission into the environment.

Maximal consideration of external influences concept



Operational experience

In Russia more than 260 nuclear-powered ships were built. The experience of operation of nuclear energy units exceeds 7000 reactor-years

Competitive economical rates*

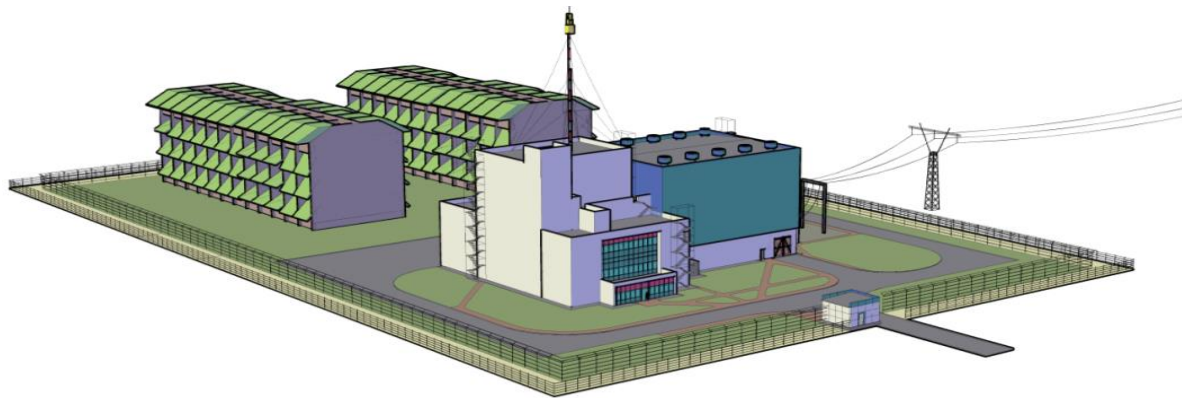
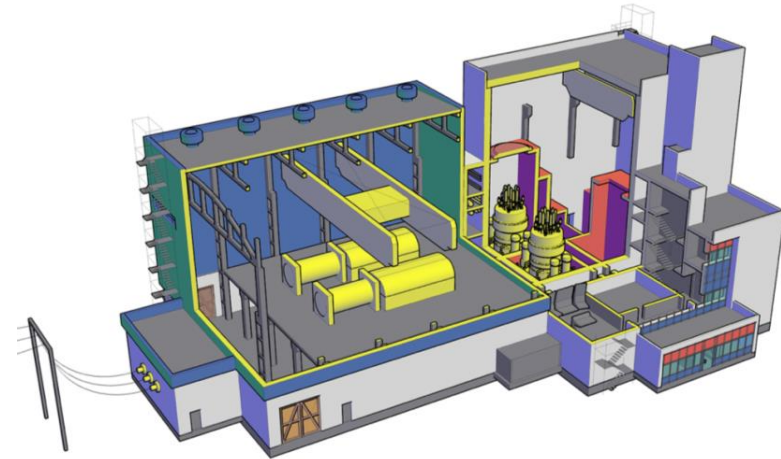
*Indicators are to be specified for a region

Indicator	ABV-6 9 MW	Shelf 6,4 MW	45 MW (RITM-200)	225 MW (Cluster 5 SMR RITM-200)
NPV, mln.US\$	20,2	14,7	196	1350
IRR, %	16,2	15,5	20	23
Pay-off period, years	12	15	10	9
LCOE real*, C/kW*h (discount rate. 10%)	22	25	14	12
LCOE nominal**, C/kW*h (discount rate. 10%)	37	39	22	19
CAPEX, mln.US\$	60,4	48,1	215,3	1015
OPEX, mln.US\$/year	5,2	4,5	11,7	48,7
Specific investments, US\$/kW (e)	≥ 7 000	≥ 7 500	≥ 4 800	≥ 4 500

*) real – non escalated expenses; **) nominal – expenses with escalation.

SMR with electricity production

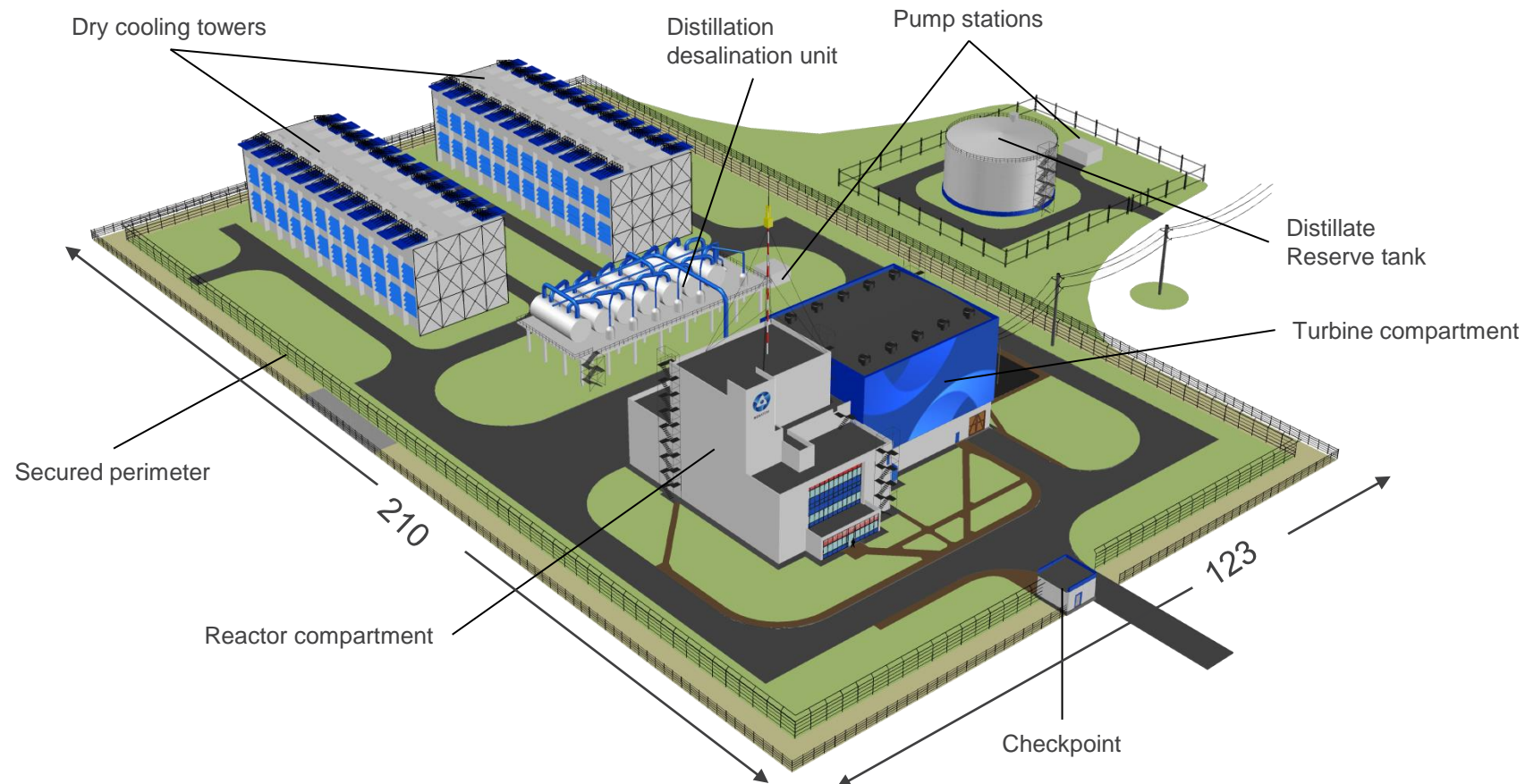
Arrangement solution with two reactor units RITM-200 and two turbines PT-50. Capacity in condensing mode up to 100 MW(e), heat capacity in heating mode 150 Gcal/h



In case of water shortage cooling towers are used

Examples of production solutions (2)

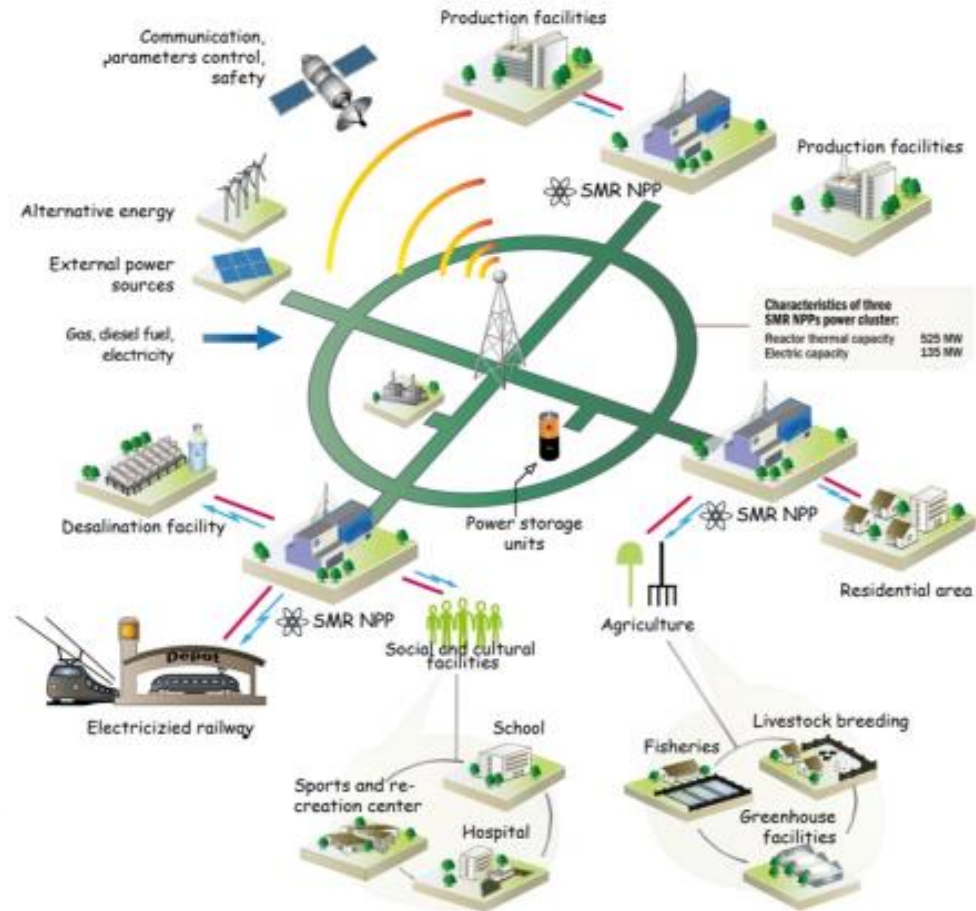
SMR with desalination complex



Energy cluster of territory development on the basis of SMR and the Smart Grid technology

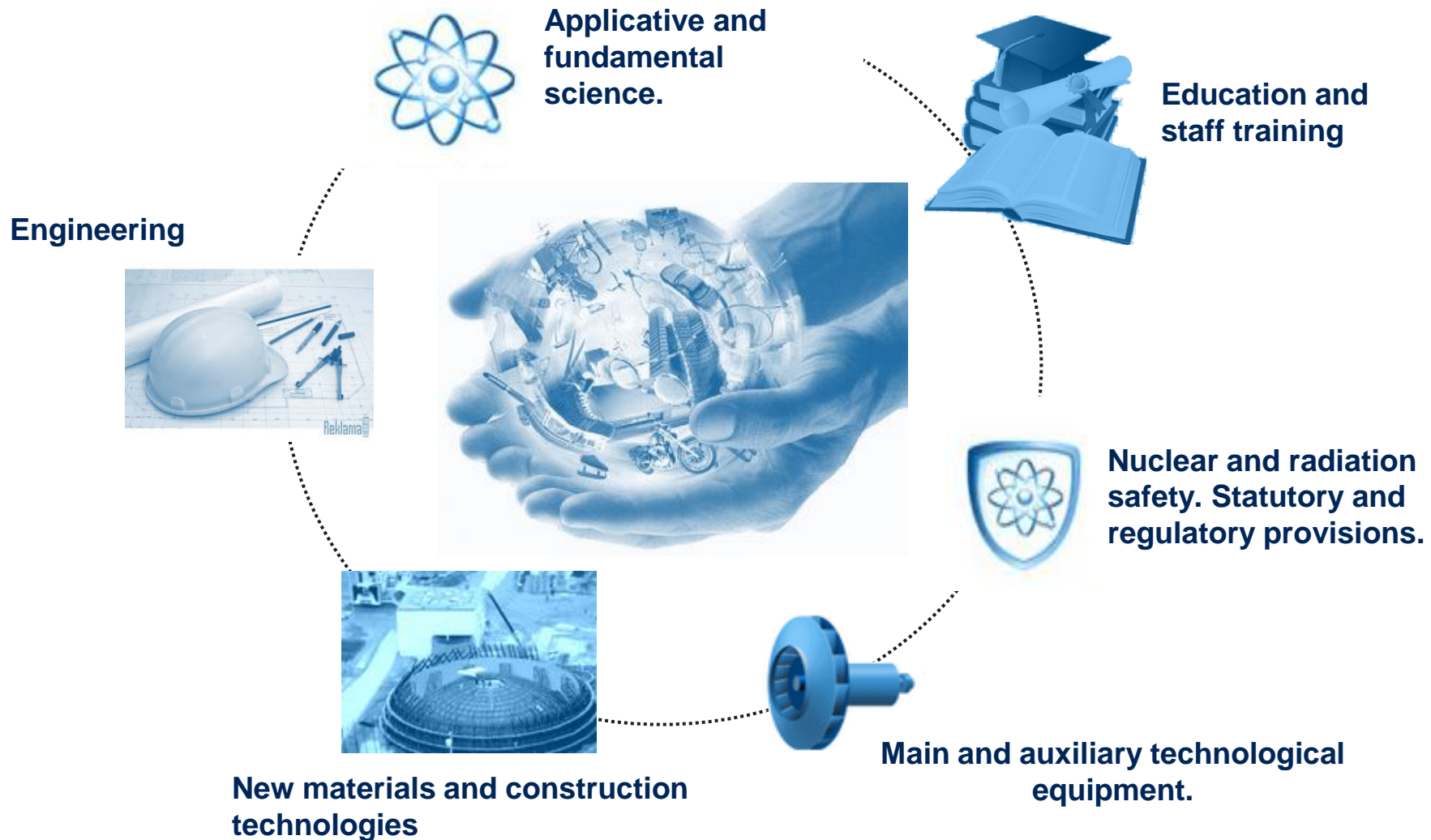
ADVANTAGES

- Reliability, sustainability of the grid;
- Quality of energy supply;
- Availability for new consumers and generation sources;
- Synchronous work of generation sources and energy storage and consumption points;
- Reduction of environmental influence;
- Improvement of life quality and territory development perspectives



*Information is given for cluster on the basis of 5 SMR RITM-200

Cooperation on SMR construction



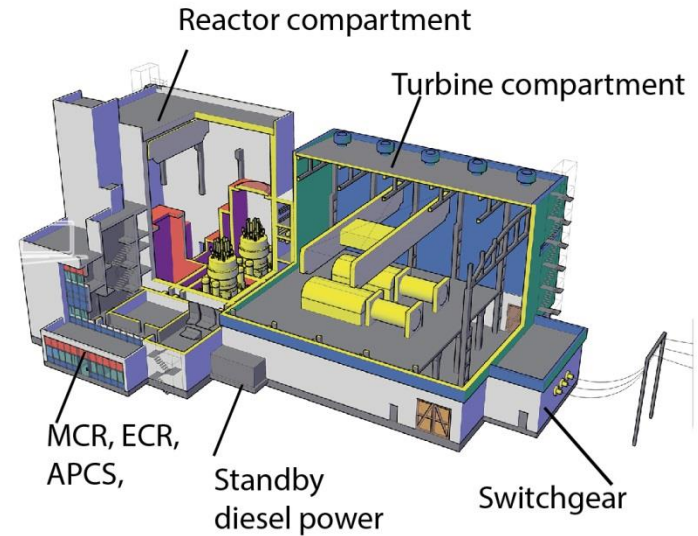
Industrial cooperation in the context of prolonged manufacturing cycle equipment production

In accordance to marketing research:

Period of SMR market formation opportunities: 2015–2023 years

Demand for SMR on the global market: 80 units until 2030.

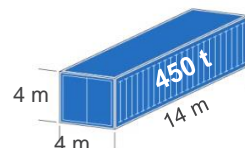
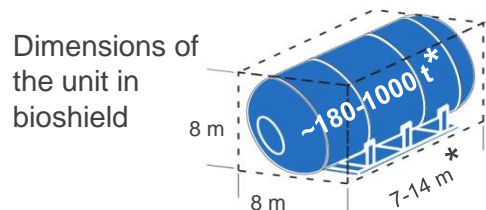
Task: Enhancement of manufacturing capacities, industrial cooperations



Main transported modules: reactor unit in the bioshield, turbine unit, standby diesel generator, construction materials, standardized equipment.

SMR Shelf

Power capacity 6,4 MW(e)

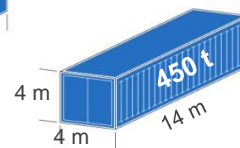
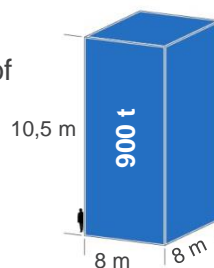


Maximal dimensions of other modules

SMR ABV-6

Power capacity 6–9 MW(e)

Dimensions of the unit in bioshield

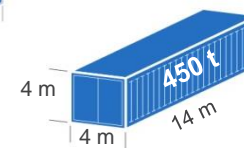
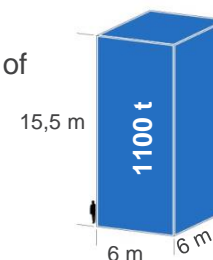


Maximal dimensions of other modules

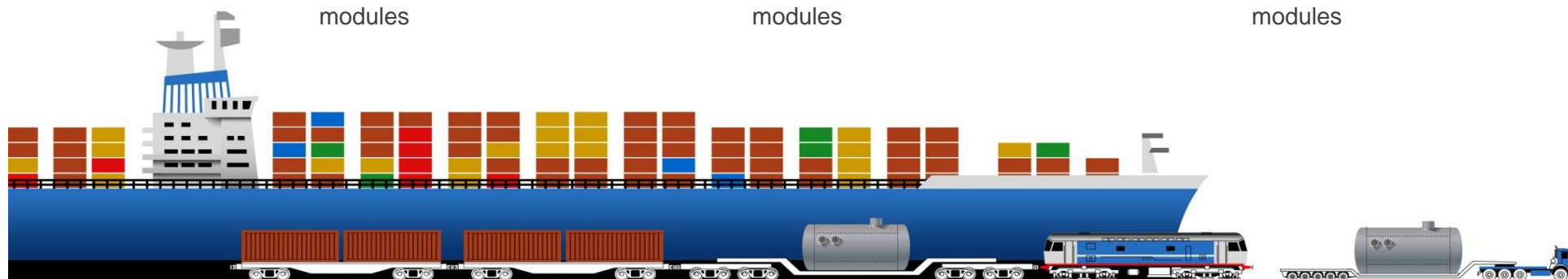
SMR RITM-200

Power capacity 45 and 90 MW(e)

Dimensions of the unit in bioshield

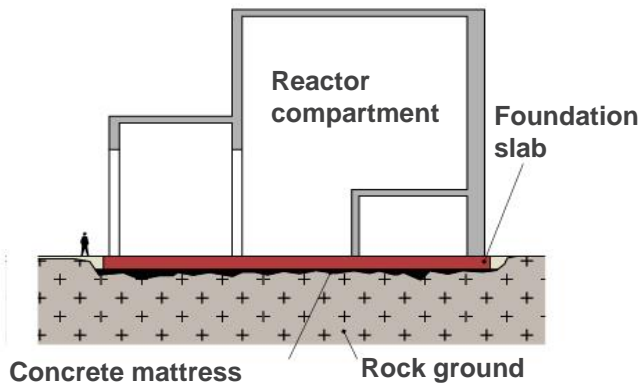


Maximal dimensions of other modules

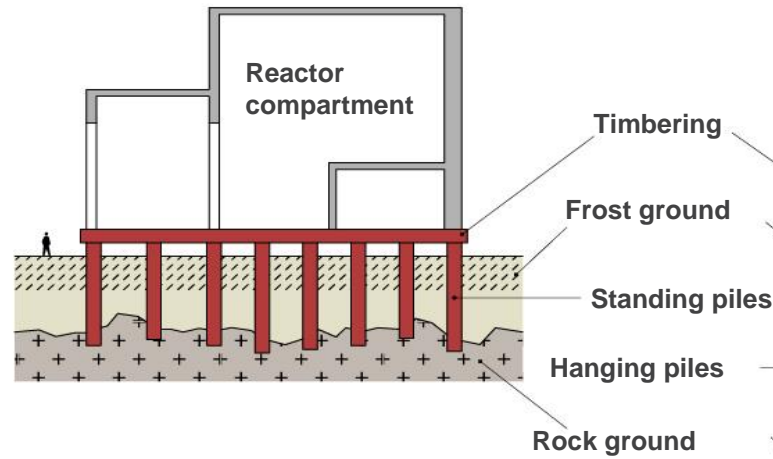


* Weights and dimensions of SMR Shelf vary depending on version

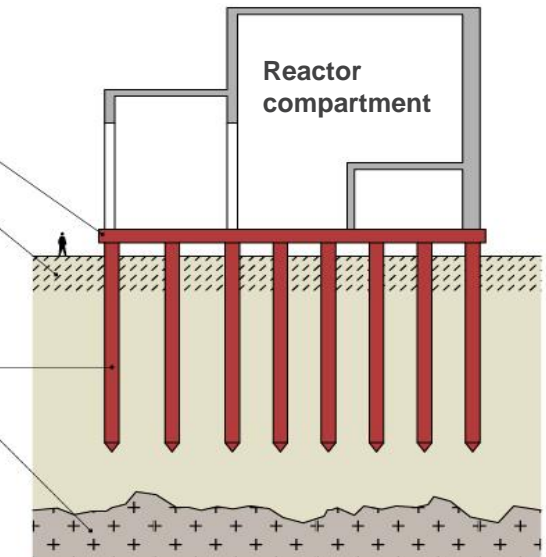
1 On rock ground



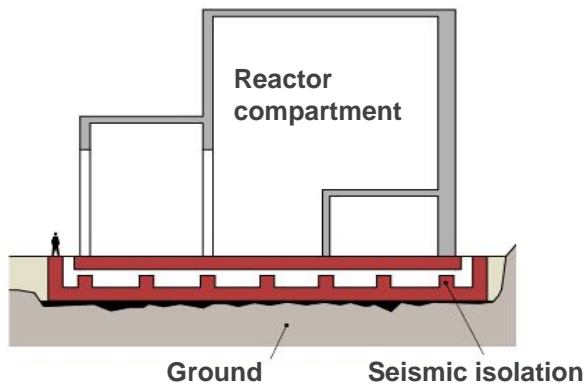
2a On weak ground of small thickness



2b On weak ground with deep attitude of rock ground



3 In seismic regions



– Earthquake isolated foundations (NPP Oikiluoto)



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**THANK YOU
FOR YOUR ATTENTION!**