



ROSATOM

JOINT STOCK COMPANY «ATOMIC ENERGY POWER CORPORATION»

ROSATOM CENTRAL INSTITUTE  
FOR CONTINUING EDUCATION AND TRAINING



# Capacity Building and Infrastructure Development for Nuclear Power Programmes

*Dr. Alexander Bychkov*

*Prof. Vladimir Artisiuk*

© ROSATOM-CICE&T



# National Research Nuclear University «MEPhI»



– NPPs



– Nuclear Fuel Cycle facilities



– MEPhI and its branches

## Key characteristics of MEPhI:

- Integration with ROSATOM enterprises
- Financial support from ROSATOM (2012-2017 – annually 400 mln Rbl)
- ROSATOM has established “request” till 2021

## NRNU “MEPhI”:

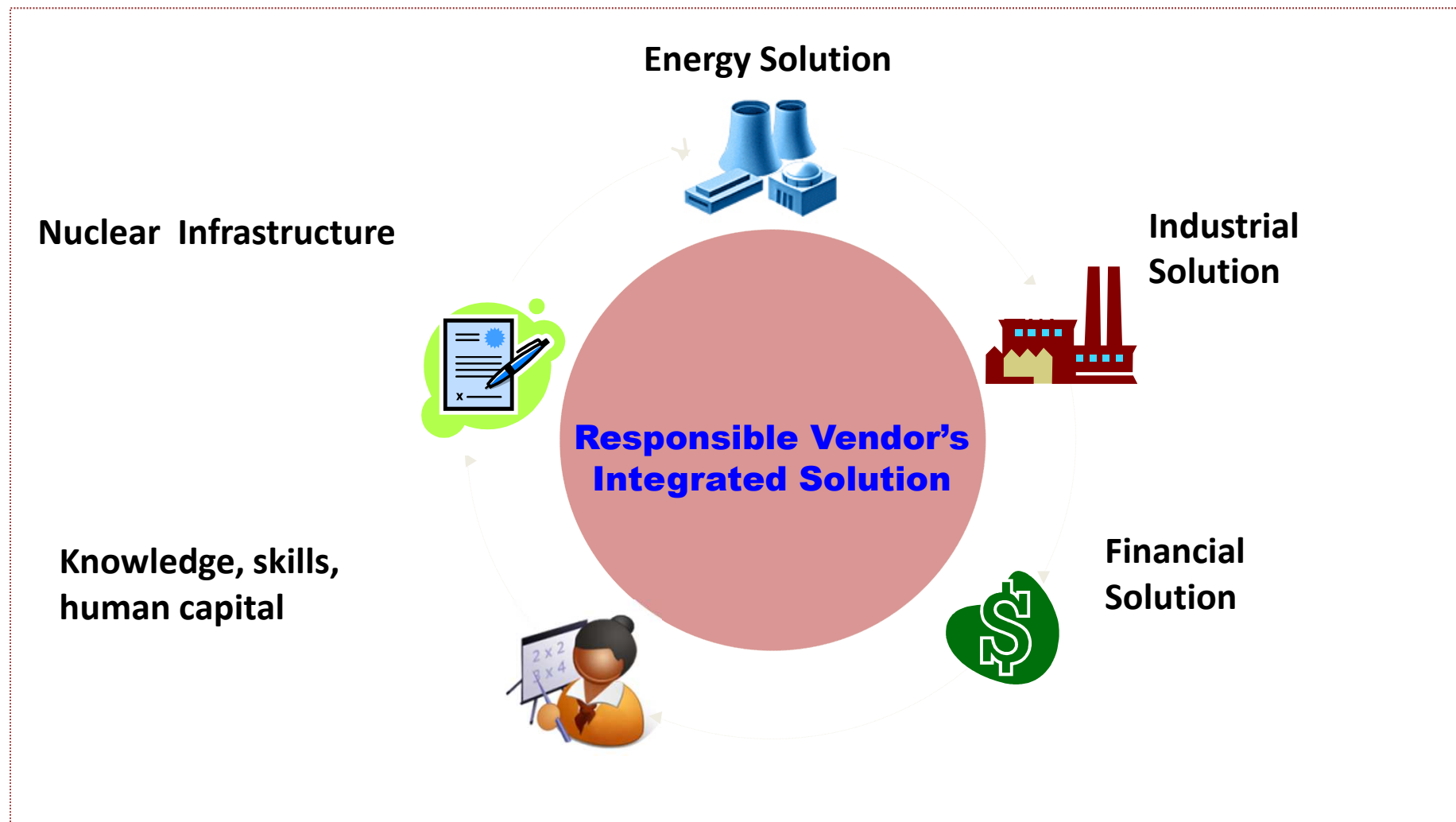
11 Universities and 13 colleges  
About 34 000 students  
More 1600 professors and docents

## Branches in 20 cities:

Moscow  
Obninsk  
Dimitrovgrad  
Volgodonsk  
Novosibirsk  
Sarov  
Snezhinsk  
Novouralsk  
Ozersk  
Lesnoy  
Trenkhgorny  
Seversk  
Zheleznogorsk  
Zelenogorsk  
Electrostal  
Novovoronezh  
Balakhna  
Zarechny  
Angarsk  
Krasnokamensk

NRNU “MEPhI” was established in 2008 on the basis of MEPhI

# Russian Integrated Offer to Newcomer States





## Russian Approach to Support Capacity Building in Newcomer Countries: Offers

# Russian Approach: Action Plan in Support NI in Newcomer Countries

1

Assessment of the current status of NI development

2

NI development schedule planning

3

Assistance in NI development implementation

Rosatom presents a customer two basic documents based on Russian practice for nuclear industry:



1. Conceptual model of the nuclear industry



2. Road map of nuclear infrastructure development

embraces 19 elements:

1. National position
2. **Nuclear safety**
3. Management
4. Funding & Financing
5. Legislative framework
6. **Safeguards**
7. Regulatory framework
8. Radiation Protection
9. Electrical grid
10. Human resources development
11. Stakeholder involvement
12. Site & supporting facilities
13. Environmental protection
14. Emergency planning
15. **Nuclear Security**
16. Nuclear fuel cycle
17. Radioactive waste
18. Industrial involvement
19. Procurement

## Consultancy

- Expert missions
- Development of normative documents
- Audit of the regulations
- Workshops

## Education & Training

- Nuclear Education
- Basic and Special training courses
- Internships
- Workshops

## Establishment of Thematic centers

- Development of conceptual models of thematic centers
- Technical & normative documentation

## Scientific & Technical visits to Russia

- Visits to the organizations of the nuclear industry (centers of competence)
- Visits to NPP'S

# Nuclear Infrastructure Training Materials Development is Completed (Y 2015)

#	NI Issue	#	NI Issue
1	National position	11	Stakeholder involvement
2	Nuclear safety	12	Site and supporting facilities
3	Management	13	Environmental protection
4	Funding and financing	14	Emergency planning
5	Legal framework	15	Nuclear security
6	Safeguards	16	Nuclear fuel cycle
7	Regulatory framework	17	Radioactive waste management
8	Radiation protection	18	Industrial involvement
9	Electrical grid	19	Procurement
10	HR development		
+			
20	Nuclear energy planning and technologies assessment		
21	Metrology support in nuclear power and industry		

ROSATOM-CICE&T

PROGRAMME OF MODULAR TRAINING COURSE  
"MANAGEMENT" ISSUE

Course title: MGT «Establishing, development and evaluation of efficiency of the management system at nuclear energy organizations»

Date of approval: \_\_\_\_\_

REVISION 1

Training is conducted according to the program presenting fundamentals of metrology for implementation of management system for nuclear energy development program in a discipline of integral management system (IMS) process approach as well as nuclear PMS scope: the role of management in implementation and promotion of SNPP safety and energy program (NEP) development in a country are presented in the course. The example world-wide and Russian practice in implementation of IMS at nuclear organizations are discussed.

Target audience: Directors and top managers from NEPO (Nuclear Energy Programme for Organizations) responsible for the implementation of development of nuclear energy program (development, middle-level managers, experts).

Developed by: Tikhonov Nikolai 18.08.2015

Reviewed by: Yurlov Andrey 18.08.2015

Final methodological control by: 18.08.2015

ROSATOM-CICE&T

LESSON PLAN

Training course: MEAS Metrology Support in Nuclear Power and Industry

Training module: MEAS01: Introduction to metrology

Lesson MEAS01.1: Introduction to metrology

Revision 1

Developed by	A.Y. Karpenko, N.B. Naryshkinov ROSATOM-CICE&T
Examined by	F.I. Kamanov ROSATOM-CICE&T
Final methodological control by	N.A. Schalepova ROSATOM-CICE&T
Approved by	O.Y. Sarayev Rosenergoatom OJSC

Prerequisites:

- Category of trainees: Directors and top managers of the nuclear power programme management and regulatory system in the countries involved in the construction or planning the construction of Russian-designed nuclear facilities (NEPO - Nuclear Energy Programme Implementation Organization), middle-level managers, experts.
- Fluent English

Lesson training objectives:

- Present information about historical aspects of metrology development
- Present information about measurements in the ancient world.
- Present information about the anthropometric and national system of physical quantities.
- Describe the International System of Units SI.
- Describe the development of metrology in the XX century and at present

Necessary materials and equipment:

- Handouts

TRAINER'S HANDBOOK

Course: MEAS Metrology Support in Nuclear Power and Industry

Module: MEAS01: Introduction to Metrology

Lesson: MEAS01.1: Introduction to Metrology

Prepared by: A.Y. Karpenko, N.B. Naryshkinov  
ROSATOM-CICE&T

Reviewed by: F.I. Kamanov  
ROSATOM-CICE&T

Final methodological control by: N.A. Schalepova  
ROSATOM-CICE&T

Approved by: O.Y. Sarayev  
Rosenergoatom OJSC

Target audience: Directors and top managers of the nuclear power programme management and regulatory system in the countries involved in the construction or planning the construction of Russian-designed nuclear facilities (NEPO - Nuclear Energy Programme Implementation Organization), middle-level managers, experts.

Fluent English

Lesson training objectives:

- Present information about historical aspects of metrology development
- Present information about measurements in the ancient world.
- Present information about the anthropometric and national system of physical quantities.
- Describe the International System of Units SI.
- Describe the development of metrology in the XX century and at present

Necessary materials and equipment:

- Handouts

Table of contents

Table of contents

1. Introduction to metrology

2. Measurements in the ancient world

3. The International System of Units SI

4. The development of metrology in the XX century and at present

5. Summary

Lesson 1. Introduction to metrology

Lesson training objectives:

- Present information about historical aspects of metrology development
- Present information about measurements in the ancient world.
- Present information about the anthropometric and national system of physical quantities.
- Describe the International System of Units SI.
- Describe the development of metrology in the XX century and at present

Necessary materials and equipment:

- Handouts

Measurements in Ancient World (2/2)

Need for quantitative assessment of:

- distance
- weight
- time
- volume etc.

Measurement means:

- arm
- foot
- finger etc.

Size of human arms and feet is different – the need to ensure the uniformity of measurements

Ancient origin of measures

Length measures on the wall

Measures:

- Grain width
- Hair thickness
- Weight of barley grain
- Ruler's elbow

Pea = 1 carat

Average foot length of several people

Notches on the walls

Henry I

Yard – distance between the tip of the nose and the tip of the middle finger of king Henry I

# Forming the Pool of Russian Experts to Support the Nuclear Infrastructure Development in Emerging Nuclear Countries

Obninsk, CICET, 3-7.12.2012

## ■ Goal:

- ❑ To build up a group of Russian Experts for providing assistance to embarking countries.
- ❑ To learn the essentials of the IAEA approach and recommendations and National nuclear power plans
- ❑ To work out the guidelines for each infrastructure element
- ❑ To establish interaction and understanding between Russian Experts and their international counterparts on NI issues



## ■ Outcome:

- ❑ Road map for each element of NI: structure, functions, forms Training courses, E&T Services, Internship, On-the-job-training
- ❑ Assistance in development of regulations, «strategies & plans», etc
- ❑ Specific solutions: «Centers» based on Russian experience







ROSTECHNADZOR

## **Cooperation agreements and memorandums with regulation authorities:**

- **Turkish Atomic Energy Authority (June 2010);**
- **Vietnam Agency for Radiation and Nuclear Safety (October 2010);**
- **Ministry of Science and Technology of Bangladesh (Bangladesh Atomic Energy Regulatory Board subordinated to the Ministry) (February 2012);**
- **Ministry of Emergency Situations of the Republic of Belarus, Gosatomnadzor of Belarus (December 2013);**
- **Egyptian Nuclear and Radiological Regulatory Authority (November 2015);**
- **Energy and Minerals Regulatory Commission of Jordan (under preparation for signing);**
- **National Nuclear Regulatory Authority of Nigeria (under preparation for signing)**



# Nuclear Infrastructure Training Materials Development is Completed (Y 2015)

#	NI Issue	#	NI Issue
1	National position	11	Stakeholder involvement
2	Nuclear safety	12	Site and supporting facilities
3	Management	13	Environmental protection
4	Funding and financing	14	Emergency planning
5	Legal framework	15	Nuclear security
6	Safeguards	16	Nuclear fuel cycle
7	Regulatory framework	17	Radioactive waste management
8	Radiation protection	18	Industrial involvement
9	Electrical grid	19	Procurement
10	HR development		
+			
20	Nuclear energy planning and technologies assessment		
21	Metrology support in nuclear power and industry		

**ROSATOM-CICE&T**

**PROGRAMME OF MODULAR TRAINING COURSE "MANAGEMENT" ISSUE**

Course title: MGT «Establishing, development and evaluation of efficiency of the management system at nuclear energy organizations»

Date of approval: \_\_\_\_\_

REVISION 1

Training is conducted according to the program presenting fundamentals of metrology in and implementation of management system for nuclear energy development program in a discipline of integral management system (IMS) process approach as well as nuclear PMS scope, the role of management in implementation and promotion of SNPP safety and energy program (NEP) development in a country are presented in the course. The example world-wide and Russian practice in implementation of IMS at nuclear organizations are discussed.

Target audience: Directors and top managers from NEPO (Nuclear Energy Programme for Organizations) responsible for the implementation of development of nuclear energy program, senior executives, middle-level managers, experts.

Developed by: Tikhonov Nikolai 18.08.2015

Reviewed by: Yurlov Andrey 18.08.2015

Final methodological control by: \_\_\_\_\_ 20.08.2015

**ROSATOM-CICE&T**

**LESSON PLAN**

Training course: MEAS Metrology Support in Nuclear Power and Industry

Training module: MEAS01: Introduction to metrology

Lesson MEAS01.1: Introduction to metrology

Revision 1

Developed by	A.Y. Karpenko, N.B. Naryshkinov, ROSATOM-CICE&T
Examined by	F.I. Kamanov, ROSATOM-CICE&T
Final methodological control by	N.A. Schalepova, ROSATOM-CICE&T
Approved by	O.Y. Sarayev, Rosenergoinform OJSC

**Prerequisites:**

- Category of trainees: Directors and top managers of the nuclear power programme management and regulatory system in the countries involved in the construction or planning the construction of Russian-designed nuclear facilities (NEPO - Nuclear Energy Programme Implementation Organization), middle-level managers, experts.
- Fluent English

**Lesson training objectives:**

- Present information about historical aspects of metrology development
- Present information about measurements in the ancient world.
- Present information about the anthropometric and national system of physical quantities.
- Describe the International System of Units SI.
- Describe the development of metrology in the XX century and at present

**Necessary materials and equipment:**

- Handouts

**STUDENT'S HANDBOOK**

Course: **Introduction to Metrology in Nuclear Power and Industry**

Module: **MEAS01: Introduction to Metrology**

Lesson: **MEAS01.1: Introduction to Metrology**

Prepared by: A.Y. Karpenko, N.B. Naryshkinov, ROSATOM-CICE&T

Examined by: F.I. Kamanov, ROSATOM-CICE&T

Final methodological control by: N.A. Schalepova, ROSATOM-CICE&T

Approved by: O.Y. Sarayev, Rosenergoinform OJSC

Final level of responsibility required:

- Director of nuclear power programme management and regulatory system in the countries involved in the construction or planning the construction of Russian-designed nuclear facilities (NEPO - Nuclear Energy Programme Implementation Organization), middle-level managers, experts.
- Fluent English

**Lesson training objectives:**

- Present information about historical aspects of metrology development
- Present information about measurements in the ancient world.
- Present information about the anthropometric and national system of physical quantities.
- Describe the International System of Units SI.
- Describe the development of metrology in the XX century and at present

**Handouts:**

- Handouts

**Table of contents**

Table of contents	2
Lesson 1: Introduction to metrology	3
Lesson 2: Measurements in the ancient world	4
Lesson 3: The International System of Units SI	5
Lesson 4: The development of metrology in the XX century and at present	6

**Table of contents**

Table of contents	2
Lesson 1: Introduction to metrology	3
Lesson 2: Measurements in the ancient world	4
Lesson 3: The International System of Units SI	5
Lesson 4: The development of metrology in the XX century and at present	6

**ROSATOM-CICE&T**

**Course MEAS: Metrology support in Nuclear Power and Industry**

**Module MEAS01: Introduction to Metrology**

**Lesson MEAS01.1: Introduction to Metrology**

Prepared by: A.Y. Karpenko, N.B. Naryshkinov (ROSATOM-CICE&T)

Examined by: F.I. Kamanov (ROSATOM-CICE&T)

Final methodological control by: N.A. Schalepova (ROSATOM-CICE&T)

© ROSATOM-CICE&T

**Training objectives**

- Terminal training objective
- Present information about historical aspects of metrology development
- Enabling training objectives
- Present information about measurements in the ancient world.
- Present information about the anthropometric and national system of physical quantities.
- Describe the International System of Units SI.
- Describe the development of metrology in the XX century and at present.

**Measurements in Ancient World (2/2)**

Need for quantitative assessment of:

- distance
- weight
- time
- volume etc.

Measurement means:

- arm
- foot
- finger etc.

Size of human arms and feet is different – the need to ensure the uniformity of measurements

**Ancient origin of measures**

Average foot length of several people

Notches on the walls

Length measures on the wall

Measures:

- Grain width
- Hair thickness
- Weight of barley grain
- Ruler's elbow

Pea = 1 carat

Yard – distance between the tip of the nose and the tip of the middle finger of king Henry I

# Training in Safeguard and Security (example)

## SECURITY AND SAFEGUARDS

A training course for NEPIO (Nuclear Energy Programme Implementing Organization) of the nuclear embarking states oriented to WWER Technology

**30 Nov. - 4 Dec. 2015**



**Mr. Gennady Pshakin**

Senior Researcher, IPPE

### Previous experience:

Participant of UN Commissions (Iraq's clandestine nuclear programme elimination); Head of bureau on Non-proliferation international division for IPPE; IAEA safeguards inspector; 20 years as a nuclear engineer in the area of Fast Breeder Reactors nuclear safety at the Institute of Physics and Power Engineering.



## Russian Experts:

**Mr. Alexander Panasyuk**

Senior Expert, JSC "IUEC"

### Previous experience:

IAEA (Senior Analyst, Iraq Nuclear Verification Office); Ministry of the Russian Federation on Atomic Energy (Division Head); IAEA (Unit Head, Dep. of Safeguards).



**Dr. Vladimir Kryuchenkov**

Senior Expert, ROSATOM-CICE&T

### Previous experience:

IAEA (Senior Expert, Nuclear Security); CTBTO (Director of On-Site Inspection); ISTC in Moscow (First Deputy Director); 20 years in Federal Nuclear Centre of Snezhinsk.



# The First Crew of the Floating NPP Started Professional Training at St. Petersburg Branch of ROSATOM- CICE&T



On April 09, 2016 in the St. Petersburg branch of ROSATOM- CICE&T a group of 20 crewmembers of the First-in-the-World Floating NPP completed their 7 month training in reactor physics, nuclear and radiation safety, damage control, reactor control and operation, regulations in nuclear reactor operation, safety systems.

<http://rosatom-cicet.ru/the-first-20-crewmembers-of-the-floating-npp-completed-professional-training-in-rosatom-cicet/>



# Training Courses in Support of Proliferation Resistant Fuel Cycles



Home » News » 2016 » From June 27th St. Petersburg branch of ROSATOM-CICE&T hosts two events under ENEN-RU II project

Any Event in two clicks:

> 2016  
> 2015  
> 2014  
> 2013  
> 2012  
> 2011  
> 2010

## From June 27th St. Petersburg branch of ROSATOM-CICE&T hosts two events under ENEN-RU II project

2016, News on 28.06.2016.

During the week June 27<sup>th</sup> – July 1<sup>st</sup> the Saint Petersburg branch of ROSATOM-CICE&T hosts two events organized under a project ENEN-RU II "Strengthening of Cooperation and Exchange for Nuclear Education and Training between the European Union and the Russian Federation":

- ENEN-RU II 2<sup>nd</sup> project and Forum meeting;
- Training course "The safety issues of WWER-type reactors with nuclear fuel based on reprocessed uranium".



ENEN-RU II 2<sup>nd</sup> project and Forum meeting

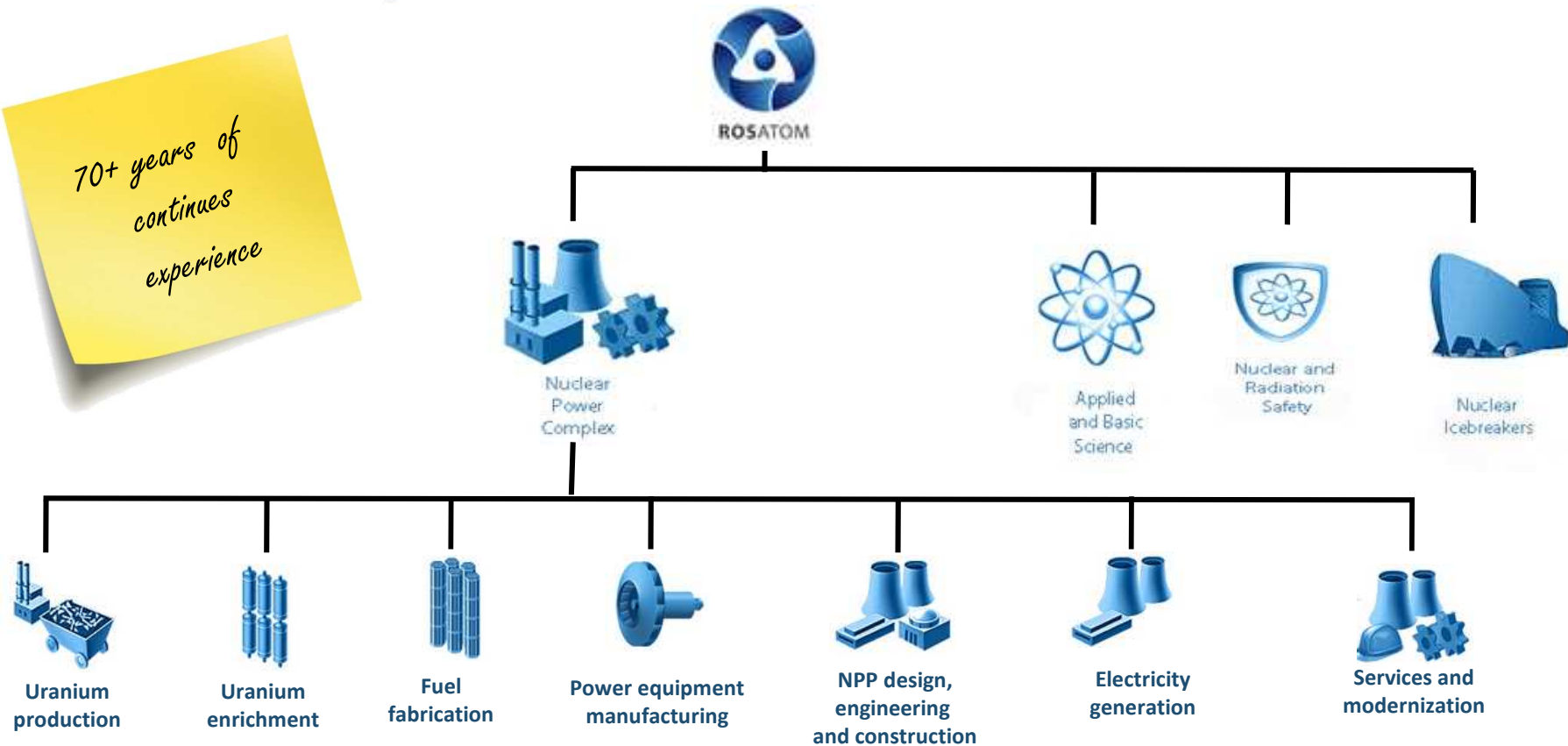
Training course "The safety issues of WWER-type reactors with nuclear fuel based on reprocessed uranium".

<http://rosatom-cicet.ru/from-june-27th-st-petersburg-branch-of-rosatom-cicet-hosts-two-events-under-enen-ru-ii-project/>

# Global Nuclear Technology Footprint

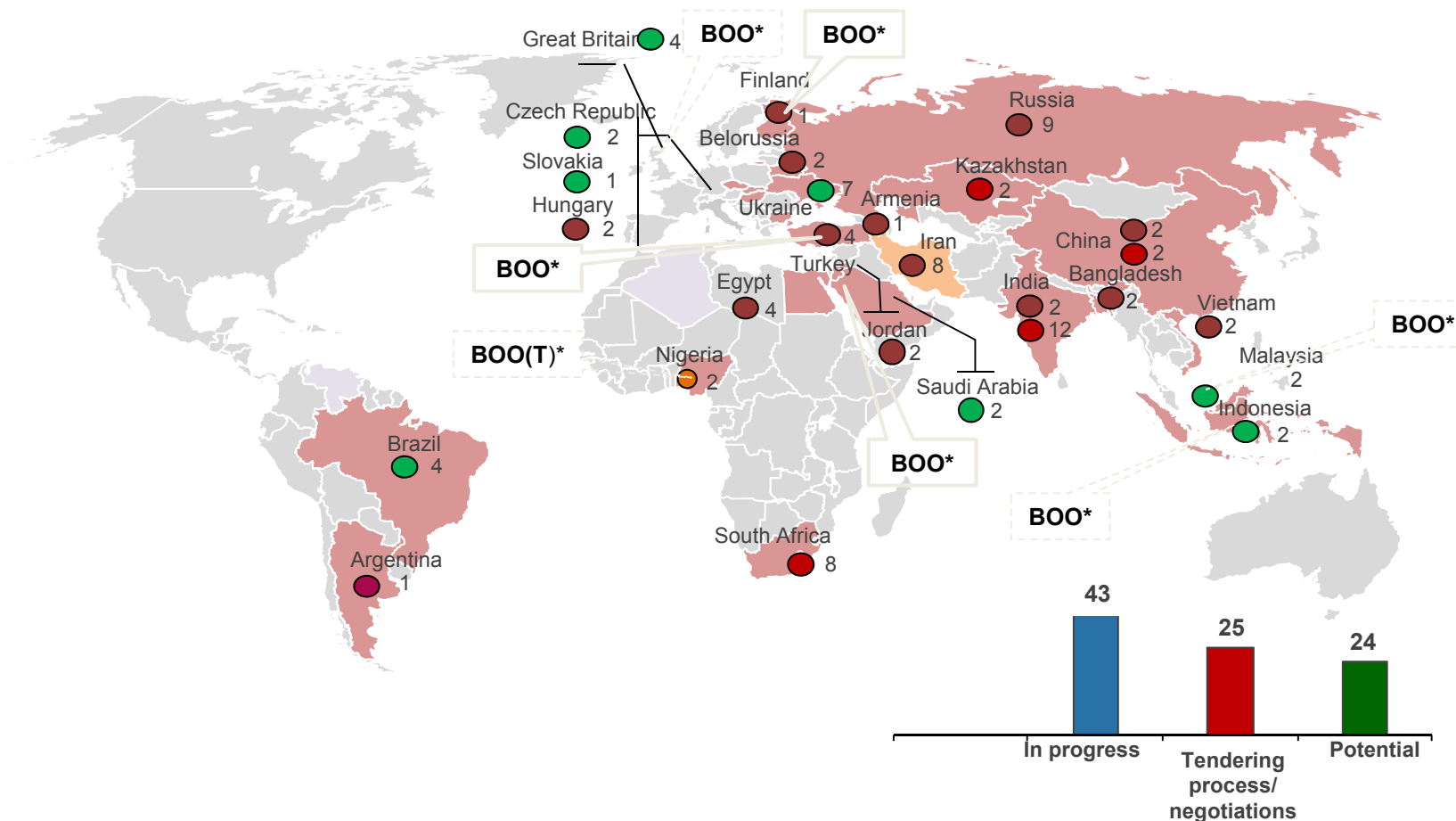
ROSATOM  
ENERGY  
INTERNATIONAL

70+ years of  
continues  
experience



*JSC Rosatom Energy International - subsidiary of State Corporation ROSATOM – integrator and project developer of ROSATOM solutions in Russian nuclear business abroad*

# ROSATOM VVER Technology Nuclear Power Plants (NPP) Perspective pipeline

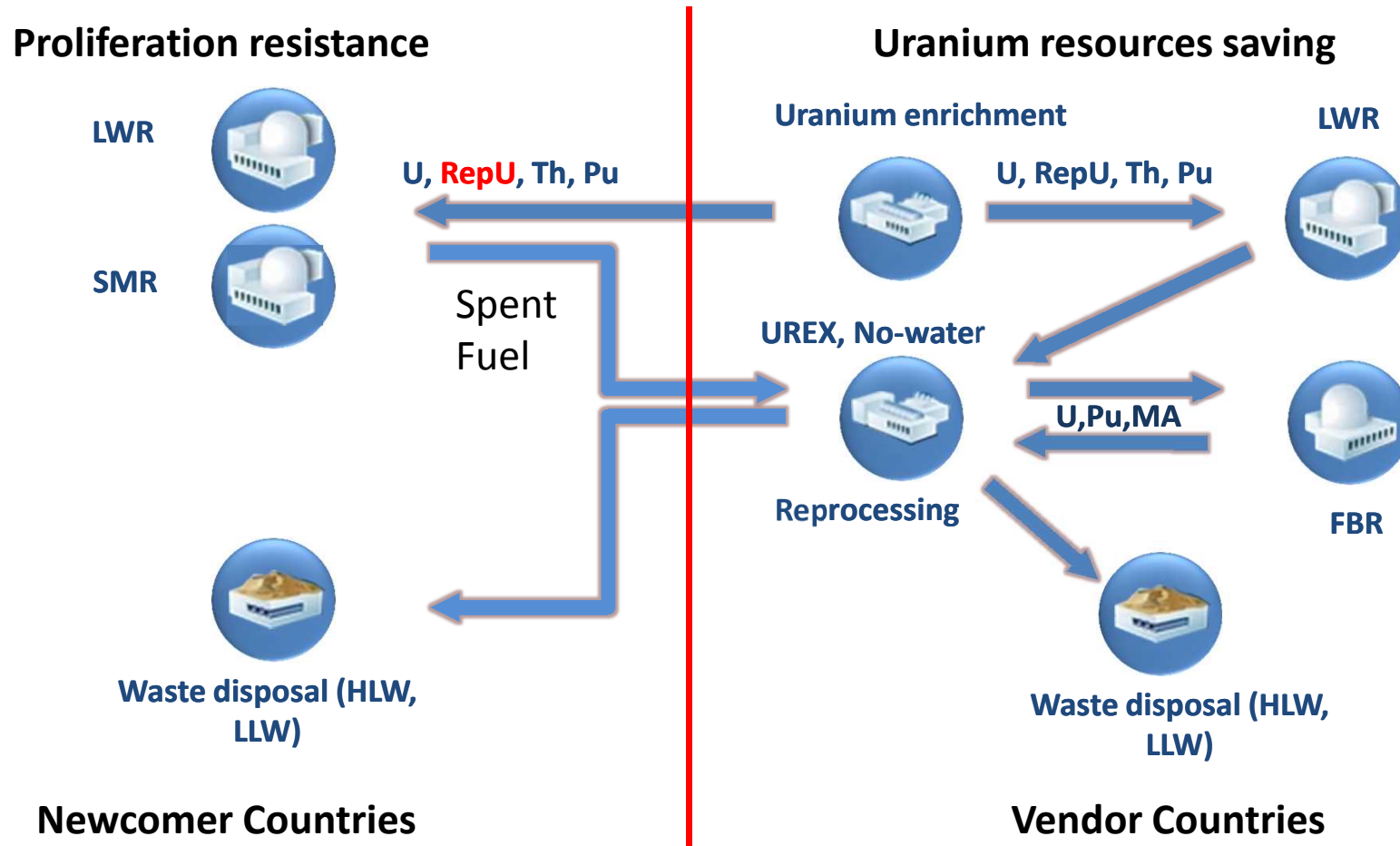


Rosatom NPP construction perspective pipeline – more than 90 units

\*Countries of BOO(T) Projects- “built-own-operate (transfer)” projects where Rosatom Group owns equity vs. the rest EPC(M) project countries where it provides engineering procurement and construction (management) services .

# The Proliferation Resistant Nuclear Fuel Cycle for Sustainable NP Development in Newcomer

**Waste minimization; Competitiveness; Synergy;**





## Conclusions

**Russian Federation offers comprehensive solutions  
in supporting the  
Nuclear infrastructure development  
in embarking countries**