CICE&T

CENTRAL INSTITUTE FOR CONTINUING EDUCATION & TRAINING

# INTERNATIONAL TRAINING CENTRE


## CAPACITY BUILDING FOR NATIONAL NUCLEAR INFRASTRUCTURE IN EMERGING NUCLEAR COUNTRIES

ROSATOM

CATALOGUE OF TRAINING PROGRAMMES

OBNINSK - RUSSIA - 2012

# Re-focusing the activities towards emerging nuclear countries


*"We have already re-focused our activities to help meet the needs of newcomers to nuclear power. The Agency will provide as much assistance as possible to countries which take this option. My goal is that Member States embarking on the path towards introducing nuclear power should start to see tangible progress in the years to come as a result of the Agency´s efforts."*

**IAEA Director General**
**Yukiya Amano**
Introductory Statement to Board of Governors
1 March 2010 Vienna, Austria


*". . . personnel training is particularly important in the countries having taken the path of nuclear power development. For this purpose an International Centre for Personnel Training, including NPP operators is created in Obninsk, Russia in the* ***Central Institute for Continuing Education and Training (CICE&T)****."*

**Director General of the State Atomic Energy Corporation "Rosatom"**
**Sergey Kiriyenko**
Presentation at the 55-th Session of the IAEA General Conference,
19 September 2011 Vienna, Austria

*Signing practical arrangements with IAEA.*
*Left to right*
*First Deputy of JSC Rosenergoatom V. G. Asmolov ;*
*Deputy Director General of IAEA A. V. Bychkov ;*
*Rector of CICE&T Yu. N. Seleznev*
19 September 2011 Vienna, Austria

## Practical arrangements with the IAEA

"Concern Rosenergoatom", **Central Institute for Continuing Education and Training** and IAEA reached understanding that enhancing interaction between them requires cooperation in the following areas:

- *Exchange and dissemination of information, including release of joint publications;*
- *Mutual support in establishing training courses to develop human resources for countries embarking on the way of developing nuclear power;*
- *Organizing joint missions to evaluate requests from recipient-countries.*

# Message from the Central Institute for Continuing Education & Training

*The achievements of nuclear technology could not have been a reality without sound basis laid by education&training system capable of building necessary technical competences. Nuclear training in Russia is a national treasure invested by geniuses and having its long traditions. Training is generally understood as a skill oriented application driven process, the skills (qualifications) being required by specific positions in the nuclear sector. Tuning engineers and scientists to nuclear engineering could be well done by the training programmes in International Training Centre of Central Institute for Continuing Education&Training in cooperation with experts from organizations affiliated to State Atomic Energy Corporation "Rosatom".*

Rector CICE&T,
**Yuriy N. Seleznev,**
Dr. (Economics), Professor

*We welcome new entrants for cooperation in nuclear power development for peaceful purposes and ready to share our experience to develop nuclear infrastructure in the countries embarking on nuclear power programmes. Russia being a technological donor does recognize its responsibility in supporting new entrants. The Collection of courses offered inhere provides a unique opportunity for the staff of emerging Nuclear Energy Programme Implementing Organization (NEPIO), regulatory body and operating organization to receive from-the-first-hand experience of Russian nuclear stakeholders. The courses were developed based on Systematic Approach to Training (SAT). Their modular form gives the freedom for potential customer to design its own training trajectory. This courses could be useful for technical universities which are about to start their nuclear engineering programmes.*

Vice-Rector CICE&T,
Director of International Training Centre
**Vladimir V. Artisyuk,**
Dr. (Nuclear Engineering), Professor

# International Training Centre

## Typical course arrangements:
## Theory, Facility Visit, Practical Training (& cross-cultural communications)

Arrival in Russia

| day 1 | day 2 | day 3 | day 4 | day 5 | day 6 |
|---|---|---|---|---|---|
| 10 AH | 10 AH | 10 AH | 10 AH | 10 AH | 10 AH |

**Training**

AH = Academic Hour

Free

| day 1 | day 2 | day 3 | day 4 | day 5 | day 6 |
|---|---|---|---|---|---|
| 10 AH | 10 AH | 10 AH | 10 AH | 10 AH | 10 AH |

**Training**

AH = Academic Hour

Free

| day 1 | day 2 | day 3 | day 4 | day 5 | day 6 |
|---|---|---|---|---|---|
| 10 AH | 10 AH | 10 AH | 10 AH | 10 AH | 10 AH |

**Practical training**

AH = Academic Hour

Departure from Russia

*Awarding certificate*

*Memorial photo*

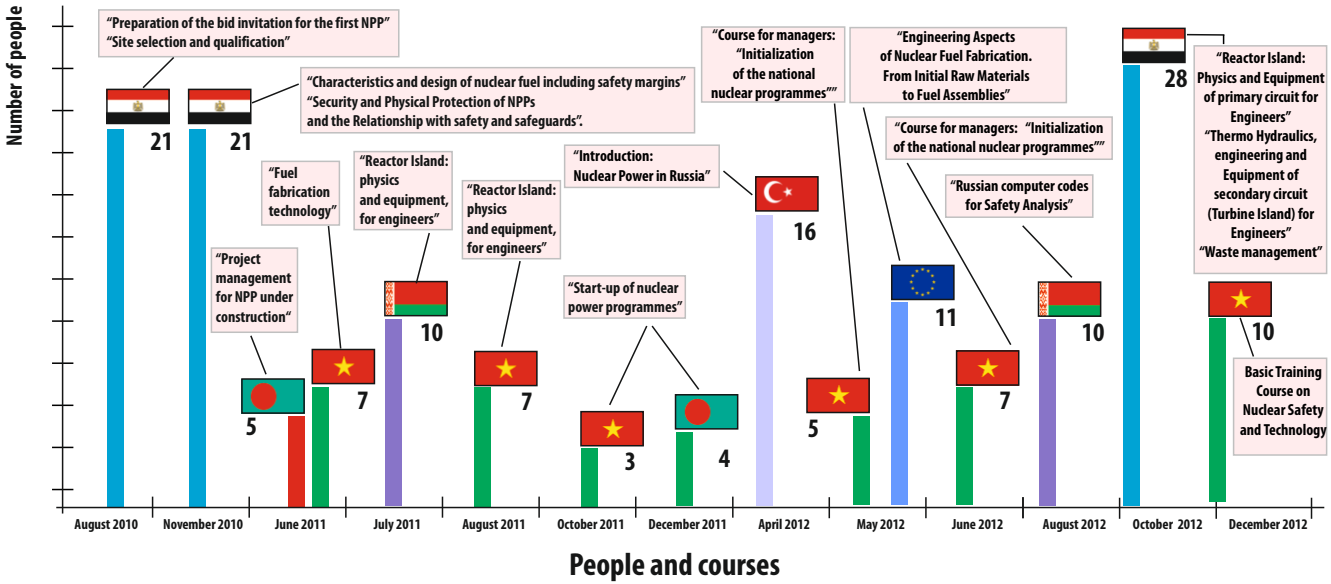
# International Training Centre

## Reporting to Director General of the State Atomic Energy Corporation "Rosatom" Sergey Kiriyenko 2 December 2011 Obninsk, Russia

Visit of Mr. Kiriyenko in CICE&T 2 December 2011 Obninsk, Russia

**Current status:**
Training of specialists
for national nuclear infrastructure
Phases 1-2 (milestone approach)

**Preparation for future activities:**
Service organizations personnel training,
NPP operational personnel training
Phases 2-3 (milestone approach)

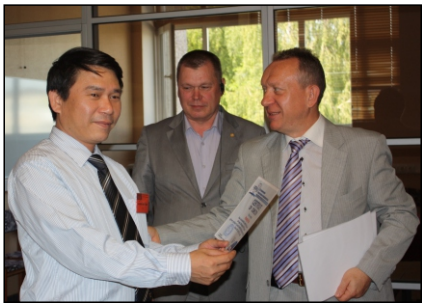


# International Training Centre

## Courses conducted in cooperation with the IAEA in 2011

To support nuclear power development in Vietnam

St. Petersburg
branch of CICE&T



5 - 18 June 2011

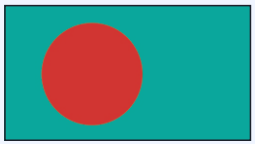
Balakovo
Branch of CICE&T

20 - 27 August 2011

Novovoronezh
Branch of CICE&T

02 - 15 October 2011

To support nuclear power development in Bangladesh



Obninsk
CICE&T

6 - 18 June 2011

Obninsk
CICE&T

4 - 17 December 2011

## List of the courses available in 2012

**Training Course**

## Preparation of the bid invitation for the first NPP

**Final objective**

Participants are expected to achieve a good understanding of present day practices in managing towards tender process

**COURSE DURATION:**
**100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Russian reactor technology and NPP system design (focusing VVER) | 7 | 7 | – |
| 2. | Fuel cycles: from mining to waste disposal | 8 | 6 | 2 |
| 3. | Siting procedures and criteria | 8 | 6 | 2 |
| 4. | Fuel cycle economics | 6 | 6 | – |
| 5. | Radiation & environmental safety | 10 | 8 | 2 |
| 6. | Safety culture | 6 | 6 | – |
| 7. | Licensing issues | 10 | 10 | – |
| 8. | National and international safeguards and accounting standards | 8 | 8 | – |
| 9. | Planning and organization of commissioning (split package and turnkey approaches) | 8 | 8 | – |

| | | | | |
|---|---|---|---|---|
| 10. | Education & training programmes in vendor country (Russian Federation) supporting nuclear capacity building | 10 | 10 | – |
| 11. | Preparation of bid invitation specification | 15 | 11 | 4 |
| 12. | Examination (final test) | 4 | | 4 |
| | **Total:** | 100 | 86 | 14 |

**Training Course**

## Site selection and qualification

**Final objective**

Participants are expected to achieve a good understanding of site qualification procedure performance

**COURSE DURATION: 100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Russian reactor technology and NPP system design | 7 | 7 | – |
| 2. | Nuclear legislation relevant to siting: international guidelines and Russian standards | 6 | 4 | 2 |
| 3. | Safety culture | 6 | 6 | – |
| 4. | Licensing issues | 10 | 10 | – |
| 5. | Radiation & environmental safety | 10 | 8 | 2 |
| 6. | Seismology | 10 | 8 | 2 |
| 7. | Site selection and qualification guidelines: international standards and Russian experience | 10 | 10 | – |
| 8. | Probabilistic safety analysis | 10 | 6 | 4 |
| 9. | Migration of radionuclides (hydrogeology and atmosphere) | 10 | 6 | 4 |

| | | | | |
|---|---|---|---|---|
| 10. | External human induced events in site evaluation | 10 | 8 | 2 |
| 11. | Social and economics issues | 6 | 6 | – |
| 12. | Recommendations on preparing documents on site selection and evaluation | 4 | 2 | 2 |
| 13. | Examination (final test) | 1 | – | 1 |
| | **Total:** | 100 | 81 | 19 |

**Training Course**

## Characteristics and design of nuclear fuel, including safety margins

**Final objective**

Participants are expected to achieve a good understanding of fuel management at various stages of NPP fuel cycle and gain an experience of computer codes'

**COURSE DURATION:**
**100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Fuel cycles: from introductory concepts to fuel design | 10 | 8 | 2 |
| 2. | Reactor operation and control (VVER) | 10 | 10 | – |
| 3. | Fuel burnup and economics | 6 | 6 | – |
| 4. | Economics of fuel cycle | 6 | 6 | – |
| 5. | Guidelines for quality and reliability assurance programmes | 6 | 6 | – |
| 6. | Fuel behavior under irradiation | 10 | 8 | 2 |
| 7. | Fuel quality and reliability for water cooled reactors. Quality assurance and quality control aspects | 10 | 8 | 2 |
| 8. | Deterministic safety analysis. Part I : Methodology | 14 | – | 14 |
| 9. | Deterministic safety analysis. Part II – Practical examples | 14 | – | 14 |

| | | | | |
|---|---|---|---|---|
| 10. | Deterministic safety analysis.<br>Part III- Russian computer codes | 8 | – | 8 |
| 11. | Full-scale transients in VVER-type reactors | 5 | 2 | 3 |
| 12. | Examination (final test) | 1 | – | 1 |
| | **Total:** | 100 | 54 | 46 |

**Training Course**

## Security and physical protection of NPPs and the relationship with safety and safeguards

**Final objective**

Participants are expected to achieve a good understanding of physical protection at NPP

**COURSE DURATION:**
**100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Basic principles of nuclear fuel cycle from nuclear physics to waste management and protection against unauthorized proliferation | 10 | 8 | 2 |
| 2. | Effect of radiation, safety and radiation protection | 10 | 10 | – |
| 3. | National and international safeguards and accounting standards | 10 | 10 | – |
| 4. | Threat assessment | 6 | 6 | – |
| 5. | Physical protection systems design and evaluation | 11 | 5 | 6 |
| 6. | Physical protection technologies and equipment | 14 | 6 | 8 |
| 7. | Radioactive waste management | 10 | 10 | – |
| 8. | Measurement methods in material control and accounting system | 10 | 8 | 2 |
| 9. | Use of non-destructive and destructive analysis methods for MC&A | 8 | 8 | – |

| | | | | |
|---|---|---|---|---|
| 10. | Statistical analysis of inventory difference in MC&A | 10 | 8 | 2 |
| 11. | Examination (final test) | 1 | – | 1 |
| | **Total:** | 100 | 79 | 21 |

**Training Course**

## Non-proliferation of Nuclear Materials

**Final objective**

Participants are expected to achieve a good understanding of fundamental issues and legislative basis for non-proliferation policy

**COURSE DURATION: 100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Physical foundations for proliferation resistance | 15 | 13 | 2 |
| 2. | Barriers against proliferation | 20 | 18 | 2 |
| 3. | Protected fuel cycles | 30 | 28 | 2 |
| 4. | Proliferation resistance assessment methodology | 20 | 16 | 4 |
| 5. | Legal base of non-proliferation of nuclear materials | 14 | 12 | 2 |
| 6. | Examination (final test) | 1 | – | 1 |
| | **Total:** | 100 | 87 | 13 |

**Training Course**

## Training Course for Top Managers of NEPIO: Start-up of nuclear power programme

**Final objective**

To form a general knowledge of the NPP life cycle, its safety and development of human resources. To brief the experience of Russian nuclear organizations in personnel training. To form skills in preparation of individual trajectories for NPP personnel training

**COURSE DURATION:**
**100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | CICE&T experience in NPP personnel training | 8 | 8 | – |
| 2. | Introduction to activities related to the NPP lifecycle and requirements for the development of human resources | 4 | 4 | – |
| 2.1. | Features of power generation at NPP | 2 | 2 | – |
| 2.2. | NPP maintenance and repair | 2 | 2 | – |
| 3. | NPP structure on the basis of qualifications and competencies | 12 | 4 | 8 |
| 3.1. | NPP structure. Competencies. Qualifications | 4 | 4 | – |
| 3.2. | Individual trajectories of training for foreign NPPs | 8 | – | 8 |
| 4. | Staffing at the NPP | 8 | 8 | – |

| | | | | |
|---|---|---|---|---|
| 4.1. | The scheme of training for foreign NPPs | 4 | 4 | – |
| 4.2. | Personnel training for operation of state-of-the-art Russian design NPPs abroad | 4 | 4 | – |
| 5. | Organizational and financial schemes for NPP construction | 8 | 8 | – |
| 5.1. | Economic aspects of nuclear power plant construction | 2 | 2 | – |
| 5.2. | Nuclear power infrastructure development: supplier to customer assistance | 2 | 2 | – |
| 5.3. | Stages of testing and commissioning | 4 | 4 | – |
| 6. | Quality management during NPP construction | 4 | 4 | – |
| 6.1. | Management system of Operating Organization (Utility) | 2 | 2 | – |
| 6.2. | Requirements to Suppliers during NPP construction | 2 | 2 | – |
| 7. | NPP's staff, knowledge inspection and recruitment policy | 14 | 14 | – |
| 7.1. | NPP's emergencies | 2 | 2 | – |
| 7.2. | Internet nuclear resources | 1 | 1 | – |
| 7.3. | Definitions of terms in the field of Nuclear Knowledge Management | 1 | 1 | – |

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|---|---|---|---|---|
| 7.4. | NPP stages and staff re-changing | 3 | 3 | – |
| 7.5. | NPPs lessons learned | 3 | 3 | – |
| 7.6. | Systems engineering | 2 | 2 | – |
| 7.7. | Requirements to the range of knowledge | 1 | 1 | – |
| 7.8. | NPP's indicators | 1 | 1 | – |
| 8. | Practical implementation of personnel policy at Russian NPPs | 32 | – | 32 |
| 8.1. | Technical tour to nuclear power plant | 16 | – | 16 |
| 8.2. | Technical tour to NPP under construction | 16 | – | 16 |
| 9. | Full-scale simulators for NPP personnel training | 8 | – | 8 |
| 10. | Examination (final test) | 2 | – | 2 |
| | **Total:** | 100 | 50 | 50 |

**Training Course**

## Management of radioactive waste and spent nuclear fuel

**Final objective**

Providing trainees with the insight of the concept of radioactive waste management for the waste produced during operation of nuclear facilities. Familiarizing with the practical implementation of recommendations from international organizations and national legislation on the issues of state administration and regulation of radioactive waste and spent nuclear fuel management in Russia. Familiarizing trainees with the contemporary technologies for radioactive waste and spent nuclear fuel management.

**COURSE DURATION:**
**100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Sources of radioactive wastes and their classification in Russia and some other countries with developed nuclear power | 4 | 4 | – |
| 2. | Legal framework for management of radioactive wastes in Russia | 10 | 6 | 4 |
| 2.1. | Legal framework for management of radioactive wastes in Russia | 5 | 3 | 2 |
| 2.2. | International approaches and governmental system for control of and accounting for radioactive materials and radioactive wastes | 5 | 3 | 2 |
| 3. | Key principles underlying the national concepts of management of radioactive wastes and spent nuclear fuel in Russia | 4 | 4 | – |
| 4. | Public communication in nuclear power industry | 4 | 2 | 2 |
| 5. | Operating NPP: radioactive waste management | 6 | 2 | 4 |

| | | | | |
|---|---|---|---|---|
| 6. | Design solutions for the RW management systems for NPP of new generation | 4 | 4 | – |
| 7. | Concept for management of RW resulting from decommissioning of nuclear facilities | 10 | 2 | 8 |
| 7.1. | Basic principles of national concepts for RW and SNF management | 2 | 2 | – |
| 7.2. | Practice of complex radioactive waste management at the Leningrad Division of the North-West Branch of RosRAO. Facility visit to the Leningrad Division of the North-West Branch of RosRAO | 8 | – | 8 |
| 8. | Problem of RW disposal | 4 | 4 | – |
| 9. | Features and basic processes of NPP SNF management | 4 | 4 | – |
| 9.1. | Features and basic processes of NPP SNF management | 2 | 2 | – |
| 9.2. | Current state and prospects of SNF management from VVER 1000/1200 reactors | 2 | 2 | – |
| 10. | Technologies for SNF storage | 6 | 2 | 4 |
| 11. | Technology for dry storage of SNF. Preparing SNF for dry storage | 6 | 2 | 4 |
| 12. | Technical requirements for RW and SNF storage and transportation containers | 8 | 4 | 4 |
| 12.1. | Common requirements to the packages. Choice of package type. Package classification on the nuclear safety level. Transport categories. | 4 | 4 | – |

| | | | | |
|---|---|---|---|---|
| 12.2. | Technical requirements for RW and SNF storage and transportation containers. Facility visit to the Design Bureau of Special Engineering | 4 | – | 4 |
| 13. | Radioactive material transportation | 6 | 2 | 4 |
| 14. | Technology for SNF reprocessing | 12 | 4 | 8 |
| 15. | Ensuring physical protection for nuclear facilities | 4 | 4 | – |
| 16. | Emergency response to radiological emergency situations | 6 | 2 | 4 |
| 16.1. | Past radiological emergencies. Emergency preparedness and response. The goals of emergency preparedness and response. Response management and concept of operations | 2 | 2 | – |
| 16.2. | Industry system of emergency preparedness. Activities of emergency rescue teams for mitigation of radiological emergency consequences during radioactive material and radioactive waste transportation at the storage facilities. Facility visit to the Emergency Response Center | 4 | – | 4 |
| 17. | Examination (final test) | 2 | – | 2 |
| | **Total:** | 100 | 52 | 48 |

**Training Course**

## Russian computer codes for safety analysis

**Final objective**

To enable gaining knowledge about the mathematical models accounting for processes occurring under VVER containment in the case of different accidents at NPP, mastering the computer code KUPOL-M, learning about special features of initial data input and how to work with the code

**COURSE DURATION:**
**72 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Containment at NPP with VVER reactor and design -basis and beyond design-basis accidents scenarios | 4 | 4 | – |
| 2. | Modeling gas dynamics processes in the code KUPOL-M | 4 | 2 | 2 |
| 2.1. | Motion equation and pressure equation | 2 | 1 | 1 |
| 2.2. | Algorithm for solving the gas dynamics problem | 1 | – | 1 |
| 2.3. | Gas dynamics for high-velocity flow | 1 | 1 | – |
| 3. | Modeling heat and mass transfer processes in the code KUPOL-M | 4 | 2 | 2 |
| 3.1. | Energy equation and mass transfer equations | 2 | 1 | 1 |
| 3.2. | Numerical solution | 2 | 1 | 1 |

| | | | | |
|---|---|---|---|---|
| 4. | Modeling heat and mass transfer on equipment and wall surfaces in the code KUPOL-M | 4 | 2 | 2 |
| 4.1. | Analogy of heat and mass transfer | 2 | 2 | – |
| 4.2. | Calculation of heat transfer coefficients | 2 | 2 | – |
| 5. | Modeling volume condensation and wall thermal conductivity in the code KUPOL-M | 4 | 2 | 2 |
| 5.1. | Volumetric condensation | 2 | 2 | – |
| 5.2. | Equation for thermal conductivity and numerical solution peculiarities | 2 | – | 2 |
| 6. | Models for hydrogen recombination and burning. Sprinkler system | 4 | 2 | 2 |
| 6.1. | Hydrogen recombination | 2 | – | 2 |
| 6.2. | Hydrogen burning model | 1 | – | 1 |
| 6.3. | Spray model | 1 | – | 1 |
| 7. | Working with the code KUPOL-M | 10 | – | 10 |
| 7.1. | Code compilation | 1 | – | 1 |
| 7.2. | Input data file | 7 | – | 7 |

| | | | | |
|---|---|---|---|---|
| 8. | Demonstration calculations using basic data | 16 | – | 16 |
| 8.1. | Input data and their preparation | 10 | – | 10 |
| 8.2. | Output file | 6 | – | 6 |
| 9. | Calculations of key accident processes in VVER containment | 20 | – | 20 |
| 9.1. | Input data and their preparation | 14 | – | 14 |
| 9.2. | Analysis of obtained results | 6 | – | 6 |
| 10. | Examination (final test) | 2 | – | 2 |
| | **Total:** | 72 | 14 | 58 |

**Training Course**

## Project Management for NPP Construction

**Final objective**

Providing the fundamental basics of project management. To ensure the learning of key terms, basic knowledge and information about best practices for project management that is necessary for effective work with projects at any form of organization. To familiarize participants with the practical implementation of the project management tasks of NPP construction with the use of the Oracle Primavera software

**COURSE DURATION:**
**100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | The main features of the modern project management | 4 | 4 | – |
| 2. | Fuel production and quality and reliability assurance | 16 | 8 | 8 |
| 2.1. | Nuclear fuel behavior under irradiation | 2 | 2 | – |
| 2.2. | Technical requirements. Manufacturing. Quality assurance. Reliability | 4 | 4 | – |
| 2.3. | Advanced nuclear fuels | 2 | 2 | – |
| 2.4. | Technical tour to fuel manufacturing plant. The process of fuel fabrication. Organizing work for acceptance of products by foreign customers | 8 | – | 8 |
| 3. | Organizational and financial schemes for NPP construction | 18 | 18 | – |
| 3.1. | Financing sources for NPP construction projects | 8 | 8 | – |

| | | | | |
|---|---|---|---|---|
| 3.2. | Introduction of Safety Culture at pre-operational phases | 2 | 2 | – |
| 3.3. | Scope of construction. NPP economic efficiency | 4 | 4 | – |
| 3.4. | Financing schemes of NPP construction projects. Risk assessment in NPP construction | 4 | 4 | – |
| 4. | Contracts for NPP construction: designing, concluding and implementing | 8 | 8 | – |
| 4.1. | The general concepts of the contract, the basic maintenance | 2 | 2 | – |
| 4.2. | The construction contract, general provisions | 2 | 2 | – |
| 4.3. | The construction contract on a turnkey basis | 2 | 2 | – |
| 4.4. | Features of contracts on NPP construction | 2 | 2 | – |
| 5. | Quality management during NPP construction | 8 | 8 | – |
| 5.1. | Key provisions of IAEA documents setting requirements to management systems at nuclear facilities | 4 | 4 | – |
| 5.2. | Quality audits and inspections during NPP construction | 4 | 4 | – |
| 6. | Project "AES-2006" with the reactor VVER-1200. Basic technological solutions | 24 | 16 | 8 |
| 6.1. | Basic provisions of NPP under construction. Construction site of NPP. Technical Tour to NPP under construction | 4 | 2 | 2 |

| | | | | |
|---|---|---|---|---|
| 6.2. | Principal heat scheme. Modes of operation | 2 | 2 | – |
| 6.3. | Reactor and circuit. Reactor pressure vessel | 4 | 2 | – |
| 6.4. | Control rod drives | 4 | 4 | – |
| 6.5. | Steam turbine K-1200-6,8/50 | 4 | 2 | – |
| 6.6. | Technical water supply for the turbine and other equipment | 4 | 2 | – |
| 6.7. | Electrical systems | 2 | 2 | – |
| 6.8. | Technical tour to Nuclear Power Plant | – | – | 6 |
| 7. | General plan for the first two power units of NPP under construction | 8 | – | 8 |
| 8. | Project management in the NPP construction based on the Oracle Primavera software | 12 | 12 | – |
| 8.1. | Project management processes. Project risk management processes | 2 | 2 | – |
| 8.2. | Information system for project management (configuration information system based on the Oracle Primavera software) | 6 | 6 | – |
| 9. | Examination (final test) | 2 | – | 2 |
| | **Total:** | 100 | 74 | 26 |

**Training Course**

## Nuclear power plants with small power nuclear reactors

**Final objective**

Familiarize with modern approaches to the development of small-power reactors in Russia

**COURSE DURATION: 100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Russian nuclear power plant projects with small-power nuclear reactors | 2 | 2 | – |
| 2. | Reactor plant of small capacity RUTA | 2 | 2 | – |
| 3. | Small-power nuclear reactor EGP-6 | 2 | 2 | – |
| 4. | Small power plant SVBR-100: The concept of nuclear technology based on the modular fast reactors with lead-bismuth coolant SVBR-100 | 2 | 2 | – |
| 5. | Floating NPP small nuclear reactor KLT-40S | 8 | 8 | – |
| 5.1. | Elaboration of floating nuclear and power plant by Afrikantov experimental machine-building design bureau | 2 | 2 | – |
| 5.2. | General technical and economic characteristics of KLT-40S | 2 | 2 | – |
| 5.3. | Principal characteristics of KLT-40S | 4 | 4 | – |
| 5.4. | Safety systems, radiation and environmental safety, analysis of non-proliferation issues | 2 | 2 | – |

| | | | | |
|---|---|---|---|---|
| 5.5. | Basic technical characteristics of floating nuclear power plant | 8 | 8 | – |
| 5.6. | Safety and environmental impact of floating nuclear power plant | 6 | 6 | – |
| 5.7. | Operational management and economics of floating nuclear power plant | 4 | 4 | – |
| 6. | Fundamentals of heat transfer | 18 | 18 | – |
| 6.1. | Fundamentals of heat transfer in nuclear reactors | 6 | 6 | – |
| 6.2. | General aspects concerning reactor safety and severe accidents | 6 | 6 | – |
| 6.3. | Heat transfer in severe accidents in light water reactors | 6 | 6 | – |
| 7. | Regulatory control of physical protection system, control and accounting of nuclear materials and radioactive substances | 10 | 10 | – |
| 7.1. | Regulatory control of physical protection of nuclear facility | 4 | 4 | – |
| 7.2. | Regulatory control of nuclear and radioactive material control and accounting system | 6 | 6 | – |
| 8. | Regulation of technical nuclear safety | 12 | 12 | – |
| 9. | Legal and regulatory framework for licensing nuclear power plants with small-power reactors | 6 | 6 | – |
| 10. | Nuclear and radiation safety of nuclear power plant | 6 | 6 | – |

| | | | | |
|---|---|---|---|---|
| 11. | National and international safeguards and accounting standards | 8 | 8 | – |
| 12. | Examination (final test) | 4 | – | 4 |
| | **Total:** | 100 | 96 | 4 |

**Training Course**

## Reactor Island: Physics and Equipment of primary circuit for Engineers

**Final objective**

Providing the knowledge on the design of the reactor unit and VVER-1000 NPP main equipment, key process parameters, norms of water chemistry. Exercises with full-scope simulator

**COURSE DURATION: 100 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | The design of the reactor unit | 16 | 8 | 8 |
| 1.1. | Design and operation of the reactor and the system of the primary circuit | 6 | 8 | – |
| 1.2. | Technical tour to NPP. The round on the route: main control room → turbine island → Diesel generating standby electric power station → onshore pump station → cooling ponds → nitrogen– oxygen plant, an overview of the industrial area of the nuclear power plant | 6 | – | 4 |
| 1.3. | Technical tour to NPP. The round with the visit of controlled area of power unit: safety systems premises, oiling systems of the main circulation pump and oiling systems, the premises of active gas purification system | 4 | – | 4 |
| 2. | Measuring parameters of the reactor island | 7 | 3 | 4 |
| 2.1. | Technical tools for measuring key process parameters (pressure, flow, temperature) | 1 | 1 | – |

| | | | | |
|---|---|---|---|---|
| 2.2. | Safety systems | 2 | 2 | – |
| 2.3. | Technical tour to NPP. The round on the route of safety systems premises, thermal automatics and measurement shop → the premises of automated system of turbine control (automatic control system of technological process, thermal automatics and measurement shop) | 4 | – | 4 |
| 3. | Emergency system | 16 | 8 | 8 |
| 3.1. | Operating principles, maintenance and repair of the neutron flux control equipment, emergency protection, alarm systems, accelerated unit unloading and their specific faults | 4 | 4 | – |
| 3.2. | Technical tour to NPP. The round on the route of safety systems premises (thermal automatics and measurement shop), neutron flux control equipment (thermal automatics and measurement shop) | 4 | – | 4 |
| 3.3. | Operating principles, maintenance and repair of the power limit regulator, the automatic power regulator, group and individual management system, the search for specific faults. Maintain the accuracy of neutron power at 100% and 104% of nominal power. The operational principle of electromagnetic step actuator of control and protection system | 4 | 4 | – |
| 3.4. | Technical tour to NPP. The round on the route: premises. (power limit regulator, automatic power regulator, alarm system), (group and individual management system) | 4 | – | 4 |

| | | | | |
|---|---|---|---|---|
| 4. | Operational modes of the reactor unit | 32 | – | 32 |
| 4.1. | Training on simulators «Reactor unit start-up, the output of the reactor unit at the minimum controlled power level, power level change, power unit unloading, turbo generator shutdown and the shift of reactor unit into a hot state» | 6 | – | 6 |
| 4.2. | Training on simulators «Beyond design basis accident» | 6 | – | 6 |
| 4.3. | Training on simulators «Violation of the conditions of normal operation, the leaks of the primary circuit coolant, compensated by a makeup-purge system of the primary circuit» | 6 | – | 6 |
| 4.4. | Training on simulators «Violation of the conditions of normal operation, shutdown of all makeup units» | 6 | – | 6 |
| 4.5. | Training on simulators «Violation of the conditions of normal operation. Opening and unclosing of one of BRU-A valves» | 4 | – | 4 |
| 4.6. | Training on simulators «The cool down of the power unit from the emergency control room» | 4 | – | 4 |
| 5. | Chemical technology of the primary circuit | 8 | 4 | 4 |
| 5.1. | Norms of water chemistry of the primary circuit, chemicals dosing in the process of maintaining water chemistry of the primary circuit, the appointment of special water purification system | 4 | 4 | – |

| | | | | |
|---|---|---|---|---|
| 5.2. | Technical tour to NPP. The round on the route: all NPP auxiliary building → makeup demineralizer → reagents block of the secondary circuit → turbine island → condensate purification plant → special water purification system → reagents block of the primary circuit | 4 | – | 4 |
| 6. | Reactor physics | 20 | 20 | – |
| 6.1. | Reactor physics. Introduction | 8 | 8 | – |
| 6.2. | Kinetics | 5 | 5 | – |
| 6.3. | Principal physics of non-proliferation | 7 | 7 | – |
| 7. | Examination (final test) | 1 | – | 1 |
| | **Total:** | 100 | 43 | 57 |

**Training Course**

## Thermo Hydraulics, engineering and Equipment of secondary circuit (Turbine Island) for Engineers

**Final objective**

Providing the knowledge on the main equipment of the secondary circuit of the reactor unit and VVER-1000 NP, thermophysics parameters, operating modes of the turbine island while the NPP operating process. Providing the knowledge on fulfilling the trainings with the usage of technical training means (full-scale simulator of Main Control Room)

**COURSE DURATION:**
**72 hours**

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | The main equipment of the turbine island | 16 | 8 | 8 |
| 1.1. | Thermal circuit and the main equipment of the secondary circuit | 10 | 8 | – |
| 1.2. | Technical tour to NPP. The round on the route: main control room of power unit → turbine island of power unit → Diesel generating standby electric power station→ onshore pump station → cooling ponds → nitrogen– oxygen plant, an overview of the industrial area of the nuclear power plant | 6 | – | 8 |
| 2. | The system of automatic control and turbine protection | 10 | 6 | 4 |
| 3. | Measuring the turbine island parameters | 8 | 4 | 4 |
| 4. | Turbine protection | 4 | 4 | – |

| | | | | |
|---|---|---|---|---|
| 4.1. | General principles of forming the technological protection | 2 | 2 | – |
| 4.2. | Technological protection of steam turbine K-1000-60/1500-2 | 2 | 2 | – |
| 5. | Operating modes of the turbine island equipment | 24 | – | 24 |
| 5.1. | Training on simulators «Turbine startup, the inclusion of the generator to the network and a set of power up to 300 MW» | 6 | – | 6 |
| 5.2. | Training on simulators «The rise of power unit capacity from 40% N up to 80% N of nominal power» | 4 | – | 4 |
| 5.3. | Training on simulators «Unloading of power unit, disconnection of generator from the network and the transfer of the reactor unit into a hot state» | 5 | – | 5 |
| 5.4. | Training on simulators «The leak from the pipeline of the main condensate» | 3 | – | 3 |
| 5.5. | Training on simulators «Spontaneous opening of steam generator control element by one SG at RU operation on low power level» | 4 | – | 4 |
| 5.6. | Training on simulators «Disabling of one electric condensate pump of the first stage with the failure of automatic transfer switch» | 5 | – | 4 |
| 6. | Chemical technology of the secondary circuit | 8 | 4 | 4 |
| 6.1. | Chemical technology of the secondary circuit | 4 | 4 | – |
| 6.2. | Technical tour to NPP. The round on the route: makeup demineralizer → condensate purification plant → laboratory of chemical analysis of the secondary circuit → the block of preparation and reagents input | 4 | – | 4 |
| 7. | Examination (final test) | 2 | – | 2 |
| | **Total:** | 72 | 26 | 46 |

**Training Course**

## Engineering Aspects of Nuclear Fuel Fabrication. From Initial Raw Materials to Fuel Assemblies

NEW 1 week

**Final objective**

Participants are expected to achieve a good understanding of features of nuclear fuel, modern technical requirements for nuclear fuel and describe the technology of its fabrication.

**COURSE DURATION:** 32 hours

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Introduction: chemical composition, types and basic operational characteristics of nuclear fuel | 3 | 3 | – |
| 2. | Fuel behaviour under irradiation | 3 | 3 | – |
| 3. | Modern technical requirements for nuclear fuel | 4 | 4 | – |
| 4. | Nuclear fuel fabrication techniques | 10 | 10 | – |
| 3. | Perspective fuel types | 4 | 4 | – |
| 4. | Technological scheme of nuclear fuel fabrication: from the powder to fuel | 6 | – | 6 |
| 5. | Test (final control) | 2 | – | 2 |
| | **Total:** | 32 | 24 | 8 |

**Training Course**

## Basic Training Course on Nuclear Safety and Technology

NEW 15 weeks

**Final objective**

Participants are expected to achieve a good understanding of the viewpoints of various professional communities engaged in NPP development in Russia

**COURSE DURATION:** 600 hours

| № | Training modules | Total, hours | Including | |
|---|---|---|---|---|
| | | | lectures | hands-on sessions |
| 1. | Nuclear Power Technologies | 40 | 40 | – |
| 2. | Theoretical Courses in Reactor Physics | 120 | 120 | – |
| 3. | Russian Computer Codes | 280 | 280 | – |
| 4. | Facility Visits (NPP) | 80 | – | 80 |
| 5. | Nuclear Fuel | 40 | – | – |
| 6. | Review of Codes used in ROSTEHNADZOR | 40 | 40 | – |
| 7. | Individual Projects | 40 | – | 40 |
| | **Total:** | 600 | 480 | 120 |

**CICE&T is located in Obninsk.**

**Obninsk - cradle of Nuclear Power Technology:**

**The First in the World Nuclear Power Plant started in Obninsk 27, June, 1954.**

**Obninsk - basis of International Campus for Education&Training for Emerging Nuclear Countries.**

**Education:** **Obninsk Institute for Nuclear Power Engineering - branch of Research Nuclear University MEPHI**

**Training:** **Central Institute for Continuing Education and Training**

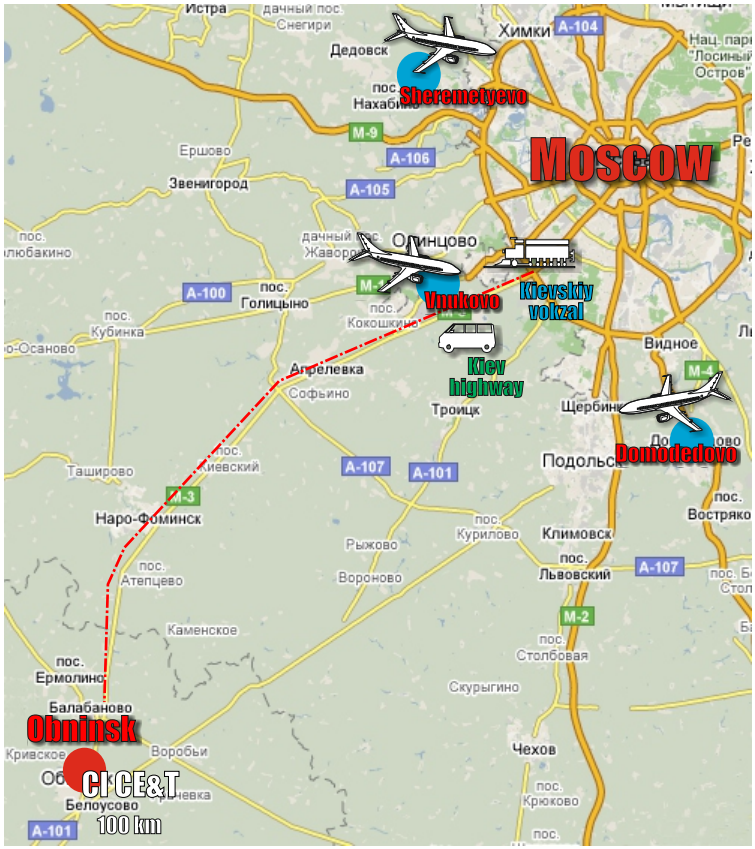
## Venue: Obninsk is located 100 km south to Moscow.

**From International Moscow Airports:**

- Domodedovo (115 km)
- Sheremetyevo (135 km)
- Vnukovo (80 km)

**From Moscow:**

- by car 101 km on the Kiev highway (100 km)
- by express- train (Moscow- Kaluga) from the Kievskiy vokzal (100 km -1,5 hour)



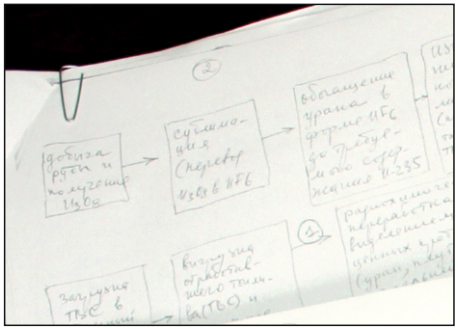

*The First in the World Nuclear Power Plant*

*Obninsk Institute for Nuclear Power Engineering - branch of RNU MEPHI*

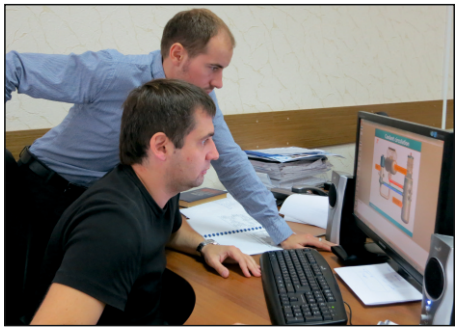
*Central Institute for Continuing Education and Training*

# Course Development

*Expertize*



*Lecture Content*



*Slide Design*

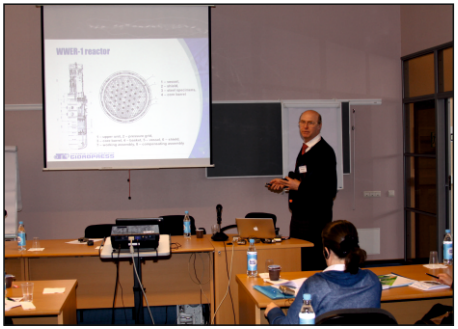
*Knowledge Management Team*

*Course*

# Course Implementation


*CICE&T Main Building*

*Visiting NPP*




*Theoretical Course*

*Visiting NPP Training Centre*

*Simultaneous Translation*

*Visiting Fuel Fabrication Plant*

**Dear Colleagues!**

**Please, select either the course or combination of training modules from particular courses and contact for details Prof. Vladimir Artisyuk by**

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**Fax: +7(48439) 29190**
**Phone: +7(915) 896-94-84**

# Welcome to Central Institute for Continuing Education and Training!


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