# RAAN – SCN Pitesti

*presented by Ilie TURCU, Scientific Deputy Director*

# Nuclear Power Programme

- Decision : 1970
- INR from IFA: 1971
- Comercial contract for CANDU: 1979

- Cernavoda Candu unit 1 – commercial operation 1996

- Cernavoda Candu unit 2 – commercial operation 2007

- Cernavoda Candu unit 3 and 4
  - target for commercial operation 2014

- Second NPP – sites evaluation

- Long term options: Advanced nuclear power reactors and fuel cycles; GEN IV

# INR Mission

- Since its foundation, in 1971, the Institute for Nuclear Research Pitesti, had the mission to provide the transfer of nuclear technologies for nuclear power program (past names: Institute for Nuclear Technologies, Institute for Nuclear Power Reactors).
- During this period, the Institute developed technologies, methods, computer codes, its own experimental infrastructure, directed towards an end-product or service with applications in a nuclear power plant (NPP).
- Main source of specialists for nuclear power program.
- The Institute is involved in nuclear power development and continues to act as a technical support institute for the safe and economical operation of the NPP, in accordance with international agreements on the safety of nuclear installations.

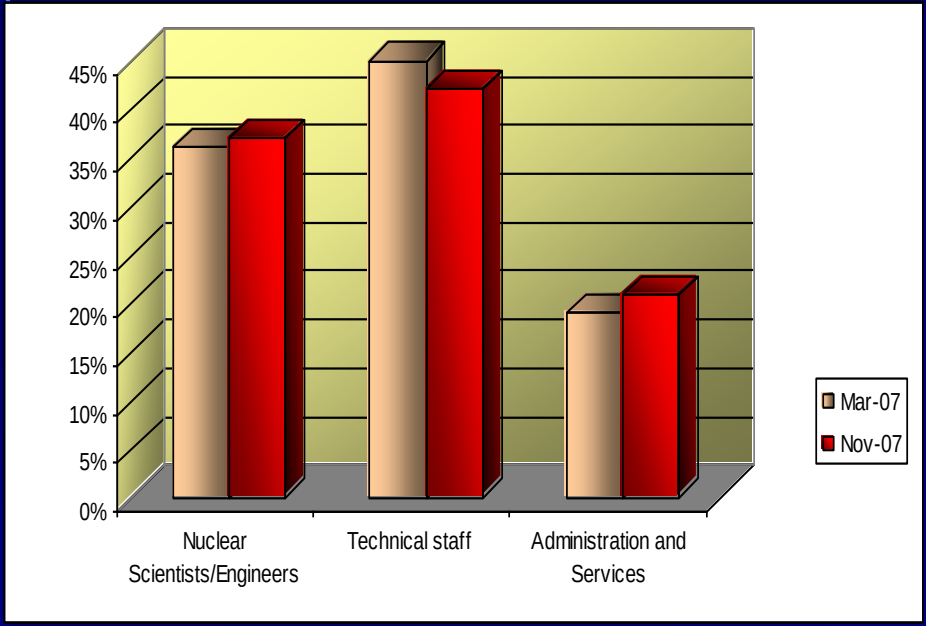
# Mission (1)

- **TSS for Unit 1 and 2 safe operation during plant lifetime:**
  - Cooperation protocol with Cernavoda NPP (Nuclearelectrica)
  - Cernavoda technical assistance for COG R&D programs
  - Safety, Licensing and PLIM; spent fuel and RWM
- **TSS for Unit 3 and 4: Licensing, commissionning, operation**
- **Provide services and products for nuclear power installations**

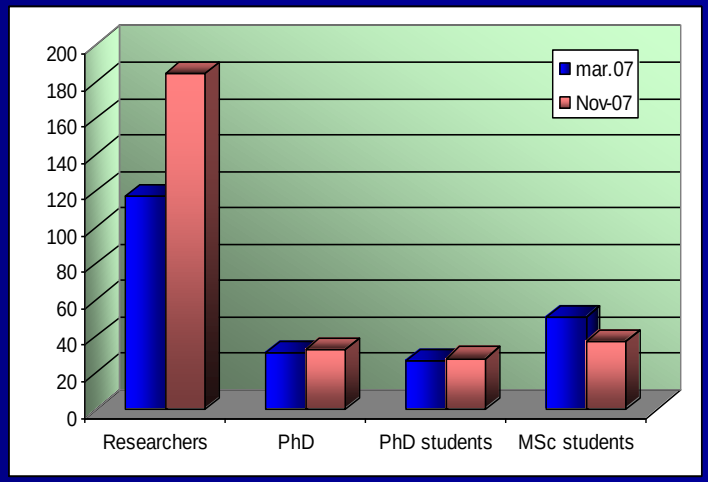
# Mission (2)

- Education and training
- R&D for generation 4 NPP, advanced fuel cycles and innovative reactors
- TSS for a new plant
- R&D infrastructure operation, maintenance and development
- International cooperation
- Provide services for non-power applications

# Staff

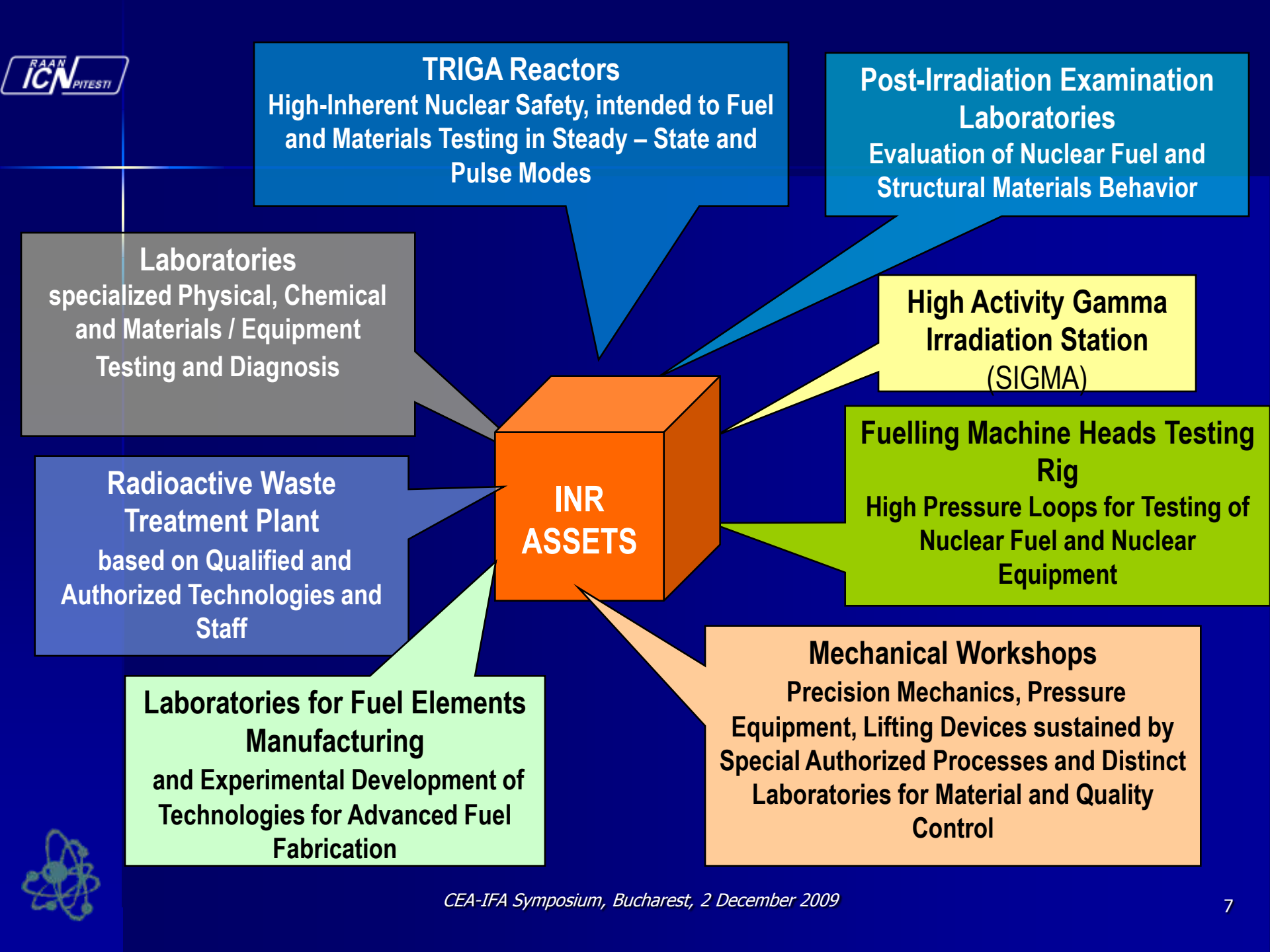



Breakdown by qualification




| | Mar-07 | Nov-07 |
|---|---|---|
| Nuclear Scientists/Engineers | 237 | 244 |
| Technical staff | 296 | 277 |
| Administration and Services | 125 | 137 |
| Total | 658 | 658 |

| | Mar-07 | Nov-07 |
|---|---|---|
| Researchers | 117 | 185 |
| PhD | 31 | 33 |
| PhD students | 27 | 28 |
| MSc students | 51 | 37 |


TRIGA Reactors
High-Inherent Nuclear Safety, intended to Fuel and Materials Testing in Steady – State and Pulse Modes
Post-Irradiation Examination Laboratories
Evaluation of Nuclear Fuel and Structural Materials Behavior
Laboratories
specialized Physical, Chemical and Materials / Equipment Testing and Diagnosis
High Activity Gamma Irradiation Station
(SIGMA)
INR ASSETS
Fuelling Machine Heads Testing Rig
High Pressure Loops for Testing of Nuclear Fuel and Nuclear Equipment
Radioactive Waste Treatment Plant
based on Qualified and Authorized Technologies and Staff
Mechanical Workshops
Precision Mechanics, Pressure Equipment, Lifting Devices sustained by Special Authorized Processes and Distinct Laboratories for Material and Quality Control
Laboratories for Fuel Elements Manufacturing
and Experimental Development of Technologies for Advanced Fuel Fabrication

# The main activities of INR - Pitesti

- Reactor Physics
- Thermalhydraulics
- Nuclear safety
- Irradiation tests and Post- Irradiation Examination of Materials and Nuclear Fuel;
- Irradiation technologies and radioisotopes;
- Nuclear materials and Corrosion;
- Evaluation of nuclear fuel performances;
- Out-of-pile testing;
- Management of Radioactive Wastes;
- Electronics, instrumentation and control;
- Tests and qualifications for nuclear equipment and instrumentation;
- Radiation protection, Environmental protection;
- Design of Nuclear equipments;
- Nuclear Prototypes;
- Support and administrative services.

# TRIGA reactor

- used in Romanian nuclear fuel licensing
  - ➢ irradiation tests on structural materials and nuclear fuel for CANDU type nuclear power plants.
  - ➢ irradiated and non-irradiated nuclear fuel behavior analysis in transient regime.
- radioisotopes and irradiated materials production with applications in health, industry and environment areas


- Irradiation tests on:
  - TRIGA Nuclear fuel,
  - experimental CANDU SEU-43 fuel type
  - Cernavoda NPP fuel - in accident conditions – LOCA, RIA

# Nuclear Materials and Corrosion

- Thermo-mechanical testing of metallic and ceramic materials under different state of stress and environment conditions;
- investigation of degradation mechanisms acting in the NPP systems/components materials;
- Fracture mechanical analysis;
- Zirconium alloys and UO2 pellets behavior under sever accident conditions;
- Microstructural and fracture surfaces analysis;
- Micro- and nano-structural analysis;
- Development of technologies for UO2 sinterable powders and sintered pellets with controlled microstructure;

# Post-Irradiation Examination Laboratory

- CANDU fuel and structural materials behavior investigation after irradiation in Cernavoda NPP and in Romanian TRIGA research reactor.
- Manufacturing of sealed nuclear radiation sources and radioisotopes used in industriy, agriculture and medicine.
- Radioactive waste characterization

Direct connected to the TRIGA reactor

# OUT-OF-PILE TESTING

- design, manufacturing and test of the equipment and facilities for Out–of-Pile testing
- design, manufacturing and operation of the specialized unique devices for Out-of-Pile testing on nuclear fuel
- nuclear and non-nuclear materials Out-of-Pile testing

# Radiation Protection, Environmental Protection and Civil Protection Department

- implementation of radiation and environment protection plan for ICN nuclear facilities

- R&D program focused to increase proficiency in human and environment protection against radiation-associated risks.

# Radioactive Wastes Management Department

- treatment and conditioning of radioactive wastes resulted from the TRIGA reactor and other research laboratories of the site, the Nuclear Fuel Factory (FCN), the Cernavoda NPP, Institute for Nuclear Physics and Engineering (IFIN-HH).

- design and manufacturing of equipment and tools for the assay and measurement of radioactive samples from the environment and from working areas, which imply radioactive sources.

# ELECTRONICS

- research and development of dedicated electronic instrumentation and equipment, mainly for nuclear applications
- an R&D program for development of radiation field measurement devices
- software development for process control and data processing

# QUALITY MANAGEMENT

***Objective:***

- Development, implementation and maintenance of a quality management system according to ISO 9001:2000 and to applicable statutory and regulatory requirements

***Activities:***

- Quality engineering activities for quality management system documentation;
- Quality survey activities for design and manufacturing of products for nuclear installations and conventional applications;
- Quality survey activities for nuclear installations operation;
- Quality assurance training of personnel;
- Quality management systems internal and external auditing.

***Main achievements:***

- INR quality management system certification by LRQA (Approval certificate No. 170254);
- INR quality management system authorization by CNCAN for research, design, manufacturing and operation activities related to the nuclear field.

# INR Research Programes

- P1. Reactor Physics and Nuclear Safety
- P2. Fuel Channel
- P3. Nuclear Fuels
- P4. Fuel Handling System
- P5. Radioactive Waste Management
- P6. Radiation and Environmental Protection
- P7. Steam Generator
- P8. Nuclear equipment and process systems
- P9. Circuit's Chemistry
- P10. Instrumentation and Control
- P11. Plant Life Management
- P12. Advanced Reactors
- P13. TRIGA Reactors- Improving of the Performances
- P14. Radioisotopes and Irradiation Technologies
- P15. Informatics
- P16. Nuclear applications
- P17. Heavy Water and Tritium
- P18. Support for international cooperation

**250 research report per year (average)**

# Products and Services

Examples of major Products/Services supplied to the public/private sector:

| Product/service | | Supplied to: |
|---|---|---|
| Failed Fuel Located System for Unit2 | | NPP-Unit 2 |
| Integrated Radiation Monitoring System for Unit2 | | NPP-Unit 2 |
| Modernization for Failed Fuel Locating System –Unit1 | | NPP-Unit 1 |
| Assistance for COG R&D Programs: Fuel channel, Plant chemistry, Safety and licensing, Computer programs, Radioprotection | | NPP U1&2 |

# National research programs

- The Research of Excelence Programes (CEEX)
  - 11 projects (2004-2007)
- The national R&D and Innovation Programs (PNCDI)
  - 14 projects (2007-2009)
- About 6% from total budget

❑ In the period 2007-2008 it has published :
- 23 papers published in magazines indexed by ISI
- 266 papers published in the volumes of some international scientific conferences with reviewers

❑ NUCLEAR 2008/9 conference organisation

❑ ANCS acreditation (2008)

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# INR National Partnerships (RDIs)

- ✓SITON, Center for engineering and Technology- Nuclear Objectives, Bucharest
- ✓ICIT, National R&D Institute for Cryogenics and Isotopic Technologies, Rm Valcea
- ✓IFIN-HH, National R&D Institute for Atomic Physics "Horia Hulubei", Bucharest
- ✓INCDTIM, National R&D Institute for Isotopic and Molecular Technologies, Cluj-Napoca
- ✓ICECHIM, National R&D Institute for Chemistry, Bucharest
- ✓INFM, National R&D Institute for Physics of Materials, Bucharest
- ✓ICPE-CA, National R&D Institute for Electrical Engineering, Bucharest
- ✓IRMM, Institute for Rare and Radioactive Metals, Bucharest
- ✓IFT, National Institute for Technical Physics, Iasi
- ✓INCDFP- National R&D Institute for Earth Physics, Bucharest
- ✓INFLRP- National R&D Institute for Laser Physics, Bucharest
- ✓IMT- Institute for Micro Technologies, Bucharest

# INR R&D International Agreements and Partnerships

**AECL** - Canada
CEA DEN – France
**GRS** –Germany, **DBE** – Germany, **ITU**- Germany
**KAERI**- Korea
**IRSN**-France
JRC IE Petten
**JSI** – Slovenia
**SCK-CEN** – Belgie

**IAEA**
**US DOE (LANL, ORNL, ANL, BNL, SNL)**
**CANDU Owners Group**

# International Cooperation: EU

- Cooperation with COMMISSARIAT A L'ENERGIE ATOMIQUE (CEA) – DEN in the field of nuclear energy research and technology, concluded in April 2008, for joint research activities in:
  - Nuclear Energy
  - Radioactive Waste
  - Decommissioning of nuclear facilities
- Colaboration with IRSN – France through the PHEBUS Agreement and Software Agreements on the use of nuclear safety computer codes
- SCN participation in the European Commission Framework Programs aims the integration of the Romanian nuclear research in European Research Area (ERA) through:
  - contributions to FP6 and FP7 Euratom Projects
  - activities in the "Sustainable Nuclear Energy Technology Platform" (SNETP)

# International Cooperation EURATOM Framework Programs

- **SCN participation in the European Commission Framework Programs:**
  - **5-th Framework Programme:**
    - **PHEBEN2 - Validating Severe Accident Codes against Phebus FP for Plant Applications;**
    - **JSRI – Joint Safety Research Index.**
  - **6-th Framework Programme:**
    - **HOTLAB – European Network on Hot Laboratories;**
    - **COWAM2 – Community Waste Management 2: Improving the Governance of Nuclear Waste Management and Disposal in Europe;**
    - **SARNET – Network of Excellence for a Sustainable Integration of European Research on Severe Accident Phenomenology;**
    - **NULIFE – NOE on Nuclear Plant Life Prediction.**
    - **MRT+I3 – Materials Testing Reactors Innovations;**
    - **ELSY – generation IV Reactors – European Lead System;**
    - **CIP – COWAM in Practice;**
  - **7-th Framework Programme:**
    - **CARBOWASTE – *Treatment and disposal of irradiated graphite and other carbonaceous waste* (2008 -2012)**
    - **SARNET 2 – *Severe Accidents* (2008 – 2012)**
    - **FORGE – *Fate of repository gases* (2009 – 2013)**
      - **ELSY 2**
      - **ADRIANA**
      - **STYLE**
  - **Technological Platform "Sustainable Nuclear Energy"**
    - **Contributions to the *Strategic Research Agenda***

# International Cooperation: Canada

- **Collaboration with AECL – CANADA**
  - **Power cycling condition for Candu fuel in C9 capsule of TRIGA reactor;**
  - **Fatigue test for Zircaloy – 4 sheaths;**
  - **Transfer, implementation and validation of computer codes for nuclear safety analysis and design parameters optimization of the advanced nuclear fuel.**

- **CANDU Owners Group**
  - **Cernavoda technical assistance for COG R&D programs (Fuel channel, Plant chemistry, Safety and licensing, Radioprotection, Computer programs;**
  - **Developing Irradiated Testing Facilities at ICN Pitesti ; to develop the capability to test irradiated material in the hot cells at ICN Pitesti. Types of tests to be develop cover DHC testing and associated with material (PT) surveillance.**

# International Cooperation: USA

- Collaboration with Nuclear Laboratories from U.S.A
  - Los Alamos National Laboratory (LANL):
    - Water flow and contaminant transport in geological environments;
    - Radionuclide migration experiments in loess, clay, concrete and limestone.
  - Oak Ridge National Laboratory (ORNL):
    - Transfer of computer codes for nuclear safety and biological protection assessments, neutron calculations and nuclear data generation, and accident analyses;
    - Assessment of 99Mo production technology at SCN - TRIGA research reactor.
  - LANL and ORNL:
    - Development of a business plan for SCN - TRIGA research reactor.

# Assistance and Co-operation: IAEA

**Regular Projects with INR as the main recipient:**

- **Development and testing of locally made fuel elements**
- **Building Nuclear Safety capabilities**
- **Development of the Cernavoda Probabilistic Safety Evaluation Studies**
- **Plant commissioning requirements and training**
- **Radiological protection**
- **Licensing of test facilities for CANDU 600 fuelling machine**
- **Full conversion of TRIGA 14-Mw Core from HEU to LEU**

**Regional projects**

**Training courses, scientific visits, expert missions, etc.**

**Ex: RER/9/076 Strengthening Safety and Reliability of Nuclear Fuel and Materials in Nuclear Power Plants: Upgrading the Hot Cells at INR Pitesti and development of the CANDU spent fuel examination and surveillance programme.**

**Others co-operation forms:**

**Research contracts**

**INR contribution to the IAEA activities (development of standards, experts)**

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