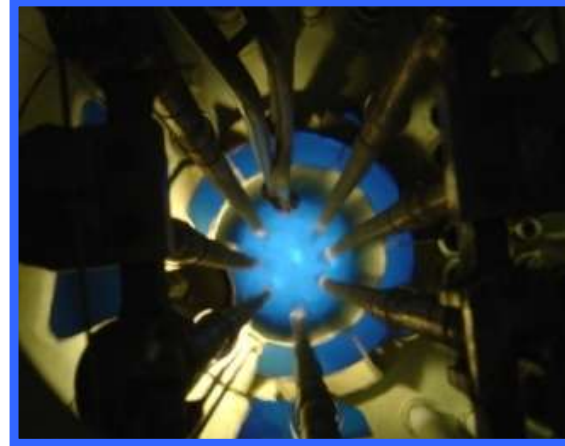


**IEEE NPSS School on
Nuclear Power for Sustainable Development
Ho Chi Minh City, Viet Nam | 7-11 September 2026**



OVERVIEW OF NUCLEAR TECHNOLOGY IN VIETNAM



**KIEN-CUONG NGUYEN
DALAT NUCLEAR RESEARCH INSTITUTE
VIETNAM ATOMIC ENERGY INSTITUTE (VinAtom)**



Content of the presentation

- **Energy & Sustainable Development Context in Vietnam**
- **History and Current Infrastructure**
- **Non-Power Applications (Medicine, Agriculture, Industry) and Scientific Activities**
- **Future Projects**
 - ✓ CNST with high power and multipurpose research reactor
 - ✓ Ninh Thuan 1 & 2 Project
 - ✓ The strategic products: SMR, Gen-IV and rare elements (fuel cycle)
- **International Collaborations & Human Capacity Building**
- **Conclusion and remarks**



Energy Context & Sustainable Development Goals

- ✓ **Vietnam's Energy Landscape:** Rapid industrial growth driving high electricity demand. As well as in high technology such as Chip semi conductor, Data center, AI application, ...
- ✓ **Climate Commitments:** Net-Zero carbon emissions target by 2050 (COP26 commitment).
- ✓ **Role of Nuclear Technology:** Supporting clean energy transition, environmental protection, health care, and industrial advancement.
- ✓ **Sustainable Development Goals (SDGs)**
 - **SDG 7 (Clean Energy):** Expand modern, reliable, and renewable power access to all regions.
 - **SDG 8 (Economic Growth):** Build green jobs and foster sustainable industrial expansion.
 - **SDG 9 (Industry and Infrastructure):** Upgrade national power grids and eco-friendly infrastructure.
 - **SDG 13 (Climate Action):** Take urgent action to lower carbon output and fight climate change.



Historical Milestones of Vietnam's Nuclear Technology

1963: Original TRIGA Mark II reactor commissioning in the Dalat.

26/2/1963: First criticality of the TRIGA reactor

1963-1968: Operating at 250 kW for 3 purposes: Training Research and Isotope Production.

1968-1975: The reactor was in extended shutdown.

1974-1975: Fuels were unloaded and shipped back to the USA.

1984: Reconstruction and power upgrade to 500 kW (DNRR).

1/11/1983: Criticality of the DNRR using HEU (36%).

1984-2007: Operating at 500 kW using HEU fuels.

9/2007-2011: Operating with mixed core using HEU và LEU (19.75%) fuels.

30/11/2011: Criticality of the DNRR using LEU (19.75%).

2012-Present: Operating at 500 kW power using LEU fuels.

2006–2016: Phase of preparations for the Ninh Thuan Nuclear Power Project.

2016–Present: Strategic pivot toward non-power applications, high-power research reactor development (CNST), and next-generation reactor R&D.

11/2024-Present: Reactivation of the NPP program of the country.



Institutional Framework & Regulatory Ecosystem

Ministry of Science and Technology (MOST): Primary state management for atomic energy and other activities related to nuclear application.

VINATOM: Lead national research institute for nuclear science, technology, and nuclear application.

VARANS: Nuclear safety and radiation protection regulatory authority.

Academic Institutions: Key university partners (VNU Hanoi, VNU-HCM, HUST, Dalat University, Phenikaa) in nuclear engineering and technology.



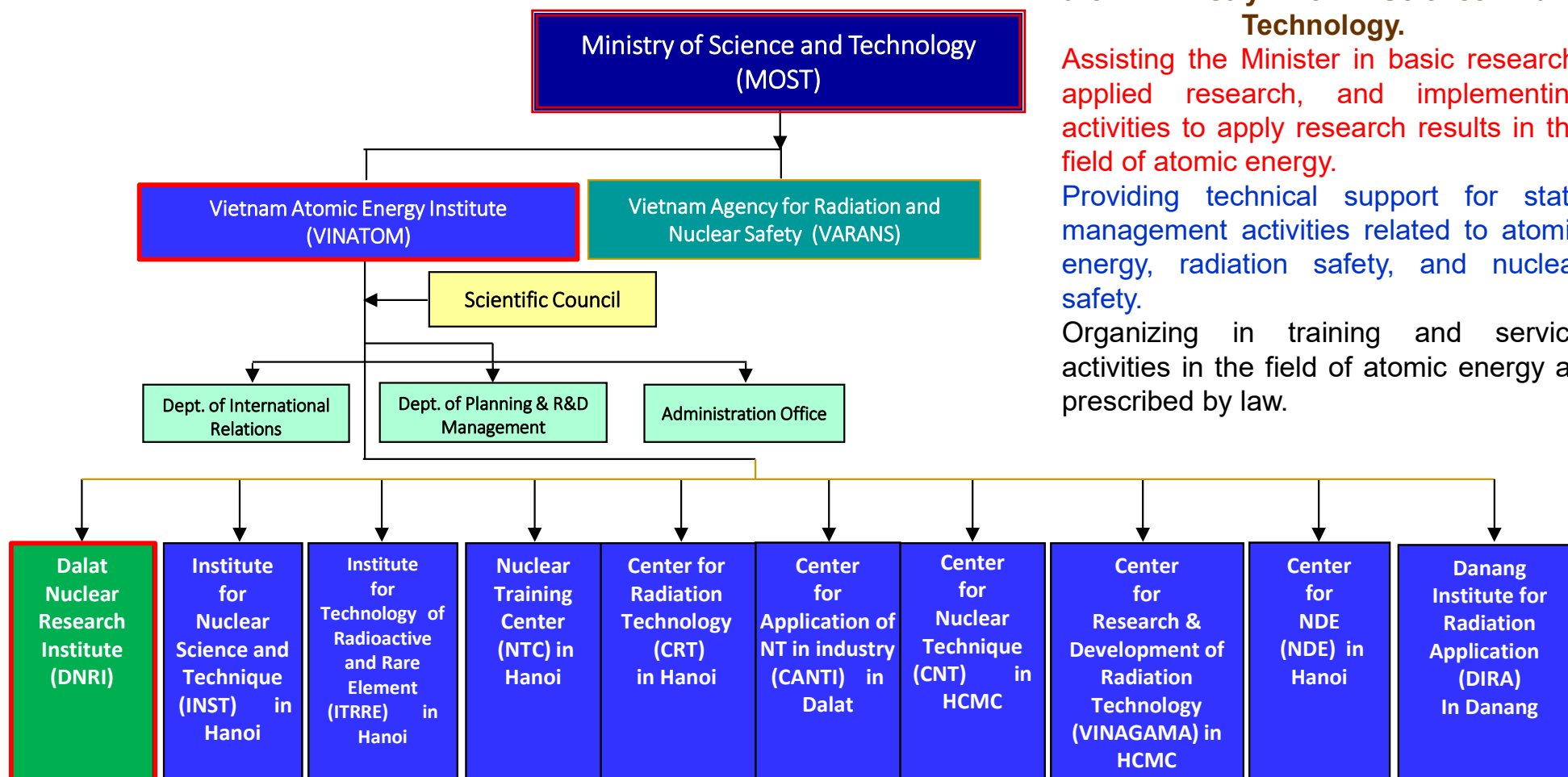
Organization of The Vietnam Atomic Energy Institute (VINATOM)

VINATOM is a special-grade scientific and technological organization under the Ministry of Science and Technology.

Assisting the Minister in basic research, applied research, and implementing activities to apply research results in the field of atomic energy.

Providing technical support for state management activities related to atomic energy, radiation safety, and nuclear safety.

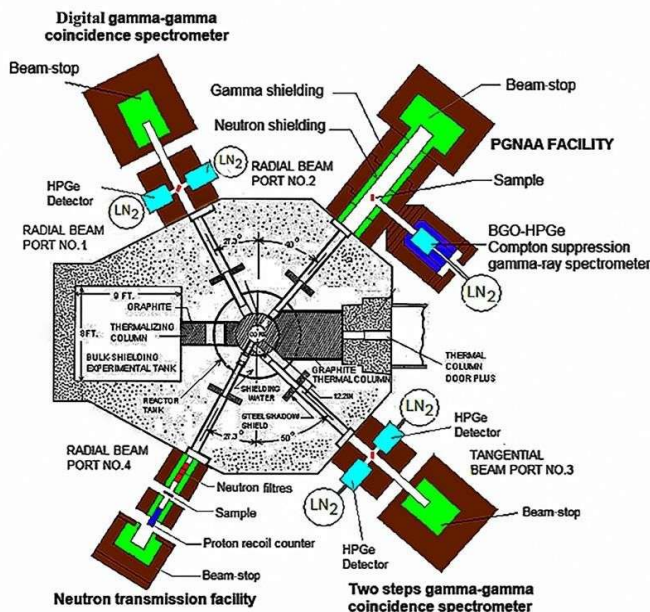
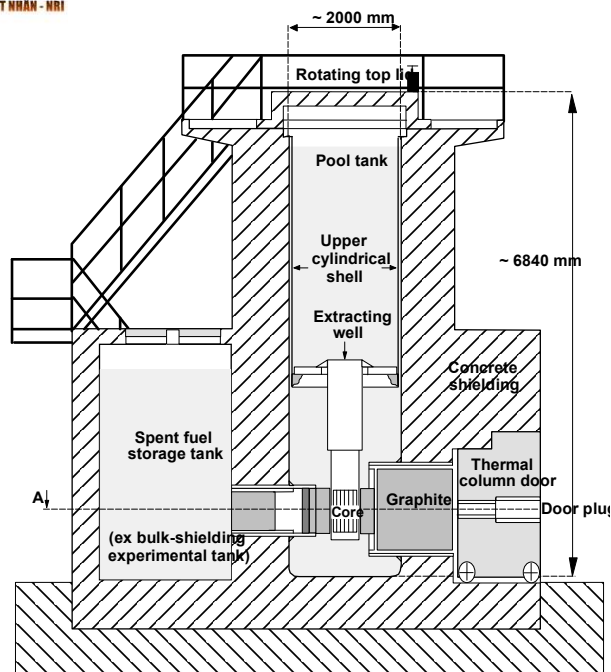
Organizing in training and service activities in the field of atomic energy as prescribed by law.





Dalat Nuclear Research Reactor (DNRR)

MAIN CHARACTERISTICS

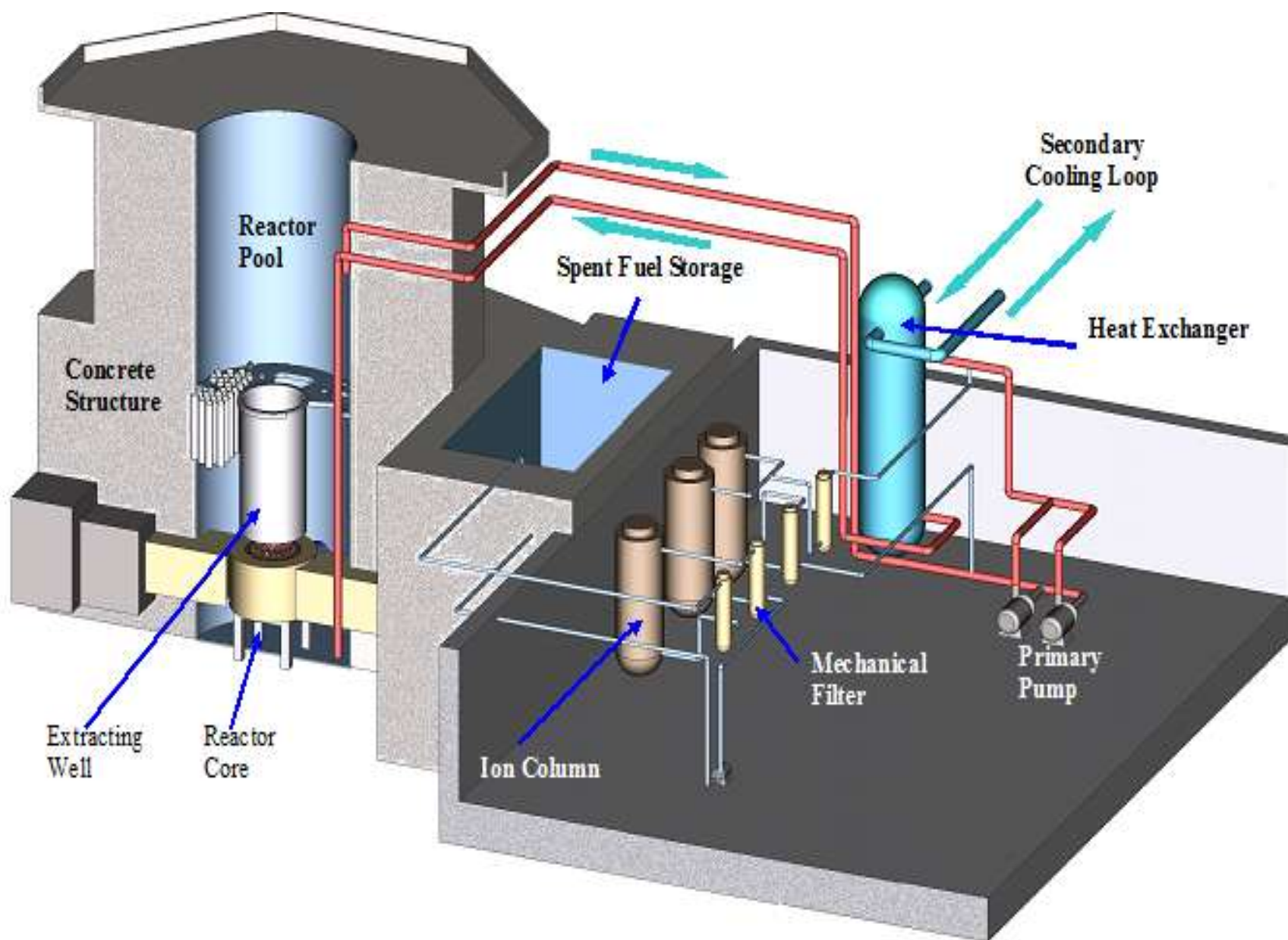


- Power: 500 kWt
- Moderator & Coolant: Water
- Core: Diameter 44.2cm and height 60 cm.
- Convection mechanism: Natural convection
- No. FAs in the reactor core:

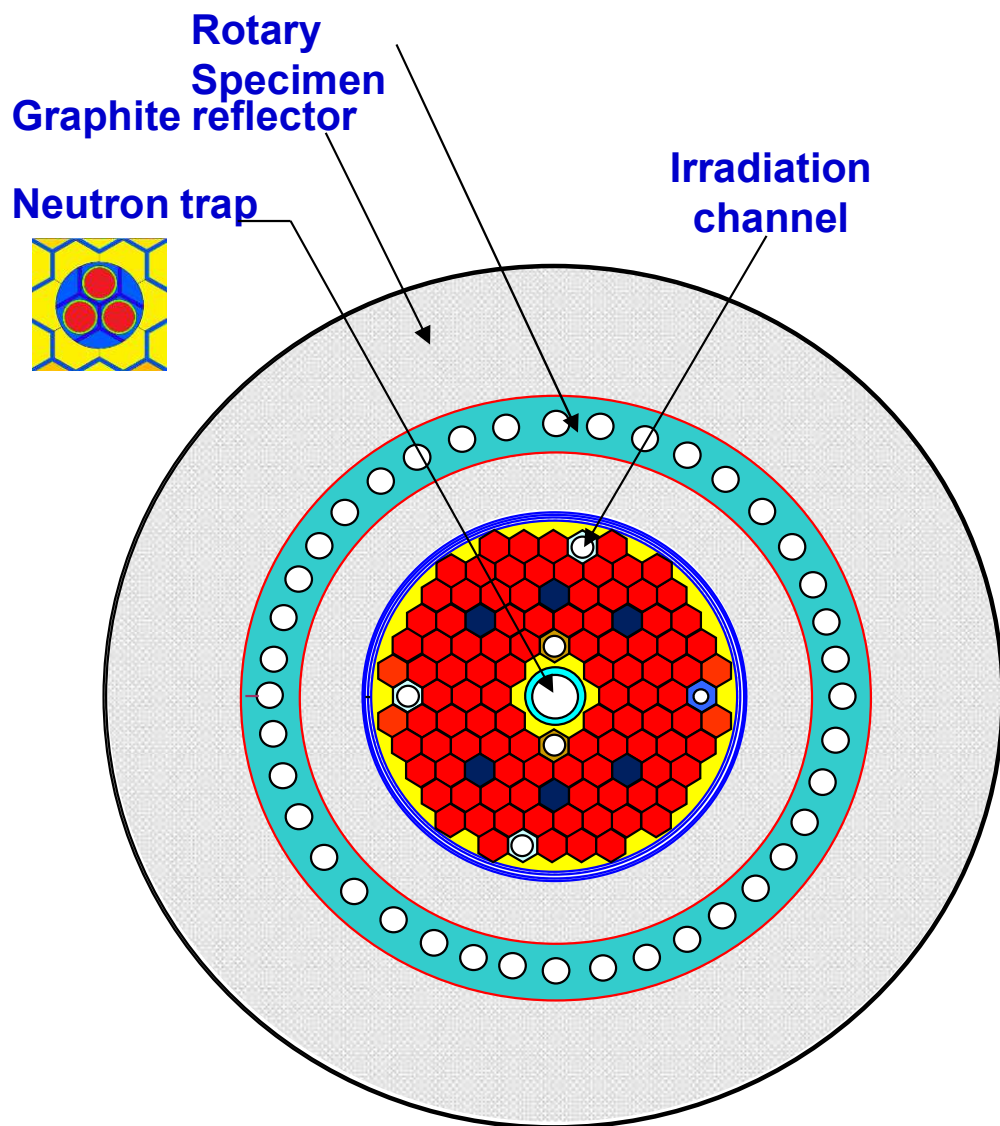
89 (1984-1994), 100 (1994-2002), 104 (3/2002-6/2004), 104 reshuffled (6/2004), 106 (10/2006), 98 HEU+6 LEU (9/2007), 92 HEU+12 LEU (7/2009-8/2011), 92 LEU (12/2011- 4/2021), 94 LEU (5/2021-5/2022), 96 LEU (6/2022 – 6/2023), 98 LEU (6/2023-3/2024), 100 LEU (1/2024-1/2025), 102 LEU (1/2025 – Now).

- 7 CT Rods: 2 Sa (B_4C), 4 Sh (B_4C), 01 RR (SS)
- 3 neutron detector ranges: 2 regions each channel (start-up and working range)
- Neutron reflector: Beryllium and Graphite.

Technological system of the DNRR



The reactor core of the DNRR



Working core from January 2025
using 102 LEU FAs

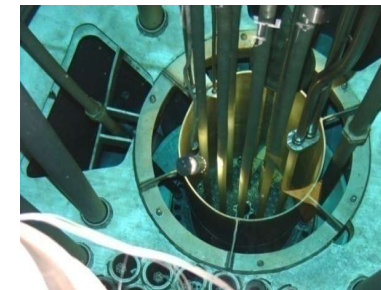
□ Irradiation channel and thermal neutron flux:
 $\text{n.cm}^{-2}.\text{s}^{-1}$

+ *Wet channel:*

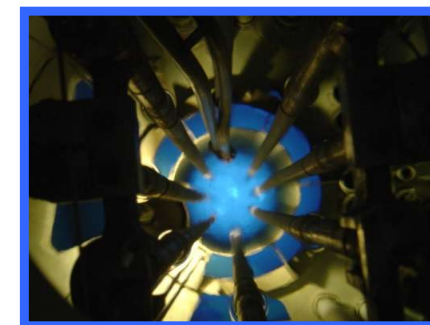
- Neutron trap: 2.2×10^{13}
- Cell 5-6 & 9-6: 1.7×10^{13}
- Channel 1-4: 1.0×10^{13}
- 40 holes at RS: 3.8×10^{12}

+ *Dry channel:*

- Pneumatics system cell 7-1: 4.2×10^{12}
- Pneumatics system cell 13-2: 4.2×10^{12}



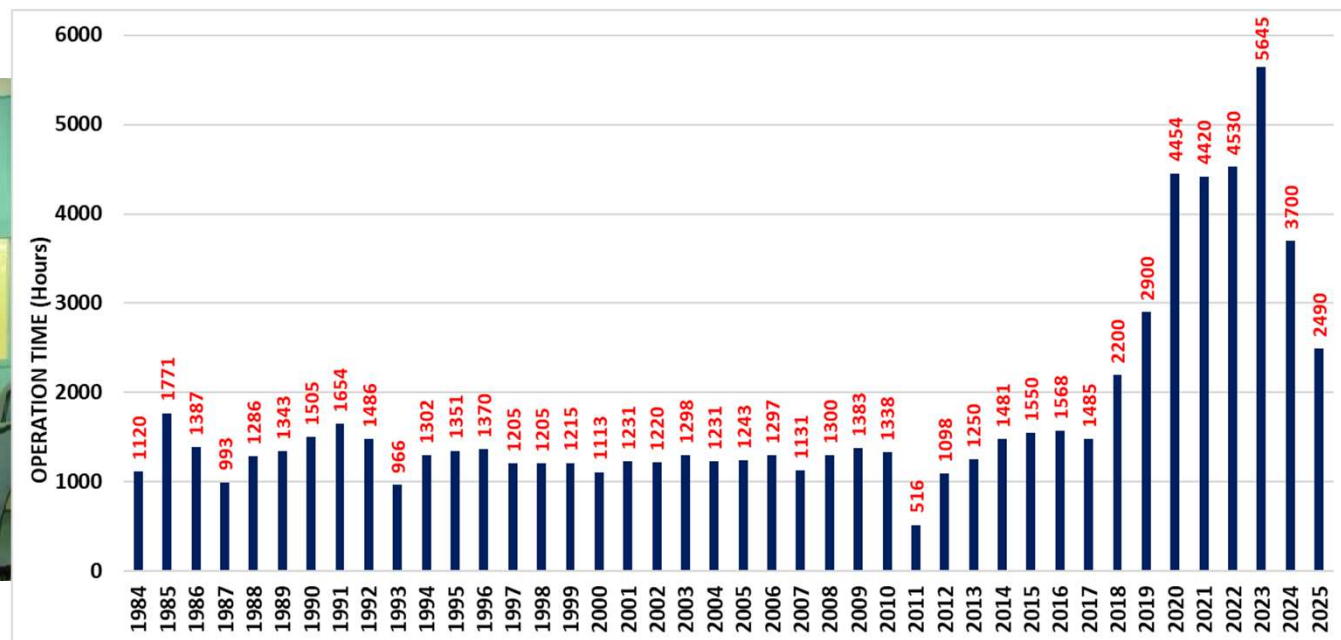
-  VVR-M2 FA
-  CT rods Sa & Sh
(Boron Carbide)
-  RR (Stainless Steel)
-  Beryllium
-  Irradiation channel



Operation of the DNRR



Control room



Time for maintenance, fixing and training or experiment are in holiday or weekend

Total operation time each year is about 1500 hrs to 2500 hrs.

During COVID-19 from 2020 to 2023 , average operation time each year is more than 4500 hrs

Radioisotopes production;

Neutron activation analysis;

Basic and applied research in nuclear physics;

Research on reactor physics and thermo-hydraulics;

Personnel training and education



Infrastructure and Manpower



- Research reactor (500 kW)
- Co-60 Irradiation Sources (VINAGAMA)
- Cyclotron (Center Radiation Technology)
- Facilities for radioisotope & radiopharmaceutical production
- Facilities for waste treatment (solid and liquid)
- Environmental monitoring stations.

- Research & RIP laboratories.
- Rare elements research equipment.
- Internal and personal Dosimetry Labs.
- Calibration of radiation measurement equipment Labs.
- Element Analytical Labs (INAA, AAS, ICP-MS, HP-LC, IC, etc.).
- Analysis environmental radioactivity Labs (gamma, alpha, beta, LCC, ...)
- Biology research Labs (bio-dosimetry, plant cell, tissue culture).
- Radiation technology research Labs
- Nuclear Training Center (Hanoi and Dalat).
- Human resources: ~ 754 staff, 12 Associate Prof., 72 PhD, 240 Master, 255 Engineer and others





Activities of VINATOM

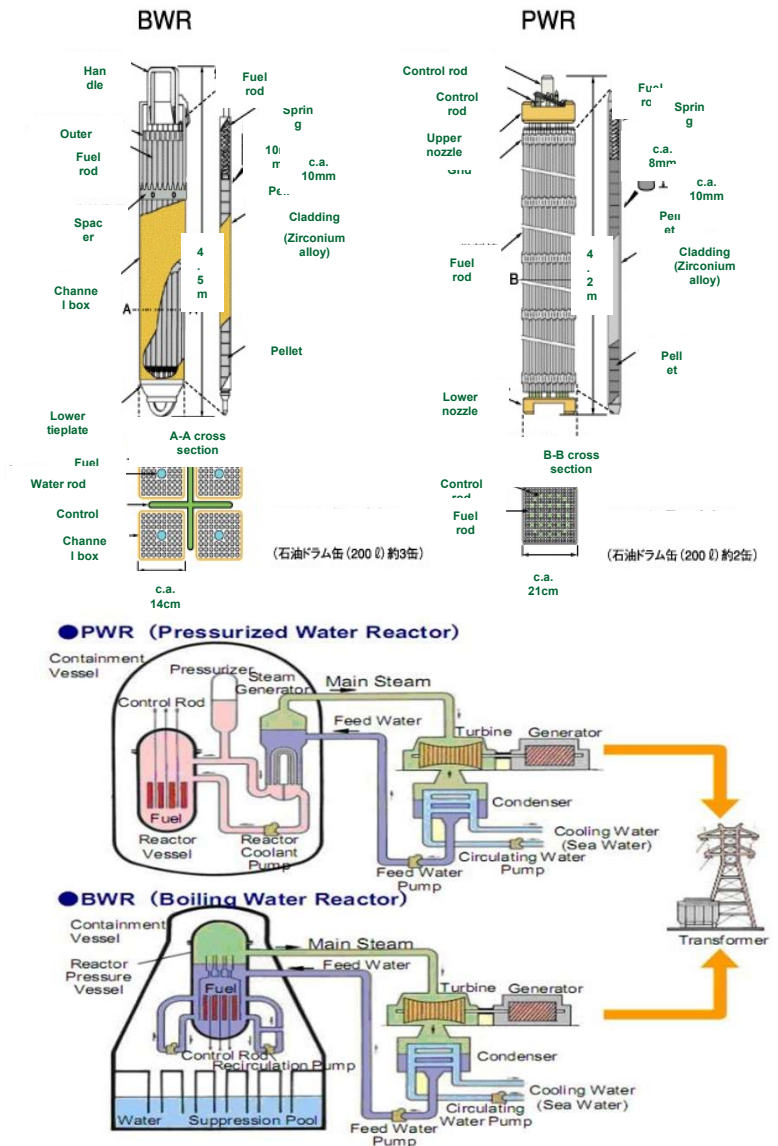
1. Basic research: nuclear physics, nuclear reactor physics, etc.;
2. Research on nuclear power technology and nuclear safety;
3. Development of technical capabilities to support state management of radiation and nuclear safety and nuclear security;
4. Application of nuclear techniques and radioisotopes in agriculture, industry, healthcare (developing nuclear medicine, supplying radiopharmaceuticals for cancer diagnosis and treatment nationwide), and natural resources and the environment;
5. Research on nuclear fuel (uranium), steel materials and alloys, rare elements, and titanium; radioactive waste treatment and management;
6. Training and development of nuclear human resources (doctoral level, specialized training);
7. Multilateral (IAEA) and bilateral international cooperation with various countries worldwide.



Scientific activities

Period 2010-2016

- ❑ Signed agreements with the Russian Federation and Japan on the construction of the Ninh Thuan 1 and Ninh Thuan 2 nuclear power plants
- ❑ Initiated and completed the Feasibility Study (FS) and Site Approval Dossier (SAD) for Ninh Thuan 1 and Ninh Thuan 2 (in 2014)
- ❑ Established the National Steering Committee on human resource training
- ❑ Conducted human resource training in Russia (over 400 students) and Japan (32 key personnel for the Ninh Thuan 2 project), as well as short-term training in Hungary
- ❑ Prepared for the appraisal of the FS and SAD for the Ninh Thuan 1 project
- ❑ Prepared for the training of nuclear experts (Project 1756).

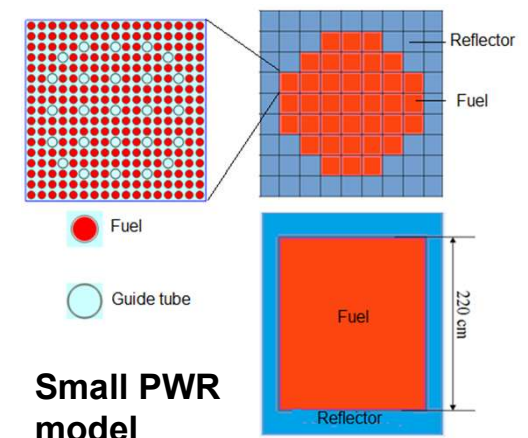
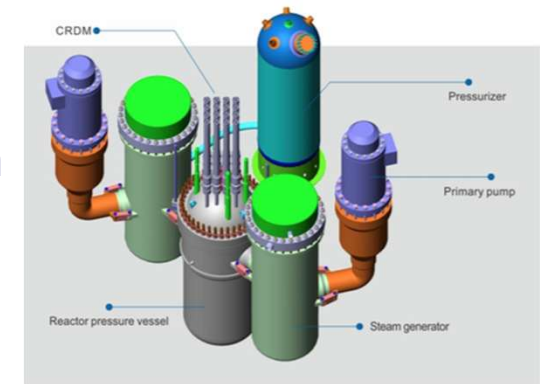




Scientific activities

SMR technology status & preliminary conceptual design proposal for SMR

- Proposing core design concepts for SMR
- Proposing thermal hydraulic design concepts for SMR
- **Preliminary design of neutronic characteristics for SMR**
 - Calculation of the physical characteristics at the beginning of the cycle
 - Calculation of physical characteristics and density of fission products during operation of SMR
- **V&V of thermal-hydraulic computation tools for PWR-SMR**
 - Demonstration of LOCA Scenario based on RELAP5/mode3.3 calculation by using FLECHT-SEASET Reflood test
 - V&V of the CFD code calculation by using PSBT – NUPEC PWR Sub-channel and Bundle Test benchmark
- **Preliminary T-H design and application safety analysis for PWR SMR**
 - Preliminary thermal hydraulic design for main components such as: Reactor Core, Reactor Vessel, SG, Pressure etc...
 - Preliminary thermal hydraulic design for passive and active safety systems
 - Application of this design to preliminary safety analysis





Scientific activities

Experiments on the DNRR:

Neutron spectra and neutron flux distribution at irradiation positions and FAs;

Differential and integral worth of control rods;

Temperature and power coefficients of reactivity and Xenon poisoning;

Fuel surface temperatures at hottest FA in the core;

Distribution of fuel burn-up;

Behavior of fuel temperature during a reactor transient due to insertion of allowable reactivity; etc.

Calculations related to Reactor Physics and Thermal Hydraulics:

Neutronics, Thermal hydraulics and safety analysis for reactors;

Fuel burn-up, core and fuel management strategy;

Reactor calculation computer codes development.

Research topics

Full core conversion from HEU to LEU;

Silicon doping testing on the DNRR;

Enhancement radio-isotope production on the DNRR;

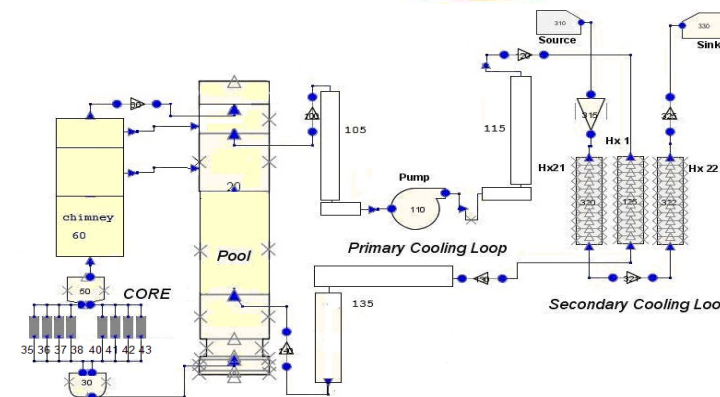
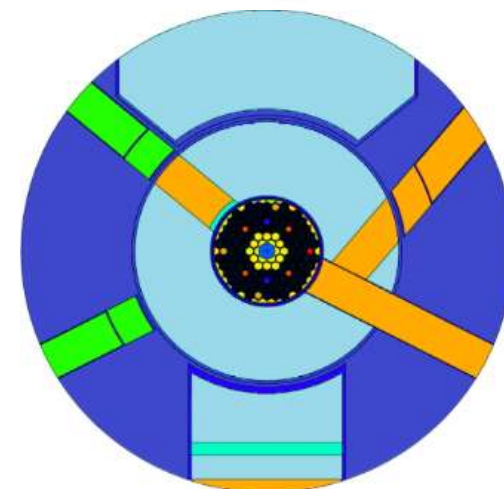
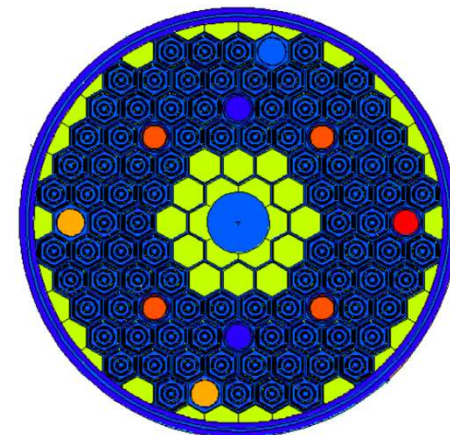
Conceptual design for new research reactor;

DNRR simulation by using RELAP5;

Establishing experimental system for safety to VVR-KN Fuel;

Optimization in refueling for NPP;

Decommissioning study: plant, technique, etc....





Scientific activities

1. Reactor physics, thermal-hydraulics and reactor engineering.
2. Nuclear physics based on neutron beam of the reactor.
3. Radioisotope and radiopharmaceutical production.
4. Radioactive waste treatment and management.
5. Development of Radiation Dosimetry Techniques.



TLD bag



Digital microscope for chromosomal aberrant analysis



Radioactive waste storage facilities (5A)



Hot cell and I-131 production line



RI products of DNRI



Scientific activities

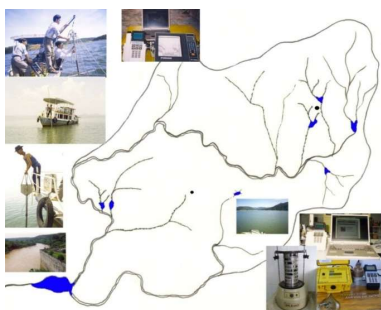
6. Monitoring and Warning of ER.
7. Development of Analytical Techniques
8. Using Radioisotopes as Tracers
9. Development of Radiation Technology
10. Development of Biotechnology
11. Design and Manufacture of Nuclear Electronic Equipment
12. Training and Education



Station for monitoring environmental radioactivity



Automated sample analysis of NAA



Sedimentation rate studies



Products of T&D and OLICIDE 9DD



Flowers by mutation technique



The CNST Project – A new milestone for Vietnam

Project Name: Center for Nuclear Science and Technology (CNST).

Key Feature: A new, high-power multipurpose research reactor (10 MWt).

Partnership: Intergovernmental cooperation between Vietnam and the Russian Federation (Rosatom).

Location: Planned site selection and infrastructure preparation.

Timeline of the Project: 2030-2035



1. Production of Radioisotopes and Seal Sources

2. Neutron Transmutation Doping (NTD) and Gemstone Coloration

7. Material Testing, Safety Tests

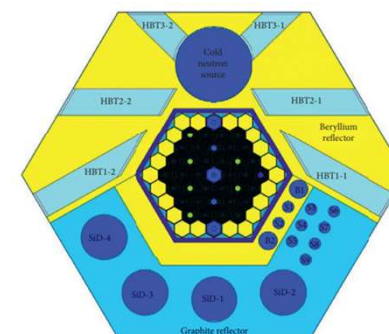
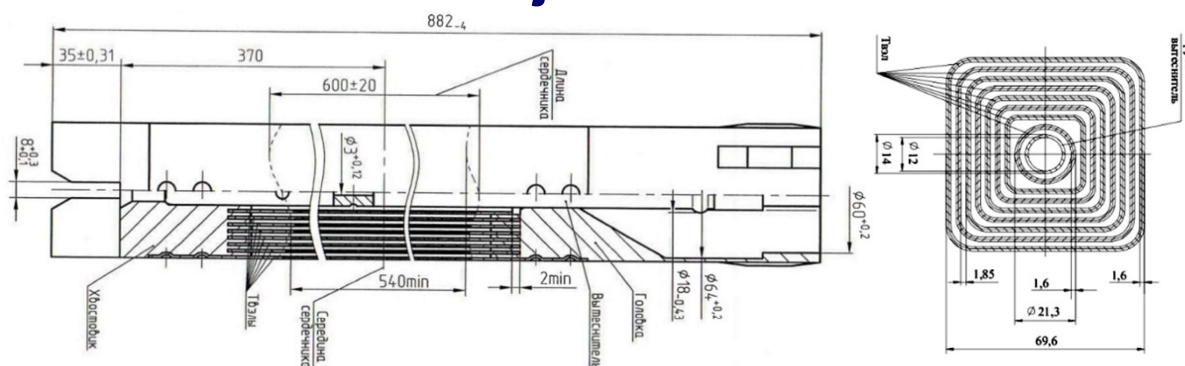
10-15 MW RR

3. Neutron Activation Analysis (NAA, PGAA)

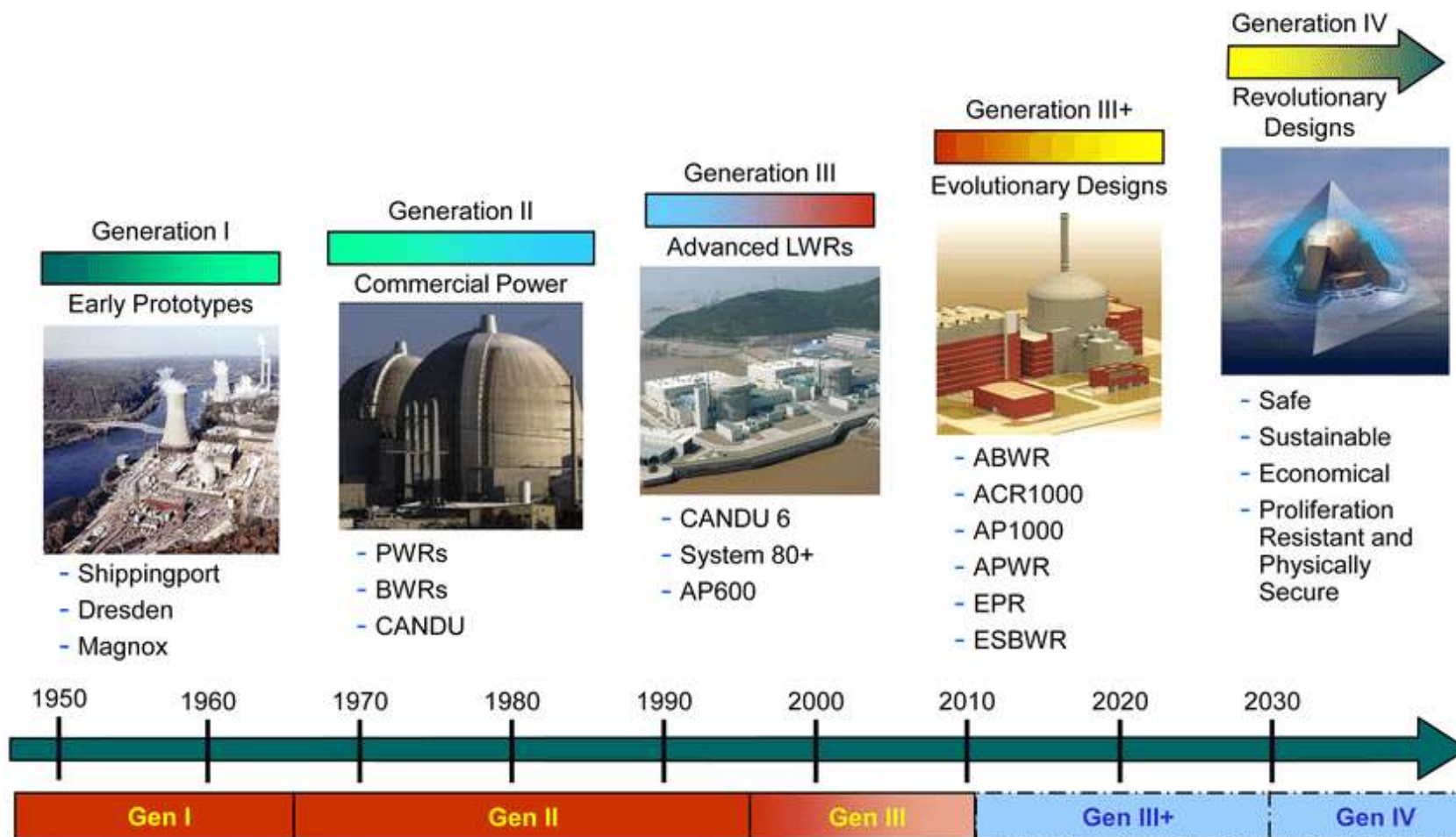
6. Neutron Imaging

5. Material Science with Scattering Techniques

4. Fundamental Research on Nuclear Physics



The development of NPP technology



Nuclear power technology is fundamentally slow to change and involves multiple fields and disciplines.



NPP program of Vietnam

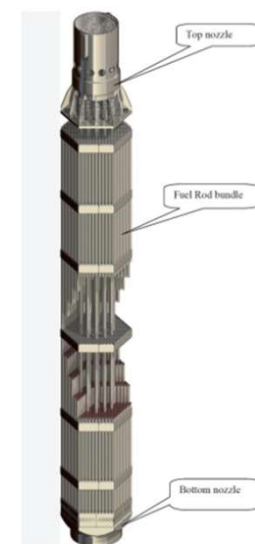
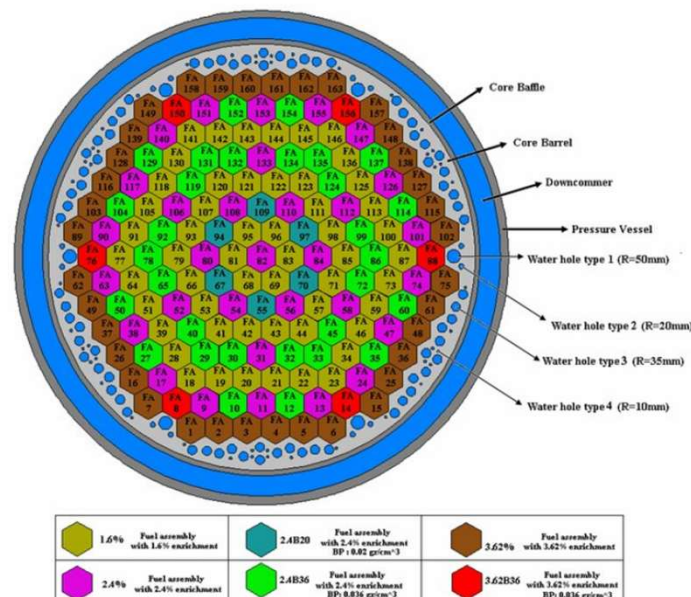
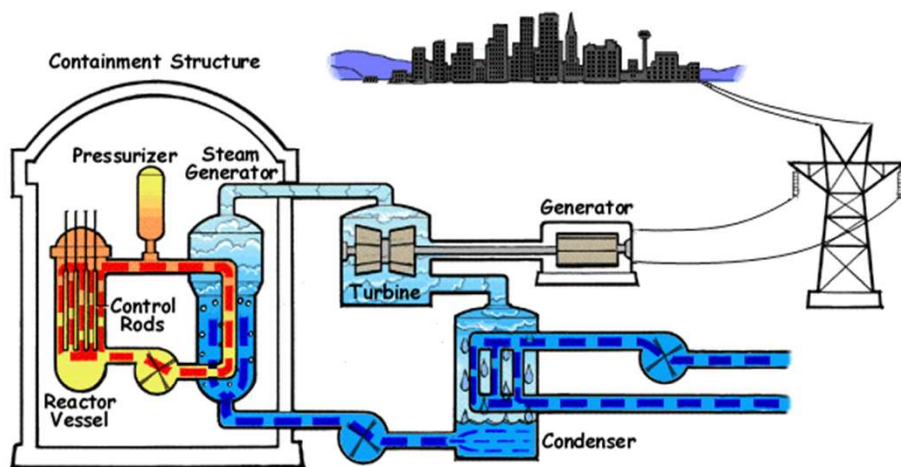
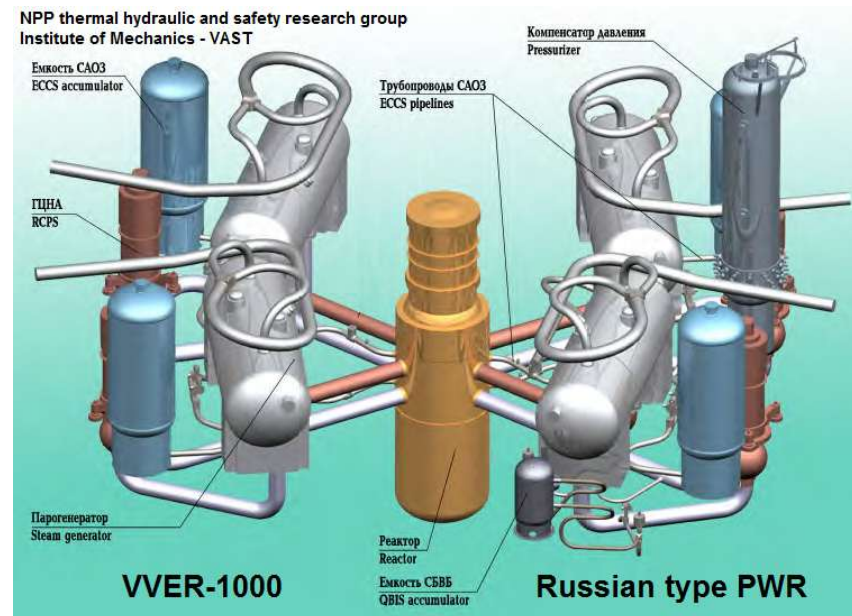
Project Name: Ninh Thuan 1 and 2. VVER-1200 technology (V491/V392M); considering.

Key Feature: New technology 3+.

Partnership: Intergovernmental cooperation between Vietnam and the Russian Federation (Rosatom).

Location: Planned site selection and infrastructure preparation.

Timeline of the Project: 2035



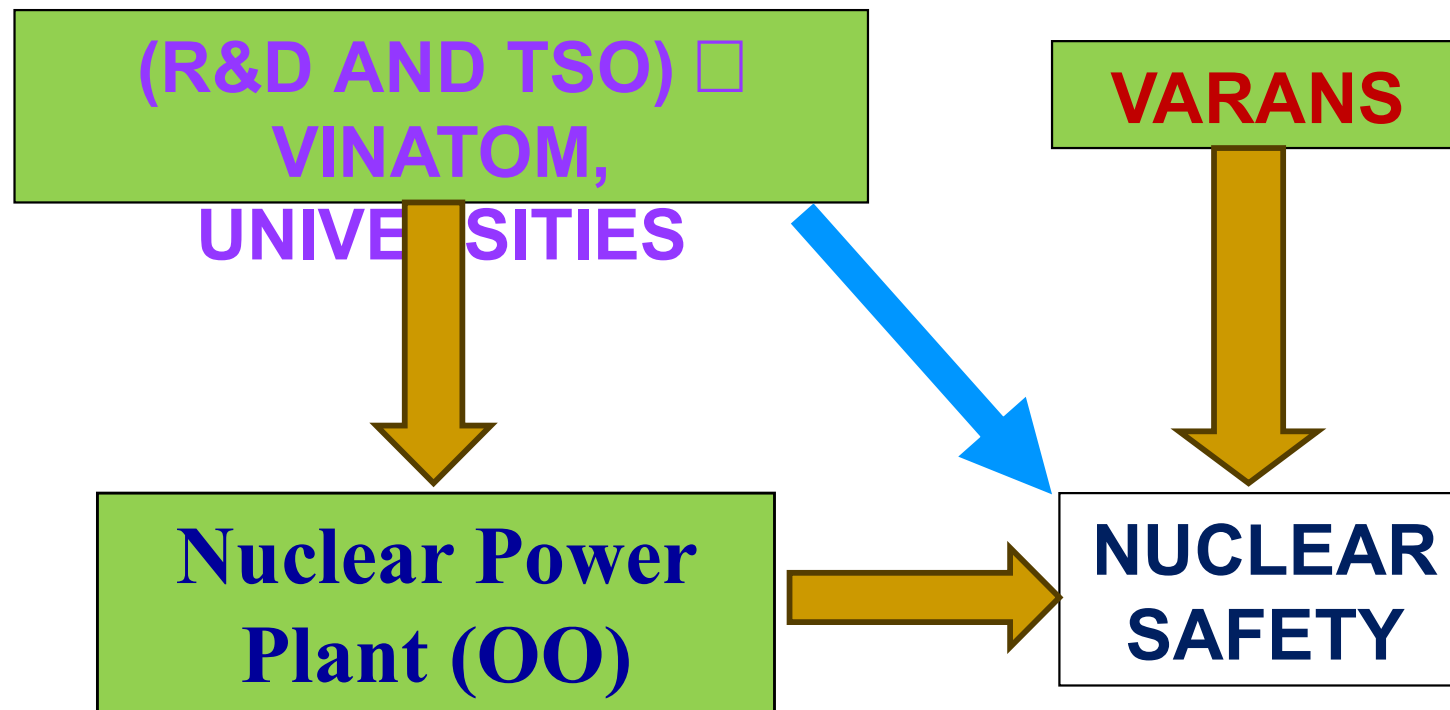


Three pillars of nuclear power program

VARANS: Regulatory body

R&D + TSO: VINATOM and Universities and Technical Supporting Organization

OO: Operating Organization



The most important: Human resource + Safety Cultures



Human resource development strategy

Current Workforce Status: Experienced core senior experts transitioning to a young, dynamic generation.

National Training Ecosystem: Synergies between research institutes, government authorities, and domestic universities.

Target: Preparing a new generation of scientists and engineers for the 10 -15 MWt research reactor (CNST) and future nuclear programs.

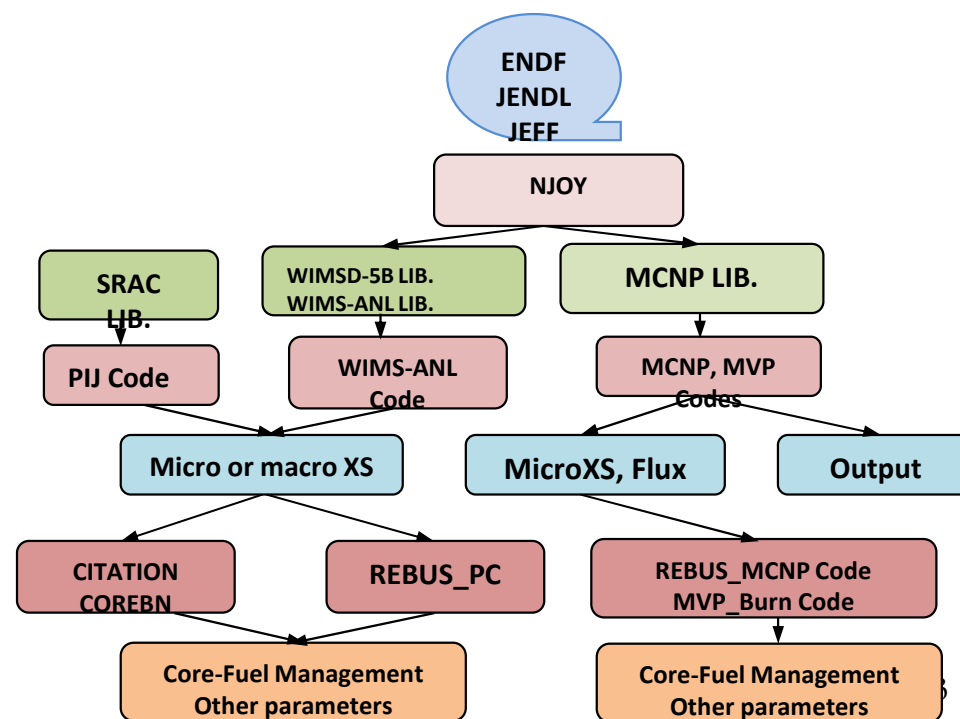
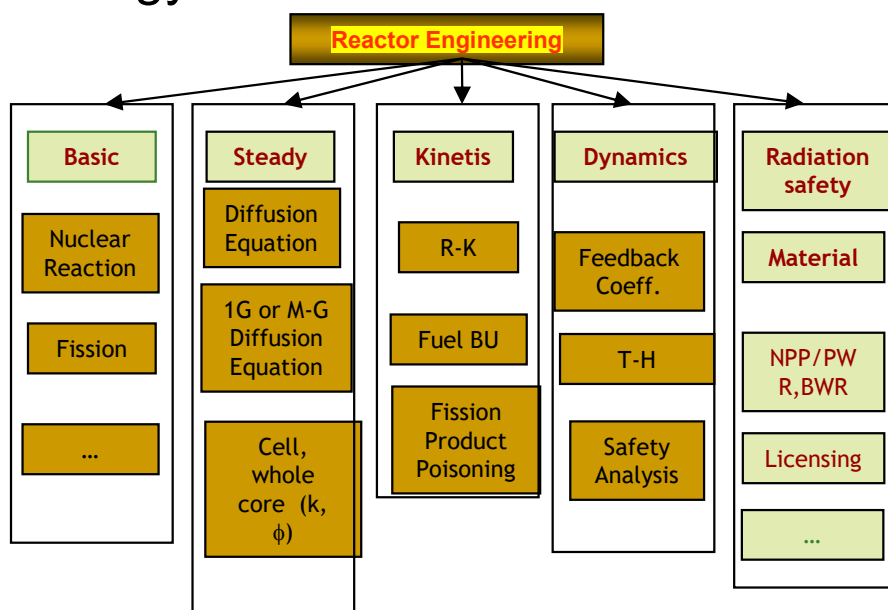
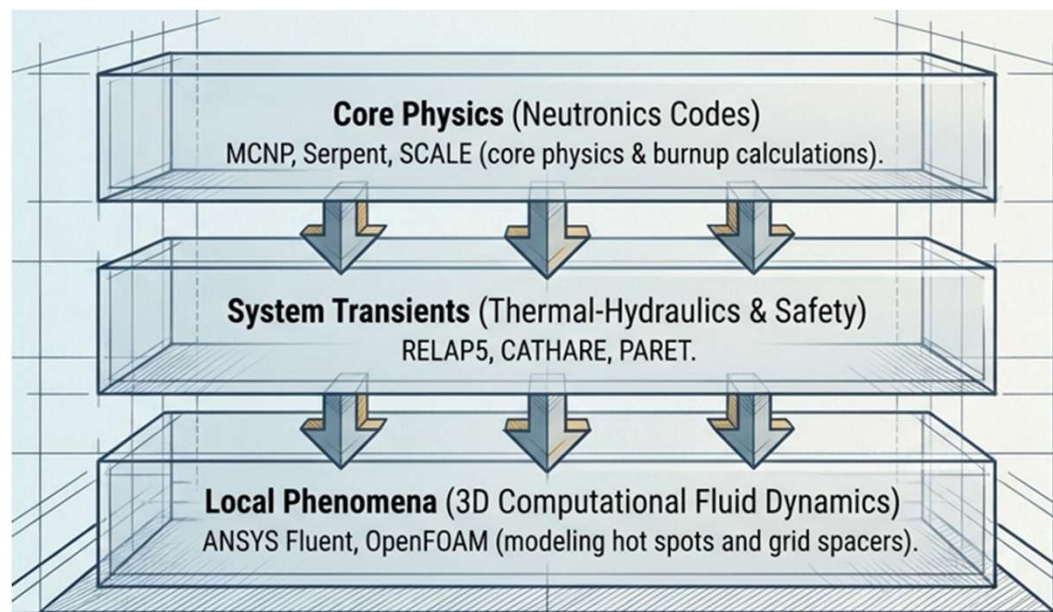


- * **Radiation Safety Training.** Advanced training for university students.
- * **FTC:** emergency preparedness, radiation monitoring, reactor engineering.
- * **Practical guidance:** short- or long- term, PhD, Master's degrees.



Subjects related to Nuclear Technology

Nuclear Physics
Reactor Engineering and technology
Radiation Protection
Material
Health Physics
Electronics (I&C)
Mechanics
Electric
Chemistry
Biology

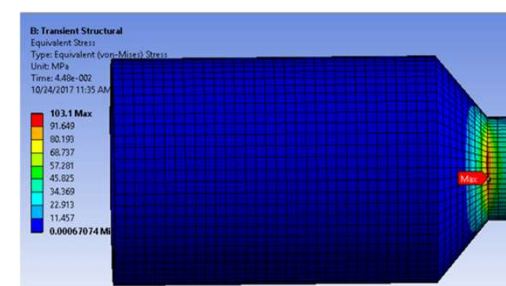
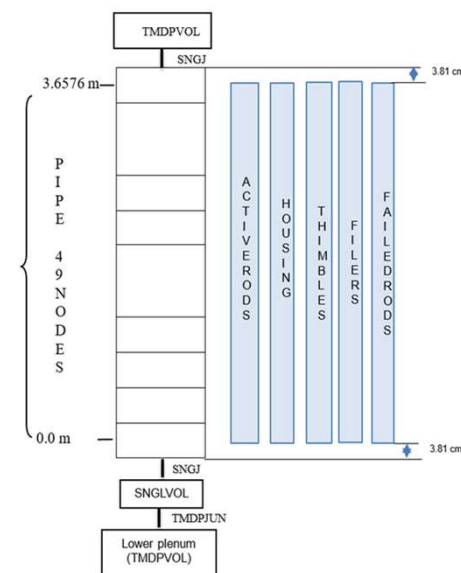
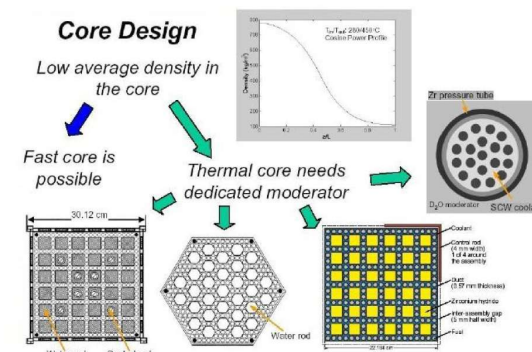
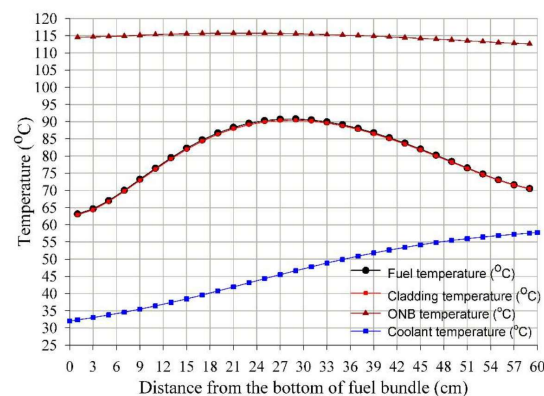
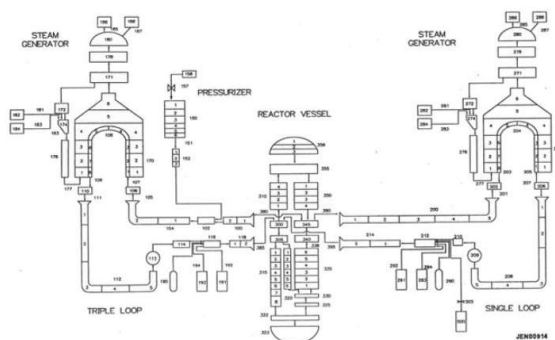




Opportunities for Graduate Students & Young Researchers

High-Impact R&D Topics for Master's & Ph.D. Theses:

- Nuclear Engineering and technology: Reactor engineering, Radiation Protection, Nuclear Application (Analysis, Radiation equipment's design and installation, etc).
- Multi-physics modeling (Neutronics & T-H, CFD coupling).
- Advanced materials synthesis and radiation damage characterization.
- AI & Machine Learning applications in reactor monitoring and fault detection.
- Medical isotope production and radiopharmaceutical chemistry.



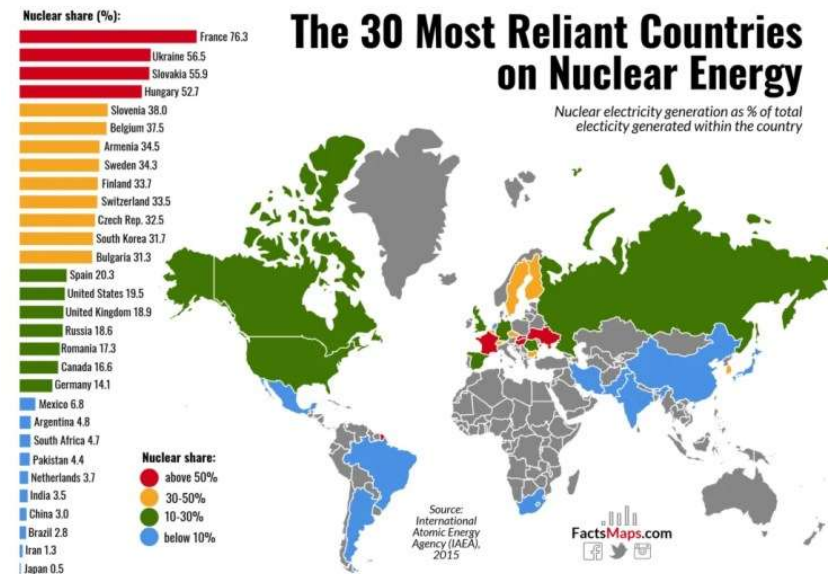
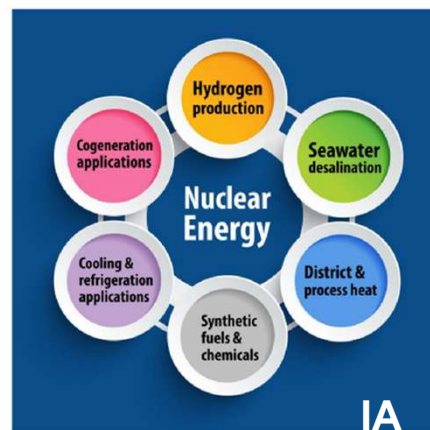


International Partnership & Mobility Networks

Global Partners: IAEA, Rosatom/JINR (Russia), JAEA/JICC (Japan), KAERI/KINAC (South Korea), CEA (France).

Student & Research Mobility: Scholarships, joint research projects, fellowship programs (TC Project IAEA - others), and international training schools (under bilateral or multi-cooperation).

International exchange program for students: Creating Network for Nuclear Program, good at linking between Universities and abroad R&D Organization.





Key challenges & Strategic Solutions

Challenges:

- Shortage of leading or experience experts, lecturers in nuclear engineering and technology.
- Universities lack the infrastructure and laboratories needed for teaching.
- Developing specialized infrastructure for high-level R&D, training, and education.
- Securing sustainable research funding and talent retention.

Strategic Solutions:

- Commitment of the government to the long-term development of the nuclear energy program.
- Enhancing cooperation with industrial countries in the nuclear industry as well as between the universities and R&D institutes.
- Establishing national consortiums connecting universities and industry as well as R&D or Operating Organizations.
- Institutional restructuring to streamline R&D and TSO activities.
- Making a clear program in human resource development in the country in nuclear engineering and technology with different periods.



Vision for 2030 - 2045

Short to Medium Term (2030-2035)

- Carrying out the CNST project
- Training and education for nuclear technology requirements
- Preparation of infrastructure for NPPs
- Embark on SMR, rare elements in the first phase
- Increasing application of nuclear in industry, medical and agriculture

Long-term vision (2045)

- Owner of research reactor technology
- Localization in nuclear technology: NPP, SMR
- Active in human resources for nuclear technology
- Establishing a center for nuclear science, and nuclear application



Concluding and Remarks

- ❑ Nuclear technology in Vietnam extends far beyond power generation—it is an indispensable driver for medicine, agriculture, industry, and environmental protection.
- ❑ The 10-15 MWt CNST reactor and international collaborations (like MBIR) usher in a new era for nuclear R&D in Vietnam.
- ❑ Young researchers and students are the key drivers for the sustainable future of Vietnam's nuclear sector.
- ❑ Leverage experienced domestic human resources to provide training for universities and research institutes.
- ❑ Establish linkages between universities and R&D entities to enhance the quality of training and education in nuclear technology.

**Thank you for your
attention!**

