Current Status of Development and Application of Atomic Energy in Vietnam

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Vietnam Atomic Energy Agency
Outline

1. Review of Nuclear Power Programme

2. Development of nuclear infrastructure

3. Radiation technology utilizations for socio-economic development in Vietnam

4. Coming plan
1. Review of Nuclear Power Programme
National Policies on Nuclear Power

2006
- Strategy on Peaceful Utilization of Atomic Energy up to 2020

2008
- Atomic Energy Law

2009
- Resolution No. 41/2009/NQ-QH12 by the National Assembly on the Investment Policy of the Ninh Thuan Nuclear Power Project

2010
- Planning Orientation on Nuclear Power Development in Vietnam up to 2030

2011
- Planning for National Electricity Development for the Period of 2011-2020 with Vision up to 2030 (Master Plan VII)

- Decided to invest in Ninh Thuan Nuclear Power Project with 2 plants (2 units/plant) to generate electricity for socio-economic development in Vietnam in general and in Ninh Thuan province (Decision to go nuclear power).
# Planning Orientation for Nuclear Power in Vietnam up to 2030 (Approved in 2010)

<table>
<thead>
<tr>
<th>No.</th>
<th>Nuclear Power Unit</th>
<th>Capacity (MW)</th>
<th>Year of Commercial operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phuoc Dinh Unit 1</td>
<td>1000</td>
<td>2020</td>
</tr>
<tr>
<td>2</td>
<td>Phuoc Dinh Unit 2</td>
<td>1000</td>
<td>2021</td>
</tr>
<tr>
<td>3</td>
<td>Vinh Hai Unit 1</td>
<td>1000</td>
<td>2021</td>
</tr>
<tr>
<td>4</td>
<td>Vinh Hai Unit 2</td>
<td>1000</td>
<td>2022</td>
</tr>
<tr>
<td>5</td>
<td>Phuoc Dinh Unit 3</td>
<td>1000</td>
<td>2023</td>
</tr>
<tr>
<td>6</td>
<td>Phuoc Dinh Unit 4</td>
<td>1000</td>
<td>2024</td>
</tr>
<tr>
<td>7</td>
<td>Vinh Hai Unit 3</td>
<td>1000</td>
<td>2024</td>
</tr>
<tr>
<td>8</td>
<td>Vinh Hai Unit 4</td>
<td>1000</td>
<td>2025</td>
</tr>
<tr>
<td>9</td>
<td>Central Region Unit 1 and 2</td>
<td>2 x 1000</td>
<td>2026</td>
</tr>
<tr>
<td>10</td>
<td>Central Region Unit 3</td>
<td>1.300 - 1.500</td>
<td>2027</td>
</tr>
<tr>
<td>11</td>
<td>Central Region Unit 4</td>
<td>1.300 - 1.500</td>
<td>2028</td>
</tr>
<tr>
<td>12</td>
<td>Central Region Unit 5</td>
<td>1.300 - 1.500</td>
<td>2029</td>
</tr>
<tr>
<td>13</td>
<td>Central Region Unit 6</td>
<td>1.300 - 1.500</td>
<td>2030</td>
</tr>
<tr>
<td></td>
<td><strong>Total capacity</strong></td>
<td><strong>15,000 - 16,000</strong></td>
<td></td>
</tr>
</tbody>
</table>
FSs and SADs for Ninh Thuan 1 and Ninh Thuan 2 NPPs were basically completed and being appraised by the competent authorities.

**Ninh Thuan 1**: Phuoc Dinh
- 2 x 1,000 MWe
- **COD**: Ninh Thuan 1: 2020-2021
- **Investment Owner**: EVN
- **Technology**: Advanced & proven (LWR)
- **Cooling**: Sea water
- **Fuel**: Imported

**Ninh Thuan 2**: Vinh Hai
- 2 x 1,000 MWe
- **COD**: Ninh Thuan 2: 2021-2022
## Component Projects of Ninh Thuan Nuclear Power Project

<table>
<thead>
<tr>
<th>Construction of NPPs in Ninh Thuan (EVN)</th>
<th>Local authorities</th>
<th>MOST</th>
<th>MOIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Construction of Ninh Thuan 1 and 2 NPP</td>
<td>• Site clearance &amp; resettlement</td>
<td>• Nuclear Science &amp; Technology Centre</td>
<td>• Project for development of nuclear power supporting Industry</td>
</tr>
<tr>
<td>• Public Relation Centre on site</td>
<td></td>
<td>• Public Information &amp; Communication</td>
<td></td>
</tr>
<tr>
<td>• Basic infrastructure for the construction of the NPPs and Operation Complex</td>
<td></td>
<td>• Training and developing human resource for TSO, State Management organization</td>
<td></td>
</tr>
<tr>
<td>• Workforce preparation for the NPPs in Ninh Thuan</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8
Organizations involved in the Ninh Thuan Nuclear Power Project

- **Ministry of Science and Technology** *(state management on atomic energy)*
  - Vietnam Atomic Energy Agency (VAEA): Policy, promotion of development, utilization and R&D management of atomic energy;
  - Vietnam Agency for Radiation and Nuclear Safety (VARANS): Safety, safeguards and security regulation;
  - Vietnam Atomic Energy Institute (VINATOM): R&D organization

- **Ministry of Industry and Trade**
  - Electricity and Renewable Energy Authority: state management of energy

- **Vietnam Electricity** *(state-owned enterprise)*: investment owner of Ninh Thuan Nuclear Power Project

- Other ministries involving in the nuclear power programme: MONRE, MOC, MOET, etc.
2. Development of Nuclear Power Infrastructure
Establishment of Key Agencies/Organizations in Vietnam Nuclear Power Programme

- Establishment of the National Nuclear Safety Council (4/2010)
- Establishment of the State Steering Committee of the Ninh Thuan Nuclear Power Project (5/2010)
- Establishment of the Ninh Thuan Nuclear Power Project Management Board (EVNNPB) (4/2011)
- Establishment of the National Steering Committee on Human Resource Development in the Field of Atomic Energy (6/2011)
Governmental Management System

Prime Minister

National Nuclear Safety Council

Ministry of Science and Technology
- VARANS
- VAEA
- VINATOM

Ministry of Industry and Trade
- Directorate of Energy

Ministry of Construction

Ninh Thuan People’s Committee

Ministry of Education and Training

Ministry of Planning & Investment, Finance, Natural Resources & Environment, Defence; Public Security; Foreign Affairs; Information & Communication; State Bank

National Atomic Energy Council

Vietnam Electricity (E VN)

Ninh Thuan Nuclear Power Project Management Board
The State Steering Committee of the Ninh Thuan Nuclear Power Project

Chairman
Deputy Prime Minister

Standing Deputy Chairman
Minister of Industry & Trade

Deputy Chairmen
Minister of Science & Technology, Minister of Construction, Chairman of the People’s Committee of Ninh Thuan Province

Members
- Deputy Ministers of Industry & Trade; Science & Technology; Construction; Planning & Investment; Finance; Natural Resources & Environment; Defence; Public Security; Foreign Affairs; Education & Training; Labour, Invalids & Social Affairs; Information & Communication; Office of Government
- Deputy Governor of State Bank
- Deputy Chairman of the People’s Committee of Ninh Thuan Province
- President of Vietnam Electricity
- Deputy Chairman of Committee on Science, Technology & Environment, National Assembly
Roles and responsibilities of Members of the State Steering Committee are defined in the Regulation of Operation of the National Steering Committee of the Ninh Thuan NPP Project (Decision No. 93/QĐ-TTg dated 17/01/2011) and the Decision Amending and Supplementing Somes Articles of the Regulation of Operation of the National Steering Committee of the Ninh Thuan NPP Project Promulgated along with the Decision No. 93/QĐ-TTg dated 17 January 2011 by the Prime Minister (Decision No. 717/QĐ-TTg dated 14/06/2012)
International cooperation on nuclear infrastructure development

• Cooperation with IAEA:
  • 2009-2011: 3 TC Projects related to the development of nuclear power infrastructure
  • 2011: Establishment of the Integrated Work Plan for the development of nuclear power infrastructure
  • 2012-2013: 5 TC Projects related to the development of nuclear power infrastructure

• Cooperation with other experienced countries in nuclear power development: USA, EU, France, Republic of Korea,...

• Cooperation with USA, Russia and IAEA in completing the conversion of the nuclear research reactor in Dalat from using highly enriched uranium to low-enriched uranium fuel.
The 2\textsuperscript{nd} INIR Mission (Phase 2)

**Organization**
- 5-14/12/2012
- 12 Experts
- Office of Gov, SSC, MOST, MOIT, MOFA, MIC, MOET, MONRE, MOJ, MOC, EVN, Ninh Thuan Province, Unis
- Interviews for each issue and condition
- Formation of Key Findings/Recommendations/Suggestions/Good Practice

**Preparation**
- Self-Assessment Report, 8/2012

**Conclusion**
- Vietnam had achieved significant improvement since the 1\textsuperscript{st} INIR Mission, there are a lot of work needed to be done to complete the Phase 2
- 7 key areas
- 42 recommendations, 12 suggestions, 2 good practices
The IAEA INIR Mission in Hanoi, Vietnam, 5 – 14/12/2012
The 2nd INIR Follow-up Mission (Phase 2)

Organization
- 11/2014
- Office of Gov, SSC, MOST, MOIT, MOFA, MIC, MOET, MONRE, MOJ, MOC, EVN, Ninh Thuan Province, Unis
- Interviews for each issue and condition
- Formation of Key Findings/Recommendations/Suggestions/Good Practice

Conclusion
- Vietnam had achieved improvement since the 2012 INIR Mission, there are still a lot of work needed to be done to complete the Phase 2
- 6/42 of INIR 2012 recommendations completed
- 3 key areas
Master Plan for developing the national nuclear power infrastructure in Vietnam up to 2020 (approved in Dec. 2014)

- Take into account INIR 2012’s recommendations, suggestions, IAEA’s guidance
- 12 projects already approved by Prime Minister
- 19 new projects: National nuclear and radiation incident response plan; Training for Staff of State Management Organisations, Regulatory Body, Research & Development and Technical Support Organisations, etc,…
However, on 22 Nov. 2016, the National Assembly voted with majority the decision to suspend the implementation of the Ninh Thuan Nuclear Power Project. The NPP Project suspending is due to the present country’s economic situation, but not due to technology nor safety reason.
New Research Reactor Project

- State Atomic Energy Corporation (ROSATOM) and Vietnam Ministry of Science and Technology (MOST) are working to establish the Research Centre for Nuclear Energy Science and Technology (RCNEST) under Vietnam Atomic Energy Institute (VINATOM)
- The RCNEST composes facilities will be located in both southern and northern Vietnam
- An early project is to build a new 15 MW RR for multi-purposes: material research, isotope production for industrial and medical use, training, etc.
- Locations and FS reports are being prepared

The IAEA INIRR Mission in Hanoi, 11/2018
3. Radiation technology utilizations for socio-economic development in Vietnam
Radiation Applications in Health Care

**Nuclear Medicines:**
- Over 40 departments;
- ~ 61 nuclear medicine equipment (47 SPECT & SPECT/CT, 14 PET/CT.)

**Production on cyclotron:**
- 5 cyclotrons are providing $^{18}\text{F}\text{-FDG}$ for PET/CT;
- 02 cyclotrons have successfully tested radiopharmaceuticals of $^{11}\text{C}$ mounted Choline, Acetat
- Production Dalat Nuclear Research Reactor

**Radiotherapy:**
- 44 Facilities
- 100 radiotherapy machine (70 LINAC, 1 Cyber-Knife, 4 true-beam, 9 gamma knife, rotating gamma knife, HDRs…)

**Radiology:**
- ~ 9000 X ray machines; 890 CT machines;
- 456 MRI machines; 76 DSA machines,…
Radiation technologies in Industry

➢ Non-Destructive Testing:
  ▪ ~ 400 Organizations;
  ▪ ~ 5,000 NDT technicians
  ▪ 69 criteria (compatible with ISO standards).

➢ Tracer:
CANTI center (VINATOM) successfully designed and made:
  - 3rd generation CT GORBIT imaging device;
  - Industrial CT/SPECT device;
  - Development of tracer techniques in oil fields.

Tracer techniques in oil fields
Radiation processing

- Processing materials technologies (mainly natural-derived polymeric materials) using gamma radiation, EB accelerators.

- Food coloring, handicraft products, wood

- Rubber vulcanisation

- Crystal super absorb water production
Radiation application in Customs - Security

03 Fixed X-ray Inspection Systems

01 Container X-Ray Scanning Portal

17 Mobile X-ray Vehicle Scanning Systems
Vietnam has a fastest growth of irradiation in Southeast Asia region

Quantity of irradiated food in Vietnam
## Food Irradiation

<table>
<thead>
<tr>
<th>No.</th>
<th>Facility</th>
<th>Location</th>
<th>Equipment</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sonson .Co.ltd.</td>
<td>Hochiminh City</td>
<td>1 X-ray accelerator</td>
<td>100 tons/day</td>
</tr>
<tr>
<td>2</td>
<td>Thaison .Co.ltd.</td>
<td>Cantho</td>
<td>2 Cobalt-60</td>
<td>200 tons/day</td>
</tr>
<tr>
<td>3</td>
<td>Anphu .Co.ltd.</td>
<td>Binhduong</td>
<td>1 Cobalt-60</td>
<td>126 tons/day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vinhlong</td>
<td>2 Cobalt-60</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bac Ninh</td>
<td>EB</td>
<td>150 tons/day</td>
</tr>
<tr>
<td>4</td>
<td>Research and Development Center for Radiation Technology (Vinagamma)</td>
<td>Hochiminh City</td>
<td>1 Cobalt-60, 1 EB</td>
<td>150 tons/day</td>
</tr>
<tr>
<td>5</td>
<td>Hanoi Irradiation Center</td>
<td>Hanoi</td>
<td>1 Cobalt-60</td>
<td>50 tons/day</td>
</tr>
<tr>
<td>6</td>
<td>Danang Irradiation Center</td>
<td>Danang</td>
<td>1 Cobalt-60</td>
<td>~ 100 tons/day</td>
</tr>
<tr>
<td>7</td>
<td>Toanphat.Co.ltd.</td>
<td>Longan</td>
<td>1 Cobalt-60, 1 EB</td>
<td>NA</td>
</tr>
<tr>
<td>8</td>
<td>01 planned facilities</td>
<td>Dongnai</td>
<td>Cobalt-60</td>
<td>NA</td>
</tr>
</tbody>
</table>
Radiation Application in Agriculture

* Mutation breeding

Up to 2021, over 80 new mutation varieties.

2014, Vietnam is the 8th country on mutation breeding (IAEA’s assessment, 2014), winning 3 awards achievements

2021, 2 Vietnamese scientists received awards from FAO and IAEA

* Sterile Insect Technique (SIT): IAEA has supported Vietnam’s Plant Protection Research Institute (PPRI) to carry out SIT research (VIE 5017) on dragon fruit fly: Completed Phase I research, the SIT trial on Thanh Long was conducted in Binh Thuan province.
Research and Application of Radiation in Environment

- Map of natural radiation background of Vietnam: Map scale 1/1,000,000; Map of scale 1/200,000
- Measuring of soil erosion rate using fallout radionuclides (Be-7, Cs-137, Pb-210).
- Study on sediment of reservoirs using radionuclides (Th-230, Th-232, Ra-226) and 13C/12C ratio to identify origin, rate, storage time of sediment.
- Application of hydrology-isotope in Mekong Delta in Vietnam
- Measuring of soil erosion rate using fallout radionuclides (Be-7, Cs-137, Pb-210) at pilot and watershed scales to assess efficiency of soil protective solutions.
Dalat Nuclear Reactor

- 500 kW RR - US TRIGA-MARK II pool type
- Commissioned in 1963
- Shutdown for many years due to the Vietnam War
- Re-commissioned in 1984 with Russia assistance
- 2013: Completed to convert from HEU (36%) to LEU (18%); shipping HEU (both fresh and spent) to Russia
- Operator: **Nuclear Research Institute** under VINATOM
- Effective operation for research, training, isotope production
Coming Plan
Developing the Planning of Atomic Energy Applications Promotion for the period of 2021-2030, vision up to 2050

• VAEA is assigned by MOST to develop the Planning of Atomic Energy Applications Promotion for the period of 2021-2030, vision up to 2050.

• Main target
  - Identify key issues to be solved and breakthrough stages in the development and application of atomic energy in the social-economic field;
  - Set out directions and plans to R&D, application and training facilities, focus on operational efficiency, application of new technologies, modern technical facilities, and develop human resources.
Amendment of Atomic Energy Law 2008

• Direction to amend Atomic Energy Law:
  ▪ Comply with the Constitution 2013 and harmonize to other Law (Environment Protection 2020, Construction 2014 (amended 2020), ect.)
  ▪ Comply with the Model Law of IAEA (NL Handbooks 2003 and 2010), update IAEA Requirements and IAEA recommendations
  ▪ Especially, amend provisions on: Regulatory Body, Licensing competence, Emergency response, Security, Safeguards, Regulatory Inspection and Civil Liability for Nuclear Damage

• Intend to submit the bill for Government comment and approval in 2024-2025 and submit to National Assembly (Parliament) in 2025-2026
In recent years, Vietnam has achieved good results in radiation technology utilizations for socio-economic development.

Government, R&D organizations, and Enterprises play an important role.

The radiation technology utilizations will contribute significantly to the country’s sustainable development and response to climate change.

To make a strategy for managing and continuing to improve the performances of existing human resources in the field of nuclear energy.

Efficient exploitation of the CNEST after it entered into operation.

To strengthen cooperation between Vietnam, IAEA and Japan, France, Russia, etc. on R&D capacity building, on radiation technology R&D for socio-economic development.
Thank you for your attention!