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Globally Sustainable Nuclear Energy Systems
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Sustainable NES Development in Viet Nam

Some Practical Issues

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1. Introduction

1.1. General Information

- Viet Nam is the easternmost country on the Indochina Peninsula in Southeast Asia. With an estimated 90.73 million inhabitants as of December 2014, it is the world's 13th-most-populous country, and the eighth-most-populous Asian country.
- In 2010, Viet Nam attained lower middle-income country status, testament to the rapid economic growth and poverty reduction the country has achieved over the past two decades.
- Viet Nam is on track to meet, or has met, a majority of the Millennium Development Goals (MDGs) at a national level.
- Viet Nam has reduced poverty at an unprecedented rate: the number of Vietnamese living on less than US\$1.25 per day fell from 64% in 1992 to 6% in 2014.
- Economic growth has slowed in recent years, although GDP continued to grow in 2014, by 5.98%, despite weaknesses in the global economy.

1.2. National Strategy for Energy Development

- *National Strategy for Energy Development of Viet Nam up to 2020 with vision to 2050* issued by the PM's Decision No. 1855/QD-TTg, dated on 27 Dec. 2007 determined the following objectives:
 1. Proper exploitation and harmonious utilization of available indigenous energy resources;
 2. Energy saving and efficient utilization;
 3. Development of new energy, renewable energy;
 4. Energy import at a reasonable level;
 5. Combining energy exploitation and utilization to environment protection; and
 6. Nuclear power development.

1.4. Projection on Electricity Demand to 2030

	2015	2020	2025	2030
Electricity Generation (GWh)	158,471	262,414	393,537	560,285
Commercial Electricity (GWh)	140,000	230,924	346,312	495,853
Installed Capacity (MW)	24,840	41,605	62,395	88,833

1.5. International Cooperation (1)

- Viet Nam has ratified and acceded to the most of international legal instruments related to the nuclear energy, such as:
 - Treaty on Non-Proliferation of Nuclear Weapons (1982)
 - Convention on Early Notification of a Nuclear Accident (1987)
 - Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (1987)
 - Safeguards Agreement (1989)
 - Comprehensive Nuclear-Test-Ban Treaty (CTBT) (ratified 2006)
 - Convention on Nuclear Safety (4/2010)
 - Additional Protocol (ratified 9/2012)
 - Convention on Physical Protection of Nuclear Material and the Amendment (9/2012)
 - Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (10/2013)

1.5. International Cooperation (2)

- Viet Nam is Member State of the IAEA, RCA, FNCA;
- Viet Nam signed Inter-Government Agreements (IGA) for cooperation on peaceful uses of nuclear energy with India (1986), Korea (1996), China (2000), Argentina (2001), Russian Federation (2002), France (2009), Japan (2011), and the USA (2014).
- Regarding Ninh Thuan 1 & 2 NPPs Projects, two IGAs were signed:
 - IGA between Viet Nam and Russia on Cooperation in Construction of NPP in the Territory of Viet Nam (Oct. 2010);
 - IGA between Viet Nam and Japan on Cooperation in Construction of Ninh Thuan 2 NPP Project in the Socialist Republic of Viet Nam (Oct. 2011).

1.5. International Cooperation (3)

- Many crucial and sensitive issues related to nuclear fuel cycle have been included in the bilateral cooperation agreements between Viet Nam and foreign countries, for instance:
 - Assurance of supply of nuclear fuel for the whole life of the nuclear power plants;
 - Cooperation in radioactive waste and spent nuclear fuel management;
 - Assist Viet Nam in safe and secure management, storage, transport, and disposition of irradiated special fissionable material produced through the use of material or equipment transferred pursuant to the agreement.

2. Plan for Nuclear Power Development

2.1. Ninh Thuan Nuclear Power Project

- Viet Nam's national commitment to a nuclear power programme was formalized by the Resolution No. 41/2009/QH12, dated 25 November 2009 of the National Assembly on the policy for investment to the Ninh Thuan Nuclear Power Project, which includes two 2-unit plants: Ninh Thuan 1 and Ninh Thuan 2 with two different vendors (Russia and Japan)
- Start of construction and operation of Viet Nam's first NPP has been postponed by several years as a result of a more realistic evaluation of the time needed to build the infrastructure to support the projects.
- At present, Viet Nam is focusing on completing the evaluation and appraisal of the Site Approval Dossiers (SAD), Feasibility Study (FS) Reports, Technical Designs, as well as prepare the Engineering Procurement Construction (EPC) Contract.

2.2. Master Plan No. 7

- *Master Plans for National Electricity Development in the period 2011-2020 with vision to 2030* (called the Master Plan No. 7) was issued by a Prime Minister's Decision No. 1208/QD-TTg, dated 21 July 2011
- According to the Master Plan no. 7, the first nuclear power unit will be operated in 2020. By 2030, nuclear power capacity will be increased to 10,700 MW (7.8%) and total nuclear power generation reached 74.4 TWh (10.7%). However, this plan has not been able to conduct as scheduled.
- At present, the Master Plan No. 7 is being adjusted with projection that national electricity demand up to 2030 will be decreased and lower than previous projection. It is expected that four first units of Ninh Thuan 1 & 2 NPPs (two units each) will be put into operation during period 2027-2030 instead of 2020-2024.

2.3. Vision on National Prospects for NE Size and Growth

		Time frames		
		2016-2035	2036-2055	2056-2100
Is the information provided (a) an official plan or (b) a scenario study or expert opinion		(a)	(b)	(b)
Nuclear energy growth taking into account decommissioning	Decreasing			
	Stabilization including replacement of units			
	Small growth (below 0.1 GWe/year)			
	Medium growth (between 0.1 and 0.5 GWe/year)	X	X	X
	Significant growth (>0.5 GWe/year)			
Nuclear energy size	Small (0-10 GWe)	X		
	Medium (10-50 GWe)		X	X
	Large(>50 GWe)			

3. Challenges to Sustainable NES Development

3. Challenges to Sustainable NES Development (1)

- Nuclear energy contributes to meeting the Viet Nam's Millennium Development Goals (MDGs). But first, Viet Nam's NES must be sustainably developed. This is a prerequisite requirement.
- Sustainability of Viet Nam's NES is considered and evaluated in the seven specific subject areas developed by the INPRO, including economics, infrastructure, waste management, proliferation resistance, physical protection , environment, and safety.
- However, the public and policy makers now are deeply concerned about **safety, economics, and nuclear fuel cycle (including nuclear fuel supply, radioactive waste and spent nuclear fuel management)**.

3. Challenges to Sustainable NES Development (2)

- Especially, radioactive waste and spent nuclear fuel management is being considered as potential burdens for the future generations and became one of the biggest challenges to sustainable NES development. This situation is caused by the current problems that nuclear power community is facing, in general, and concrete conditions and resources of Viet Nam, in particular.
- In order for sustainable NES development, the Government of Viet Nam has paid special attention and supported for national nuclear power infrastructure development, including formulation of National Policy for Nuclear Fuel Cycle, which is going to be submitted to the Prime Minister for approval.

4. Some Main Issues on National Policy for Nuclear Fuel Cycle

4.1. Viewpoint and Objectives

- The policy is consistent with the requirements of the national legislative system, relevant international principles, and all international agreements to which Viet Nam is signatory.
- This policy is implemented to achieve the following objectives:
 - To establish a according nuclear fuel cycle ensuring fuel supplies for nuclear power plants in Viet Nam;
 - To achieve and maintain the high level of safety and security in radioactive waste and spent nuclear fuel management;
 - To ensure transparency in the activities related to the nuclear fuel cycle, radioactive waste and spent nuclear fuel management;
 - To develop infrastructure and prepare the necessary resources for activities related to the nuclear fuel cycle, radioactive waste and nuclear fuel management .

4.2. Nuclear Fuel for NPPs

- Viet Nam intends to rely on existing international markets for NF services, rather than acquiring sensitive nuclear technologies, as a solution for peaceful, safe, and secure uses of nuclear energy.
- In the beginning stage, the supply of nuclear fuel for NPPs shall rely on the international nuclear fuel supply markets, through bilateral agreements signed with nuclear power plant suppliers or other countries/ organisations that manufacture and export nuclear fuel.
- In the long term, Viet Nam implements a programme for localization of fabrication of nuclear fuel from imported enriched uranium. The establishment of nuclear fuel fabrication facilities shall be decided on the basis of evaluation of the national capacities on science, technology and industry, the international situation, especially the economics and other associated benefits.

4.3. Management of SNF

- Spent nuclear fuel discharged from nuclear power plants shall be wet stored in the reactor building for a specific period, then transferred to long term dry storage at the site of NPP (on-site) or at a national interim storage facility (off-site).
- In the course of implementing the nuclear power program, based on the level of development of nuclear science and technology in the world and international agreements, Viet Nam will consider, evaluate and decide to apply options and solutions appropriate to safe management of spent nuclear fuel, including: long-term surface storage at a separate facility; geological disposal; or repatriation to original countries for recycling or final disposal.

4.4. International Cooperation

- Viet Nam attaches great importance to cooperation with the IAEA, the international organizations and foreign countries on the nuclear fuel cycle, radioactive waste and spent nuclear fuel management to develop the infrastructure and ensuring safety and security for the related activities.
- Viet Nam implements the international nuclear instruments in a responsible manner; and supports initiatives, agreements, and projects on nuclear fuel cycle, radioactive waste and nuclear fuel management at both international and regional levels.
- The Government provides favorable legal conditions and resources necessary to establishment and implementation of multilateral and bilateral cooperation in this field.

4.5. National Prospects for NES Collaboration Strategy

		Current	2016-2035	2036-2055	2056-2100	
NES collabora tion strategy	NES Function	Reliance on (1) National indigenous technology development, (2) Single bilateral agreement, (3) Multi-lateral agreement, (4) Multiple bilateral agreements/ Multiple suppliers providing				
	Obtain/produce Uranium					
	Convert/enrich uranium			(2), (4)	(2), (4)	
	Fabricate/ obtain fuel		(2)	(2), (4)	(2), (4)	
	Produce Energy	NPP design		(2)	(2)	(4)
		NPP operation		(1)	(1)	(1)
	Store SNF		(1)	(1), (2)	(1), (2), (4)	
	Reprocess SNF			(2), (4)	(2), (4)	
	Dispose HLW/SNF			(2), (3)	(2), (3)	

4.6. Technology Options of Interest to Viet Nam

- Viet Nam is a newcomer embarking to nuclear power. Therefore, at present, Viet Nam is mainly interested in the *Option A: Once-through Fuel Cycle*.
- In addition, in view of long-term sustainable NES development, Viet Nam should be also interested in the *Option C. Partial Recycling of Used Fuel*; and the *Option F: Final Geological Disposal of All Nuclear Waste*.
- For Viet Nam, the Options C and F are strongly depended on the technology development in the world and will be implemented via the international cooperation agreements, including bilateral and multilateral agreements.

5. Conclusions

5. Conclusions (1)

- For Viet Nam, Roadmap for a Transition to Globally Sustainable Nuclear Energy Systems is policy-oriented, which will provide a strategic development orientation that supports the Government in making decision of the important issues related to sustainable NES development.
- For enhanced sustainability for NES, the option based on advanced fuel cycle plays a vital role.
- In order to have effective long-term solutions for radioactive waste and spent nuclear fuel management, the implementation of NES collaboration strategy is very necessary.

5. Conclusions (2)

- Together with enhancement of bilateral cooperation, Viet Nam supports multilateral approaches to the back end of the nuclear fuel cycle, including sharing knowledge or R&D activities; collaborating in HRD; developing and sharing facilities; and assisting reprocessing SNF...
- Roadmaps for a transition to Globally Sustainable Nuclear Energy Systems should be based on the robust cooperative mechanism between vendors and users. This mechanism will be able to harmonize benefits and mobilize every efforts of all relevant stakeholders for a common target of long-term sustainability of nuclear energy system.

Thank you for your attention