

The Implications of Developing a Philippine Nuclear Energy Program

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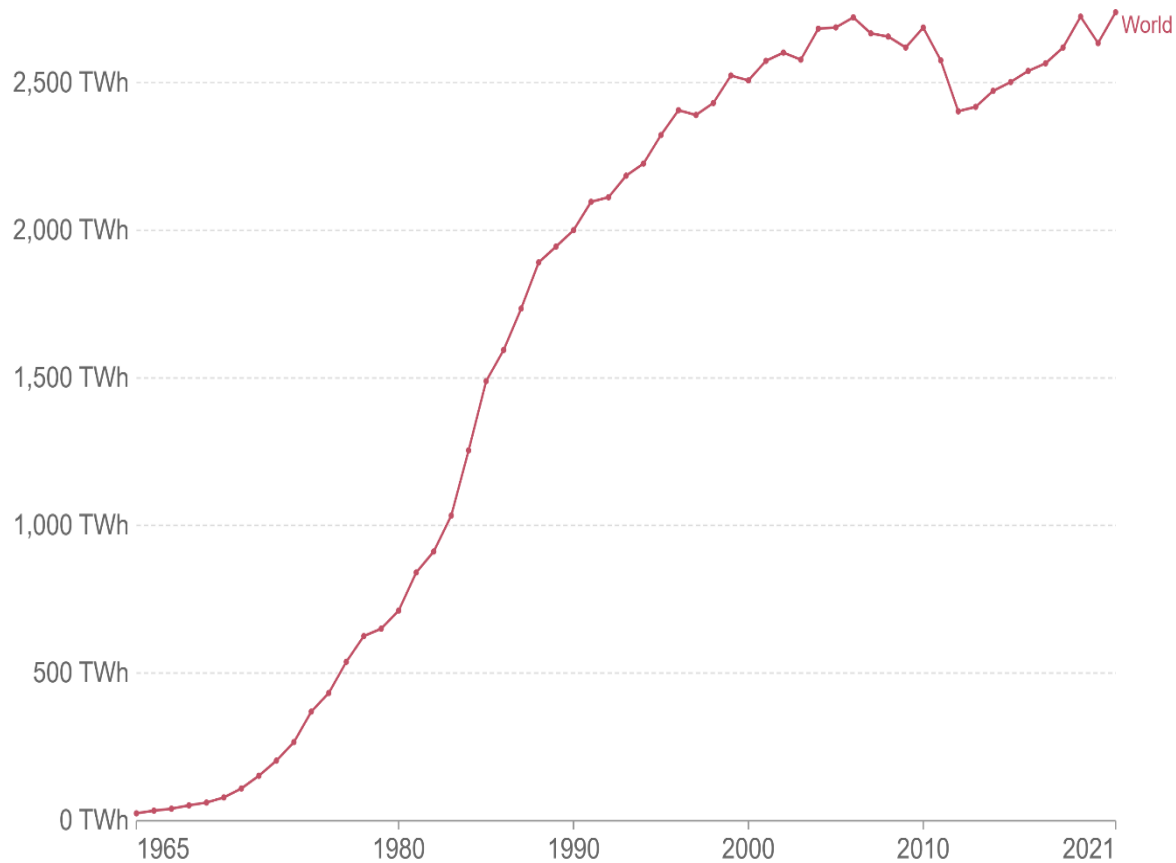


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Surian sa mga Pag-aaral Pangkaunlaran ng Pilipinas

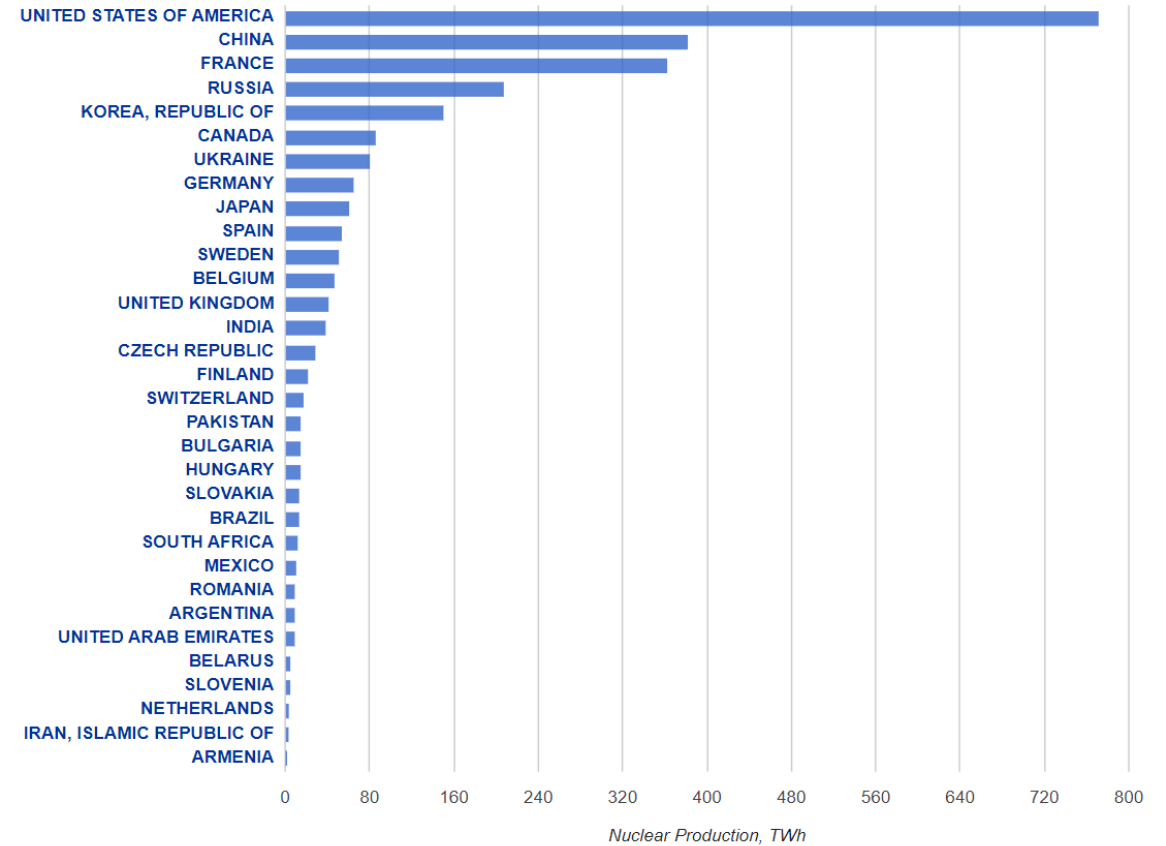
International experience in nuclear energy development

Figure 1. Nuclear power generation in the world, 1965-2021 (in TWh)



Note: TWh – Terawatt-hour.
Source: Our World in Data (2022).

Figure 2. Nuclear Energy-Producing Countries, 2021 (in TWh)



Source: International Atomic Energy Agency (2022).

International experience in nuclear energy development

Figure 3. Permanent Shutdown Reactors (by country), 2022

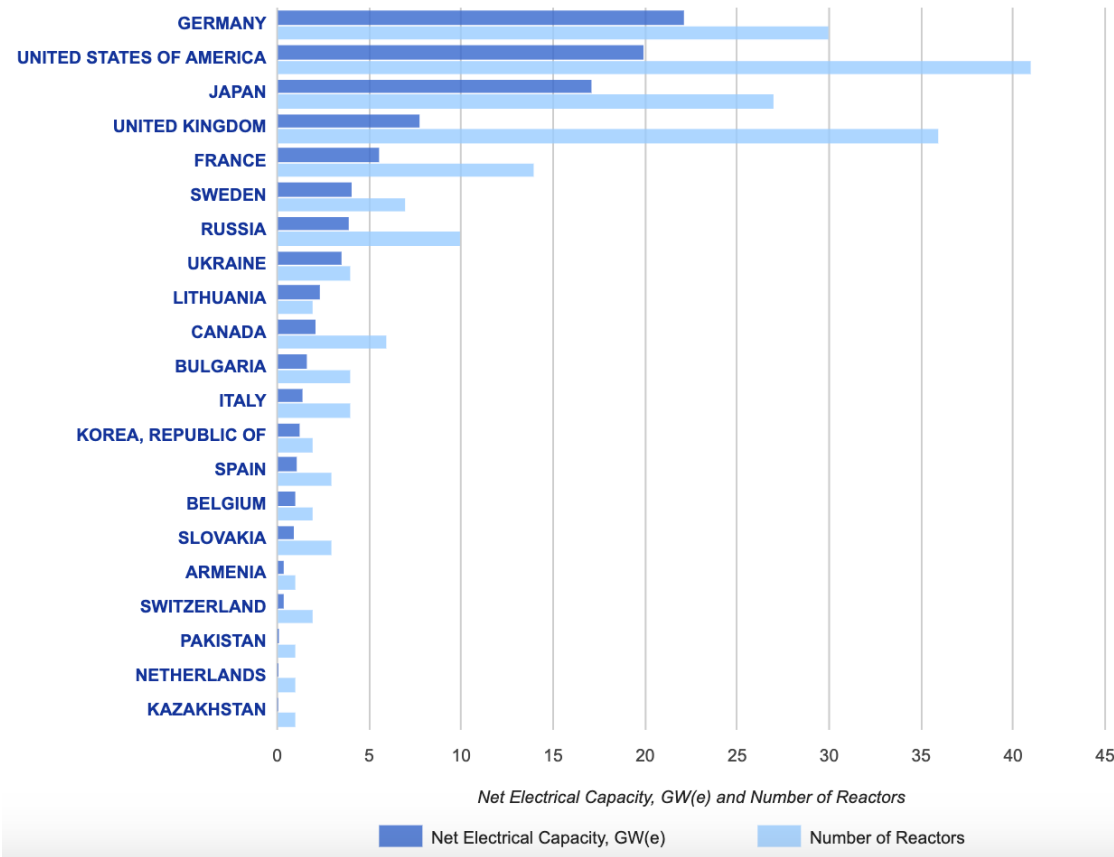
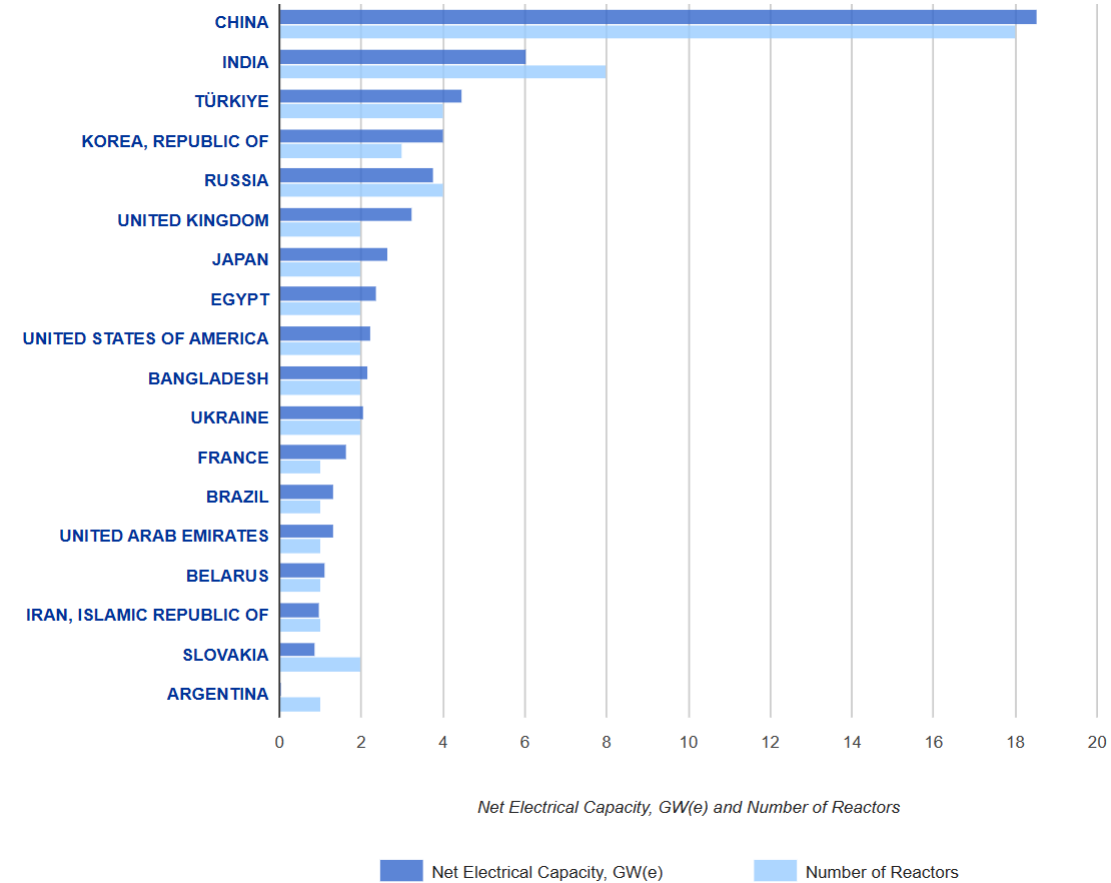


Figure 4. Under Construction Reactors (by country) in 2022



Note: Above figure and data generated by the Power Reactor Information System (PRIS) database. Last update on December 16, 2022. GW(e) means gigawatts of electricity.

Source: International Atomic Energy Agency (2022).

Interesting cases

Phaseout then turnaround in Germany, France and Japan

Germany – The phaseout has a long history, beginning with anti-nuclear movements in the 1970s; the complete phaseout, however, was delayed by the unprecedented energy crisis caused by Russia's invasion of Ukraine

France - France legislated in 2015 a nuclear energy share reduction, then backtracked in 2017 because it would endanger the country's security of supply

Japan - After the Fukushima accident in 2011, Japan switched off its 50 nuclear power reactors. In 2014, started operating the reactors again. At present, it is constructing two additional reactors.

Nuclear energy ambition in Indonesia and Vietnam

Indonesia - Its nuclear ambition suffered from policy reversals: 1997 nuclear energy law, 2015 halt in plans in favor of renewable energy, 2021 reversal given the announcement on deploying nuclear power by 2045

Vietnam - Abandoned its plan in 2016 because power demand turned out to be low; experts say that nuclear energy is still an option given the long-term power demand

Recent progress in Bangladesh

Bangladesh – The plan for the Roopur Nuclear Power Plant was crafted in 1961 prior to independence; revived after independence in 1974. IAEA rendered technical assistance in 2011. Roopur 1 started construction in 2017 and might be operational by 2023/24, Roopur 2 started construction in 2018 and might be operational by 2024/25

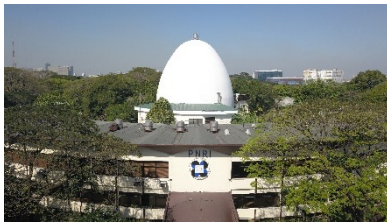
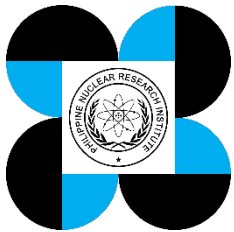
The continuing debate on the pros and cons of nuclear energy

- Nuclear power plants are considered the most reliable energy source of an electric power system because they can run 24 hours a day in all days of the year and are designed to refuel only every 1.5 to 2 years. Even though capital cost is initially high, the operating cost per kWh is very small given the low fuel cost. Given this reliability and low operating cost, nuclear energy has fueled the prosperity of many countries since the 1960s.
- A development that tempers environmentalists' opposition to nuclear energy is the increasing recognition that it can play a large role in quickly achieving climate targets.
- But issues in the utilization of nuclear energy remain, such as safety, economics, radioactive waste disposal, and nuclear weapons proliferation.
 - Note: Although the world's first permanent nuclear waste disposal site is being built under the bedrock of Olkiluto Island in Finland, operation will still be in 2024 or 2025.
- Hidden subsidies in many parts of the nuclear fuel cycle are also a large concern, especially for less developed countries, e.g., explicit purchase mandates for nuclear power, subsidies to various primary factors of production, subsidies to intermediate inputs, subsidies for security and risk management during operation, and decommissioning subsidies.

History of exploring the nuclear energy option for power generation in the Philippines

Creation of the
Philippine Atomic
Energy Commission

1958

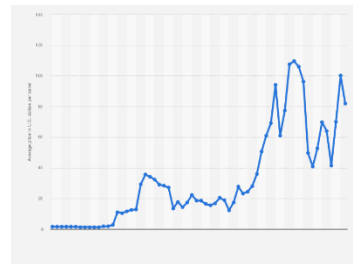


1960s

First nuclear reactor
for research
purposes was built.

Global oil crisis

1970s

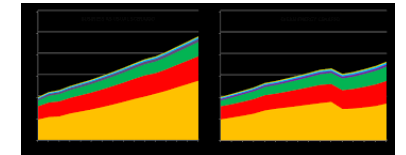
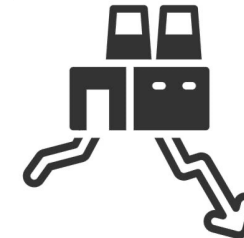


1976-1984

Construction of the
Bataan Nuclear
Power Plant (BNPP)

Plant mothballed

1986



1998

Nuclear energy as a
long-term option in
the PEP 1998-2035

History of exploring the nuclear energy option for power generation in the Philippines

Mission review by
the IAEA

2008



2010

KEPCO – BNPP
rehabilitation at
PHP 1 billion

Fukushima incident

2011



2015

Inclusion of nuclear in
the energy mix in
Ambisyon Natin 2040

Continued mission
reviews with the IAEA

2016-present



The Bataan Nuclear Power Plant case

Two conflicting IAEA reports after completion, delivered only months apart made the Corazon Aquino (Aquino I) cabinet cautious: **1984** report cited **plumbing problems**; **1985** report concluded that **all problems had been solved**. The Chernobyl nuclear accident happened in 1986, and the Aquino I cabinet voted to mothball the BNPP due to lingering safety concerns.

When the economic realities of costly maintenance and need for electric power set in, the Aquino I government attempted to settle with Westinghouse on addressing the safety issues and operating the power plant. Eventually, a **compromise** was reached in **March 1992** (Beaver 1994).

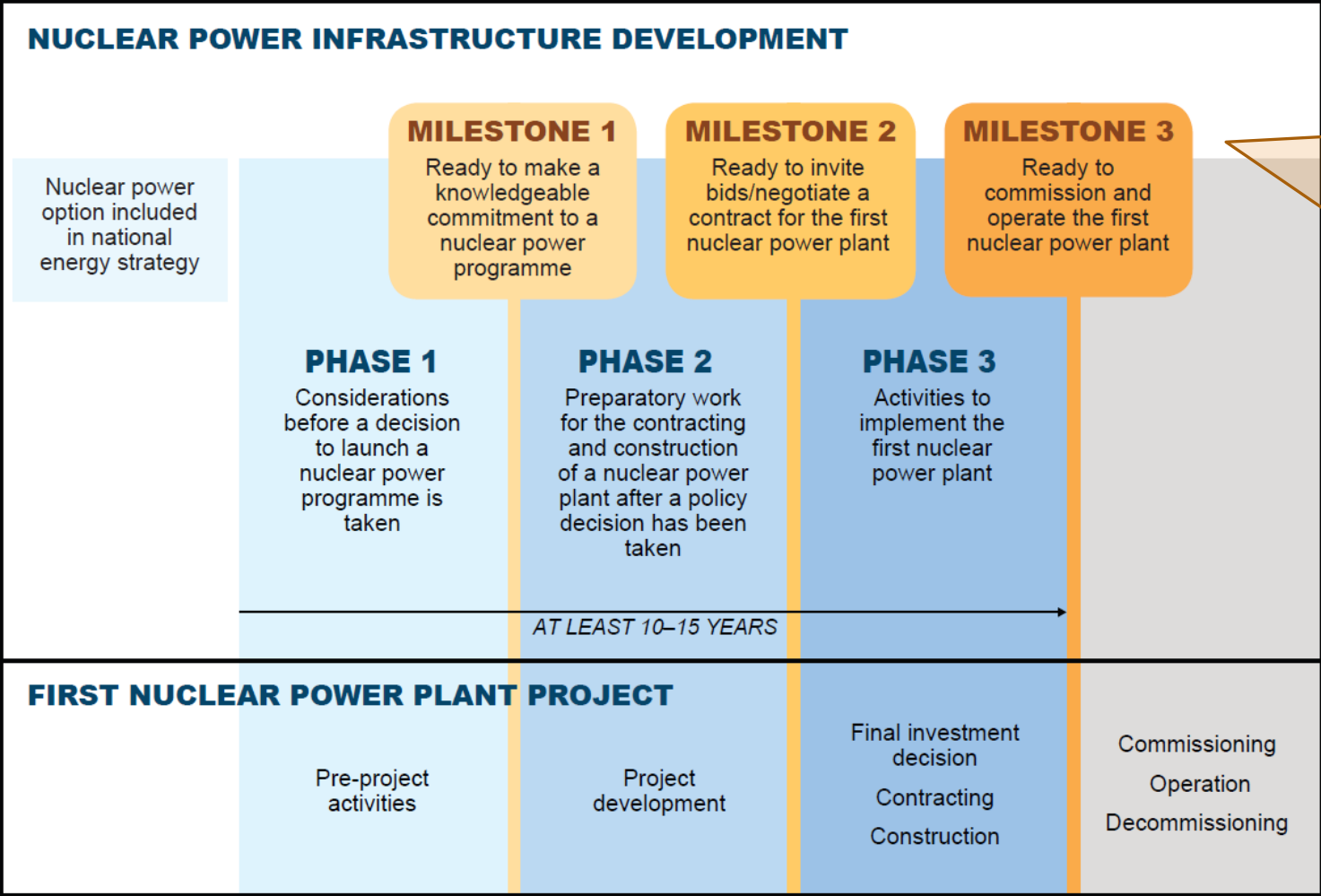
The Ramos administration decided to **renegotiate** for better terms in the compromise agreement but negotiations broke down (Branigin 1992). The Ramos administration **resumed the legal action** before the US federal court, but the jury acquitted Westinghouse in May 1993. Then the government filed an appeal, which was ultimately turned down by the court (Albor 1993).

At present, the **National Power Corporation (NPC)** continue to **maintain** the mothballed power plant.

In response to the Duterte administration's query, Russia suggested that the **Bataan plant** can be made **operational with \$3 billion to \$4 billion** in repairs (Maulia and Venzon 2020).

Assessing the requirements for developing a Philippine nuclear energy program

Figure 5. Schematic diagram of the phases and milestones in nuclear power infrastructure development



Note that the same Milestones Approach will have to be followed even under the modular reactor (SMR) technology option

Source: IAEA (2015).

Assessing the requirements for developing a Philippine nuclear energy program

19 Infrastructure Issues that must be considered during Phase 1 of the IAEA Milestones Approach



Source: IAEA (2015).

Phase 1 Integrated Nuclear Infrastructure Review (INIR) Mission in 2018 yielded recommendations and suggestions on the 19 infrastructure issues.

But progress in addressing the recommendations and suggestions in the INIR report is quite slow, except for the establishment of the nuclear energy program implementing organization (NEPIO).

Summary of the Phase 1 INIR Mission Results

1. National Position

Recommendations: Expansion of the DOE-NEPIO to enhance nuclear power program coordination. The NEPIO to implement the work proposed in an EO (EO 116, s. 2020) to define a national strategy for the Nuclear Power Program.

Suggestion: The NEPIO is encouraged to finalize the consultations on the EO to achieve consensus on the way forward.

2. Nuclear Safety

Suggestion: The NEPIO is encouraged to continue developing its own and all relevant stakeholders' understanding of nuclear safety.

3. Management

Suggestions: The NEPIO is encouraged to implement a leadership development program to ensure that future leaders in key organizations gain the experience needed for a successful nuclear power program. The NEPIO is encouraged to gain awareness of approaches to promote safety and security culture in the key organizations of the nuclear power program and to plan relevant activities at the appropriate time.

4. Funding and Financing

Recommendation: The NEPIO should review the viability of various financing options for a nuclear power project in the Philippines and identify any need for changes in the current legal framework.

Suggestions: The NEPIO is encouraged to develop a multi-year assessment of the costs of nuclear power development activities. The Philippines is encouraged to further consider arrangements to ensure the availability of adequate funds for radioactive waste management and commissioning.

Summary of the Phase 1 INIR Mission Results

5. Legal Framework

Recommendations: The Philippines should further review some aspects of the current bills and ensure that its legislative plans include all necessary provisions of a comprehensive national nuclear law. The Philippines should complete an analysis of laws that may affect the nuclear power program and plan for their enactment or amendment as appropriate.

Suggestions: The Philippines is encouraged to complete the legislative approval process of the Convention on Nuclear Safety, and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. The Philippines is encouraged to carry out an analysis and develop a plan to pursue legislative approval of the Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage, the Convention on Supplementary Compensation and the Joint Protocol relating to the Application of the Vienna Convention and the Paris Convention.

6. Safeguards

No recommendation/suggestion at present.

7. Regulatory Framework

Recommendations: The NEPIO should review the proposed structure and staffing requirements for the future regulatory body and develop a plan for the development of needed regulations.

Suggestion: The PNRI is encouraged to identify regulators and organizations that can provide external support to PNRI or the future Philippine Nuclear Regulatory Commission (PNRC)

8. Radiation Protection

Suggestion: Continue assessing and planning for enhancements to radiation protection programs

9. Electrical Grid

Recommendation: Conduct a preliminary study of the grid system covering reliability and compatibility.

10. Human Resource Development

Recommendation: Outline plans for human resource development for each key organization.

Summary of the Phase 1 INIR Mission Results

11. Stakeholder Involvement

Suggestion: Further develop outreach activities and materials.

12. Emergency Planning

Recommendation: Assess existing arrangements against the requirements for a nuclear power program.

Suggestion: Ensure consistency between the comprehensive nuclear law and the National Radiological Emergency Preparedness and Response Plan.

13. Environmental Protection

No recommendation/suggestion at present.

14. Sites and Supporting Facilities

No recommendation/suggestion at present.

15. Nuclear Security

Suggestion: Review and adopt national coordination mechanisms for nuclear security.

16. Nuclear Fuel Cycle

Recommendation: Further assess options for the nuclear fuel cycle, including supply of fuel and management of spent fuel.

17. Radioactive Waste Management

Recommendation: Perform a preliminary evaluation of the amounts and types of radioactive waste generated by a nuclear power plant and consider options for their management. Consider disposal options for radioactive waste, from operation to decommissioning.

18. Industrial Involvement

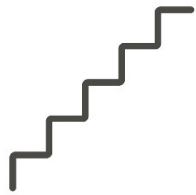
Recommendation: Seek further information from local industries and technology providers and develop a national policy for industrial involvement

19. Procurement

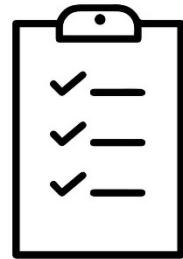
No recommendation/suggestion at present.

Conclusion and ways forward

Nuclear energy remains a promising option, but the Philippines must be ready for a long-term commitment, one that considers a time frame of 100 years, from construction to decommissioning and waste disposal or storage.



Consistently follow the IAEA's Milestones Approach.



Set a new timetable for the Phase 1 requirements.



Ratify the international legal instruments.



Enact a comprehensive Philippine nuclear regulation law.



Be guided by project economics in deciding on the BNPP rehabilitation.



Communicate the nuclear energy strategy well to the public.

- 1994 Convention on Nuclear Safety
- 1998 Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
- 1998 Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage Philippines
- 1998 Convention on the Supplementary Compensation for Nuclear Damage
- 1998 Joint Protocol Relating to the Application of Vienna Convention and Paris Convention

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