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Nuclear Power Programme Development NEPIO

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NUCLEAR POWER PROGRAMME DEVELOPMENT NEPIO

A. INTRODUCTION

1. General Description

Poweria is a developing country. Certain sectors of its economy are moderately advanced and have a supporting technological infrastructure. Poweria is located on the seacoast and has a warm climate with good agricultural conditions. The country has a narrow, flat coastal plain, which extends inland approximately 50 km, where there is a row of hills which rise to an interior plateau (a 'piedmont') at an average elevation of about 300 to 500 meters. The interior boundary of the country is defined by a rugged, high mountain range, and is about 500 km inland from the sea. The coast line of the country is about 500 km in length, so the overall shape of the country is roughly rectangular. Several rivers rise in the interior mountains, feed large lakes in the interior plateau and drain through the coastal plain to the sea. The interior plateau and the mountains are known to be a seismically active area, although specific data are scarce.

The population of Poweria is about 45 million. About one-third of the population lives in cities located on the coastal plain. The cities and coastal plain, while crowded, have generally adequate public services, rail and road transportation. Electrical power is limited and often unreliable, which has limited the growth of tourism and the high-tech, financial and service industries that the government would like to develop to augment the current agriculture- and resource-based economy.

The remainder of the population lives in towns, villages and farms on the interior plateau, which is much more rural in character. It is here that the agriculture, mining and oil and gas industries that are the principal basis of the country's economy are located. Central-station electricity is very limited in availability and unreliable when it is available, because most of it comes from the coastal plain through long transmission lines. Limited rail and road transportation is available, but is mostly used for transport of agricultural products and minerals from the mines.

2. Government

Poweria is a republic, with a parliamentary form of government. The country has enjoyed several decades of political stability and peaceful transitions of power from one government to another. It is a multi-party state, with two dominant parties, and numerous smaller parties that usually have a role in a coalition government. Elections, while often contentious, are considered to be fair and honest by international observers.

The President of the Republic is Chief of State, but has little real political power. However, the current President is a highly popular and respected figure who exerts considerable influence and moral authority with the people. He must leave office in 2013, due to Constitutional term limitations. The Prime Minister, the Head of the Government, holds the real power to govern. His party holds a comfortable, but not absolute, majority in the

Parliament, so the Government is reasonably responsive to pressure from minority parties, many of which represent the interior of the country.

The Government consists of a number of ministries. In the current context, the most important are the Ministries of Foreign Affairs, Energy, Finance, Industry, Science and Technology and Health. A National Regulatory Authority, part of the Ministry of Science and Technology, has the responsibility for licensing and regulating the use of radioactive sources and radiation-producing machines. Regulation of the electrical power industry is the responsibility of the Electrical Regulatory Authority (ERA), part of the Ministry of Industry. An Environmental Protection Authority, part of the Ministry of Health, is responsible for regulation of such things as land and water use, releases of pollutants on land and into the air and water, and pollution abatement.

Poweria is a Member State of the IAEA and a recipient of Technical Cooperation assistance, primarily in Nuclear Applications. It is expected that up to USD 1 million in Technical Cooperation funds can be applied to TC Projects supporting nuclear power. Even though it does not now possess any nuclear material, it has signed and ratified the Non-Proliferation Treaty and a Comprehensive Safeguards Agreement is in place. It possesses and uses numerous radioisotope sources used in the mining and oil industries, and in medical applications, so it has also signed and ratified the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

3. Economy

The economy of Poweria is primarily based on agriculture, mining of coal and various minerals, oil and gas extraction (sufficient for domestic needs and some export), and manufacturing of small and medium industrial goods, most of which are used to support the domestic industries. There is no heavy industry in the country, and such products must be imported. The country is self-sufficient in food and basic goods, and has sufficient income from exports to support expansion of its infrastructure and improve public services.

A principal goal of the government is to diversify the economy by introducing high-tech industries, a financial services sector and increased tourism in the cities of the coastal plain. Realization of this goal has been limited by the unreliable electrical power in the cities. In addition, the population and industries of the interior plateau have exerted heavy pressure on the government to improve the availability and reliability of electricity in the region. Thus, improvements in the electrical sector have a high priority in the government's economic planning. It is projected that the equivalent of 1 billion USD/year will be available for expansion of the electrical power sector. Loans and/or credits from outside the country will be needed to raise additional funds.

Electrical power in Poweria is generated by assets owned by GEN-ELEC, a government-owned corporation. Another government-owned corporation, TRANSCON, owns, operates and maintains the national electrical grid. Local distribution is handled by local companies or cooperatives. Rates are regulated by the ERA, but are generally high enough that the cost, along with unreliable supply, is a significant deterrent to economic growth in some energy intensive industries.

Poweria's electric power sector is characterized by insufficient generating capacity, unreliable long-distance transmission lines, and high rates due to high fuel costs. The current (2010) installed capacity is 6000 MWe, 85% of which is fossil-fired stations, and the balance is hydroelectric and renewable sources. The fossil-fueled power stations are all situated along the coast, and their output is directed to the coastal cities. Several of these stations are old, inefficient and polluting. The hydroelectric assets are located in the hills below the piedmont and their output is limited by seasonal variations in the available water flow. Grid connections with neighbouring countries are very limited in capacity, but could be expanded. However, no neighbouring countries have excess generating capacity at this time, and are more likely to want power exports from Poweria than sales to Poweria.

Poweria's electrical generating system provides an average of about 30 TWh of energy per year, half of which is available to the cities, and half to the interior towns and villages. Thus, there is about 1000 kWh per capita available in the cities and about 500 kWh per capita in the rural areas. The government wishes to increase electrical production by a factor of three over a ten-year period, partly by improving the performance of the existing system and partly by increasing installed capacity. An increase in installed capacity of about 1 Gwe/year is projected for the decade through 2020. Most of this expansion will have to be in fossil-fired plants, nuclear plants or renewable sources. Possible expansion of hydroelectric output is very limited.

4. Education

Poweria has one major university having undergraduate and graduate programmes in agriculture, engineering (civil, mechanical, chemical, electrical, mining and petroleum) and earth sciences. Isotope and radiation applications are taught in the various technical curricula; a survey course in nuclear reactor technology is taught as part of a programme in energy engineering in the mechanical engineering department. The medical school teaches nuclear medicine, but advanced training in the specialty must be obtained abroad. The government of Poweria sends students abroad for advanced training in foreign universities, and sends participants to IAEA training events under its TC Projects.

Poweria also has two technical institutes that train technicians for the mining and oil industries, and for various positions in the medical community, including X-ray and nuclear medicine technicians.

5. The Nuclear Power Programme

While on a state visit to Oecdia, a developed country with which Poweria has long standing cultural, economic and political ties, the President of Poweria was shown a new nuclear power plant and briefed on the advantages of nuclear power. Oecdia's well-developed nuclear industry has built several 1000 Mwe-class nuclear power plants, and has a small modular reactor of about 250-300 Mwe/module under development. It is anxious to enter the export market with either of the reactor designs. The President, anxious to show progress towards improvement of Poweria's electricity problems before he leaves office in three years, has publically announced that nuclear power will be introduced at the earliest possible time, and has asked the Prime Minister to undertake a nuclear power programme designed to lead to

starting construction of a new nuclear power plant at the earliest possible date; if possible, before he leaves office.

Because of the popularity and influence of the President, the nuclear power programme has considerable popular support. Although he is sceptical of the feasibility of the schedule, recognizing that little or no groundwork has been laid for a nuclear power project, the Prime Minister has decided on an aggressive approach to the problem, involving the Government, the existing National Regulatory Authority, and the electricity generating company GEN-ELEC. He has taken the following actions:

- The Ministry of Energy has been charged with setting up a Nuclear Energy Programme Implementation Organization (NEPIO) called the Nuclear Power Authority (NPA). This group will coordinate the work of the Government and other entities. It has the responsibility of making a final recommendation to the Prime Minister on the feasibility and schedule of the nuclear power programme.
- The National Regulatory Authority is charged with developing a new, independent nuclear regulatory body which will have the current functions of the NRA, plus the responsibility for regulating the new nuclear power programme. The immediate mandate is to develop the legal framework, a regulatory approach, the regulatory framework, and the human resource strategy.
- The national electricity generating company, GEN-ELEC, has been asked to define a strategy and assess the schedule and costs of acquiring approximately 2000 Mwe of nuclear capacity over the next ten years, with the first increment to be commissioned at the earliest possible time. GEN-ELEC should also consider the available technologies and those under development and recommend whether Poweria should procure one or two large plants, or several smaller plants over a longer period of time.
- The national electricity generating company, GEN-ELEC, has been asked to define a strategy and implement siting activities. GEN-ELEC is therefore asked to determine siting options, considering the needs for power, site characteristics, transmission lines, transportation, and other relevant factors.

B. EXERCISE

1. Work to be Performed

The Prime Minister of Poweria has charged the Ministry of Energy with setting up a Nuclear Energy Programme Implementation Organization (NEPIO) called the Nuclear Power Authority (NPA). This group will coordinate the work of the Government and other entities. It has the responsibility of making a final recommendation to the Prime Minister on the feasibility and schedule of the nuclear power programme.

Your Team constitutes the NPA and you are requested, based on the scenario described including organizations described in Section 2, to initiate relevant action that would lead to build without any delay, the first NPP of POWERIA. The outcome of your work will help the

Government to make the final decision to go ahead with acquisition of one or more nuclear power plants and be ready to undertake the significant work necessary to build the nuclear power infrastructure and prepare for ordering the country's first nuclear power plant, should the decision be to proceed. With this purpose in mind, address the following points:

(1) Consider whether the decision of the President is a knowledgeable decision in the sense of the 'Milestone Approach' and sufficient to proceed with Phase 2 of the programme. If it is, justify the decision and consider the future role of the NPA in establishing the nuclear power infrastructure. If it is not, propose the main actions and activities to be implemented before a knowledgeable decision is taken.
(2) Assuming the President's announcement does not constitute a knowledgeable decision to proceed, identify the critical tasks to be conducted by the NPA in Phase 1.
(3) Consider the schedule for the critical task, keeping in mind the objective of the President to show substantial progress before leaving office.
(4) Identify the main stakeholders that should constitute the NPA in the initial phase.
(5) Propose NPA's organization and consider whether the NPA organization needs to be adjusted during the programme implementation.
(6) The NPA should identify critical workforce and competencies required for the Programme, and develop a strategy for acquiring the competencies.
(7) Propose an outline for a roadmap or action plan for nuclear power introduction with the different aspects to be considered and the plan for acquiring the NPPs, including a timeline.
(8) Identify potential challenging issues and risk that could hamper smooth implementation of the nuclear power programme.

2. Terminology & Assumptions

NPA	= Nuclear Power Authority (the NEPIO)
GEN-ELEC	= National Electricity Generating Company (Owner-Operator)
NRA	= National Regulatory Authority (to be renamed the Nuclear Regulatory Authority upon passage of suitable legislation)
ERA	= Electrical Regulatory Authority
EA	= Environmental and Land Management Authority
TRANSCO	= National Transmission Company
NGOs	= Non-Government Organizations (some pro- and some anti-nuclear)

2.1. Government's Responsibilities

The Government will be responsible for building the required NP infrastructure able to support and absorb the output from the countries' first NPPs and has delegated its coordinating responsibilities to NPA..

2.2. GEN-ELEC's Responsibilities in the NPP building

GEN-ELEC will be the Owner-Operator of the NPPs with the entire responsibility for procurement, construction, commissioning and operation of the NPPs to be built.

2.3. NRA's Responsibilities in regulating NPPs

The NPA in its role as the NEPIO should draft legislation that will establish the NRA as an independent nuclear regulator with the authority and resources to effectively regulate the NPPs. In accordance with IAEA Standards, the NRA should be responsible for:

- establishing and conduct a licensing process;
- developing regulations and guidance material;
- reviewing and assessing safety documentation;
- conducting inspections and enforcing its regulations;
- communicating with the public and other stakeholders; and
- coordinating off-site emergency preparedness and response.

The NPA should also initiate action, in cooperation with the Ministry of Foreign Affairs, to sign the Convention on Nuclear Safety and secure its prompt ratification.

The National Regulatory Authority, in its current role as the regulatory of sources and radiation-producing machines, has issued a set of documents, sufficient to cover current industrial and medical activities. The current staffs at NRA are well trained and experienced in radiation safety, emergency response, safety, security and control of sources, physical protection of sources, management of low-level radioactive waste, etc. It is not, however, experienced in nuclear and reactor safety.

2.4. EA's Responsibilities in regulating environmental, water and land issues

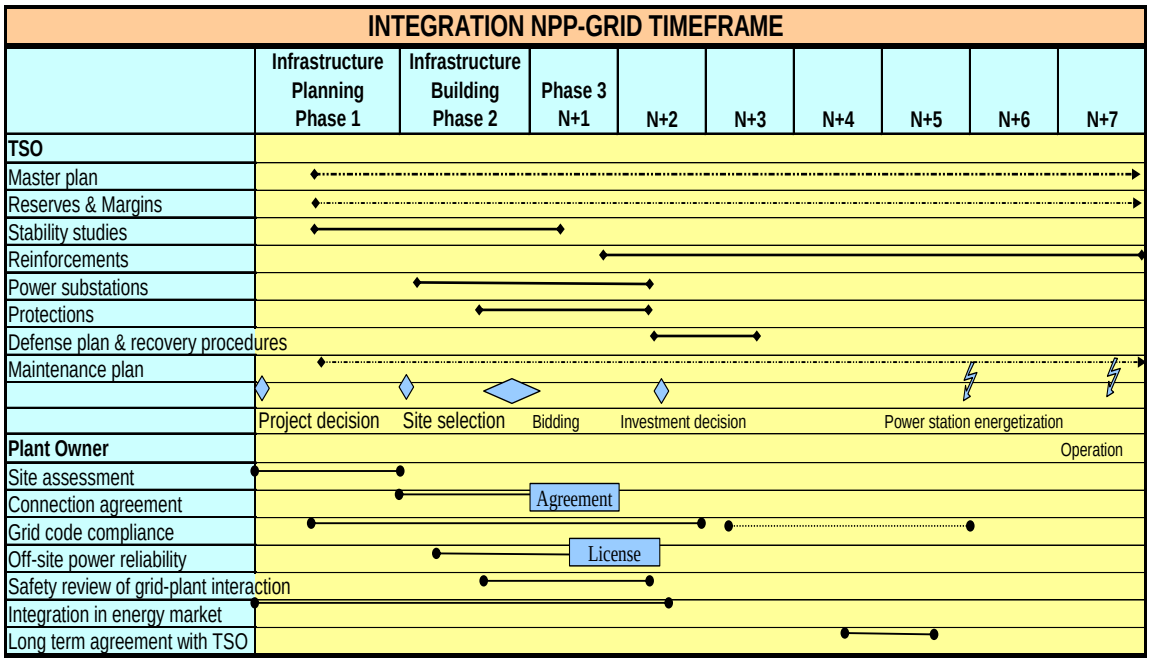
The EA is responsible for the permitting and licensing related to land acquisition, land use and water use. The EA sets environmental standards and reviews the environmental impact assessments produced by organizations wishing to undertake major projects. The EA is also responsible for managing the relevant environmental impact assessment discussions with communities and all stakeholders. For the NPP programme, the NPA or GEN-ELEC should prepare an environmental assessment for the candidate sites, submit it to the NRA for its approval, and then to the EA for final approval.

2.5. Management of the Grid

1. ***ERE's Responsibilities in regulating the Grid***
   ERE is established with the responsibility to regulate the electrical sector and the grid.

2. ***TRANSCO's Responsibilities in managing the Grid***
   TRANSCO is fully established with the responsibility to manage the electrical grid and ensure the transport of electricity.

3. ***Integration NPP - Grid plans***
   The current grid is not able to absorb the three-fold expansion of the electrical generating capacity projected by 2020. It is therefore necessary that the following activities are implemented by ERE and TRANSCO:



The NPA should coordinate with these entities to ensure that sufficient progress is made.

2.6. Technical Support for NP Activities

Several local organizations have started to develop programmes to provide technical support to NPA, GEN-ELEC, ERE, TRANSCO and NRA. These local organizations include the university and technical institutes and contract research centres currently serving the oil and mining industries. Their scope of assistance includes research, education and training in most of the required field of activities.

2.7. Contracting Approaches

Typical lead responsibilities for the different contractual approaches are presented in the Table.

Typical lead responsibilities for different contract types

Activity	Contract types		
	Turnkey	Split package	Multiple package
Pre-project activities	U	U	U
Project management	MC	AE or U	U + AE
Project engineering	MC	AE or U + SS	U or AE
Quality assurance / Quality control	MC + U	AE + SS + U	U + AE
Procurement	MC	AE or U + SS	U or AE
Application for license	U	U	U
Licensing	RA	RA	RA
Safeguard, physical protection	U	U	U
Manufacturing	MC	SS + EM	EM
Site preparation	U or MC	U or AE	U or AE
Erection	MC	AE + SS	U or AE
Equipment installation	MC	AE + SS	U or AE
Commissioning	MC	AE + U	U or AE
Plant operation and maintenance	U	U	U

Fuel procurement	U	U	U
Fuel fabrication	FS	FS	FS
Waste management	U	U	U

Symbols:
AE: Architect engineer
EM: Equipment manufacture
FS: Fuel supplier
MC: Main contractor
RA: Regulatory authority
SS: System supplier
U: Utility

The selection of the type of contract is one of the basic decisions to be taken concerning the construction of nuclear power plants. It should, therefore, receive great attention and be based on a careful analysis of all aspects. These aspects include:

- Potential vendors and their particular experiences and attributes
- Standardization and proven quality
- Government and industrial relationships
- Competitive and economic considerations
- Foreign financing possibilities
- Guarantee and liability considerations
- Planning and implementation of the project and subsequent projects
- Availability of qualified project management, co-ordinating and engineering manpower
- Development of national engineering and industry capability
- Owner experience in handling large projects.