

Sustainable Development: The Role of Nuclear Power in Brazil

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I will not be overambitious to talk on the role nuclear power could play in developing countries in general. Instead, I will talk about nuclear power in Brazil and its past and future role for a sustainable electricity supply. I will then suggest some general guidelines based on our experience in implementing nuclear power in Brazil, experience which could be of some help for those countries initiating a nuclear power programme. First let me give you some information on energy needs, Brazil and its power programme. Energy, particularly electricity, is essential to economic and social development and improved quality of life. Electricity demand continues to grow worldwide, particularly in OECD countries, notwithstanding the considerable efforts for efficiency improvements and energy savings. In Brazil, electricity demand has been growing during the last 30 years, much faster than primary energy and the economy (gross domestic product), and this is expected to continue well into the future. With an area of about 8.5 million km², more than twice that of Western Europe, and occupying over half the South American Continent, Brazil is the fifth largest country in the world. With a GDP of over US\$ 810 billion, Brazil is also one of the ten largest economies of the world. The Brazilian population is some 162 million. The Brazilian power system, with a total installed capacity of over 61,000 MW is also among the ten largest of the world. However, due to large regional economic differences and development patterns the average electricity per capita consumption in the country is only about 1,900 kWh/inh, below the world average and well below those of developed countries. In some parts of the country there are suppressed electricity demand and part of the population is still not served with electricity. A strong plan for electricity development in the country is one of the main tools which is used by the government to decrease large regional differences. A peculiarity of the generating structure is that some 95% is hydropower due to substantial indigenous resources. As hydro resources around the most developed regions of the country are practically exhausted, and some 50% of the remaining potential still to be used is located in the distant Amazon area, an increasing thermal programme will have to be implemented in the country. Although modest in the short term, nuclear power is viewed as an essential part of this development plan. With one unit in operation (Angra 1, 657 MW), nuclear power accounts for about 1% of the total installed capacity and electricity generation in the country. This nuclear plant is very important for the local supply in the state of Rio de Janeiro, which is the second most important state in the country in terms of GDP formation. Angra 1 accounts for about 30% of local generation and is responsible for supplying some 15% of the state needs and plays a fundamental role regarding the stability of the interconnected power grid, as a whole. As a matter of fact, ELETRONUCLEAR, the utility owner and operator of Angra 1, is already the second largest electricity producer in the State of Rio de Janeiro. With the second ELETRONUCLEAR nuclear unit, which will start operation by early 2000 (Angra 2, 1309 MW), nuclear contribution will increase considerably, and the company will be the largest electricity utility in the state, both in terms of installed capacity and electricity generation. With the third unit (Angra 3, 1309 MW), which according to the present ten-year plan, should start operation by late 2005, ELETRONUCLEAR will have a production capability of about that of the present CEMIG power utility, in Minas Gerais, with 38 hydro units, which supplies an area of the same size of

France. The Angra nuclear power plant is situated in the load center of the main developed region of the country, some 130 km from Rio de Janeiro, 220 km from São Paulo and 350 km from Belo Horizonte. Due to intensive international co-operation, in which IAEA has an important contribution, Brazil has now the know-how to design, build and operate the nuclear plants and its uranium reserves are the sixth largest in the entire world. The country also has the technology for fuel production. Uranium prospecting has been carried out in only about one third of the country, thus, these reserves could increase substantially. The present reserves (about 300,000 t in situ) are enough to fuel about 30 large PWR nuclear power plants of the size of Angra 2, during 30 years of operation. Improvements in uranium extraction technologies and increase of fuel use efficiency will increase substantially in the future allowing for a better use of natural resources (more kWh per natural uranium mined). Environmental issues are becoming important worldwide. By the beginning of next century, all forms of primary energy for electricity production will be needed if sustainable development is aimed at. In this context, governments, including those in developing countries, have the moral obligation to utilize those energy resources which lead to the lowest possible environment impacts. Nuclear energy is a form of energy which does not emit any greenhouse gas (Carbon dioxide, Methane, nitrous oxide and others) and any gas causing acid rain (Sulphur dioxide, Nitrogen oxides). It does not emit any carcinogenic, teratogenic and mutagenic metal (As, Hg, Pb, Cd etc), which some other alternatives do. The utilization of nuclear energy also does not release gases or particles that cause urban smog or depletion of the ozone layer. For all these reasons, nuclear power is considered important for a long-term sustainable energy supply and economic development in Brazil. In 1997 the nuclear power sector was strengthened to fulfill the long range targets of the government. The nuclear directorate of FURNAS, the state-owned power utility responsible for the bulk supply of electricity in the most developed region of Brazil, merged with the state-owned architect engineering company (NUCLEN), responsible for design, management of construction, and procurement of equipment for nuclear power plants. The new company, named Eletrobrás Termonuclear S.A.- ELETRONUCLEAR, is responsible for design, procurement and follow-up of Brazilian and foreign equipment, management of construction, erection and commissioning of nuclear power plants and is the sole owner and operator of nuclear power plants in the country. In addition, it is responsible for acquiring and preserving the relevant know-how and promoting the private industry. Other actors in the nuclear sector are ELETROBRÁS, holding of federal utilities, for co-ordination and financing of the power programme of the country; CNEN, the licensing authority; INB, the fuel supplier; NUCLEP, the heavy components manufacturer; private engineering companies and private suppliers of mechanical and electrical equipment. Based on our long experience in introducing nuclear power in Brazil, some general guidelines can be suggested to be adopted by other countries initiating a nuclear programme. Nuclear power is a complex and capital-intensive technology. Hence it does not tolerate long delays: to be competitive a nuclear power plant has to be built in the shortest possible period of time according to schedule and budget. For this to be achieved a stable political climate should be in existence in the country. The local government has to provide continuous support. Timely financial availability is essential. Public perceptions of risks and waste disposal will continue to be the critical determinants of the extent of use of nuclear power in the future in any country. Total transparency of the programme and continuous public information is a must to gain the confidence of the public. Communication programmes should be established with key government officials, selected media and opinion leaders. Local and regional integration with local municipalities and communities are very important. Nuclear power requires substantial high qualified manpower: adequate manpower qualification in all levels, basic and "on-the-job", in the country and abroad, is an essential key factor for the success of any nuclear power programme. The local engineering and manufacturing

companies should be integrated into the programme. Services and industrial surveys should be carried out well in advance for good results and adequate national participation to be achieved. Our partnership with German organizations within the general Brazilian-German agreement provided for all these needs. Maximum safety and minimum environmental impacts should be the permanent target of operational and engineering personnel. Safety culture should permeate all levels of the utility organization. Because large parts of the energy sector are being deregulated and privatized in many countries, new challenges and opportunities are faced by nuclear power. Nuclear power has to be part of the expansion plan of the country and not an isolated project only of the interest of the nuclear sector. All these recommendations are based on our long experience- some 20 years- of technology transfer programme related to building a large nuclear power plant and we hope they can be of some use to you. We in Brazil are convinced that nuclear power has an important role to play towards a sustainable development. I thank you very much for your kind attention.