Nuclear Energy – Opportunities and Challenges for Sri Lanka

This article was prepared from the keynote address by Dr. Ranjith Wijayawardena, Chairman of the Atomic Energy Authority of Sri Lanka, delivered at the SLEMA Annual Sessions, on 29th July 2011.

The Present Context of the Sri Lanka Power System

Future directions are always foreseen by the present. The paper article "The Real Truth behind the Power Crisis" published in the Daily Mirror on 18th July 2011, argues that the recent power interruptions were caused by non-functioning of two main power plants: Lakvijaya and Yugadhanavi, each of 300 MW of capacity. Continued power cuts were not needed on merit to the thermal power, mainly petroleum and coal, even at a cost. This highlights that the country's uninterrupted power supply mainly depends on thermal power. In contrast, purchasing thermal power from private sector since 1996 paved the way for the present financial crisis in Ceylon Electricity Board (CEB).

The article in the Daily Mirror further explains that the average price of a unit of electricity in 2010 was Rs. 13.10. The cost of hydro-electricity ranges between Rs. 3.57 for Laxapana complex, Rs. 4.29 for Mahaweli complex and Rs. 4.84 for other hydro including Kukule and Samanalawewa, all expressed in terms of the depreciation and maintenance costs per kWh. The typical electricity requirement of the country is around 25-35 GWh per day. The share of hydro-electricity in the generation mix varies between 45% and 30% under average rain and drought conditions, respectively. Hence the balance demand has to be met with other resources, which are mostly thermal. The cost of thermal power from petroleum products vary from about Rs. 15.00 to even Rs. 49.00, eventually a loss of an average of Rs. 6.00 per kWh to CEB. The total loss or burden on the tax payer per year is a staggering Rs. 36 billion, if 6,000 million kWh are generated annually. This presents a major challenge to economists to find remedies to get rid of this large loss to the economy.

Future Challenges and Remedies

As generation planners proposed coal would play a vital role which has a lower unit cost of generation, Rs. 6.00 in 2010. However, now in 2011 it has increased to Rs. 10.71, and in 2020, predicted to be between Rs. 45 and 53, as coal price is on an upward trend. Electricity generation in large scale from sun and wind is not yet practicable. Reliable and uninterrupted electricity supply is essential for the economic development of any country. Electricity at affordable price always boosts investments in any country. Economic planners forecast that Sri Lanka will reach a steady annual economic growth rate of 8% in the near future. It is generally accepted that we are in the middle of a crisis, which need to address short term, medium term and long term remedies.

Nuclear Power Generation: A Feasible Option?

From an environmental standpoint, compared with coal and hydroelectric generation, nuclear power is a safe and clean way to produce electricity. In a nuclear power plant, waste is managed through containment. In contrast to fossil fuels, generation of electricity using nuclear energy emits no harmful gasses or toxic materials to the environment. Unlike dams built for hydroelectric power plants, a nuclear power plant does not alter a region's eco system. Despite what activists and media say, the waste nuclear material is far less a problem than the waste produced by coal, or the slit that builds up behind hydropower dams. A nuclear power plant generates high-level radioactive waste of the size of one aspirin tablet per person per year. Actually a nuclear power plant's yearly waste would fit comfortably under a dining room table. Coal-fired plants on the other hand generate about 150 kg of ash and other poisonous materials per person per year, of which 10 percent is released (spewed) into the atmosphere. Sri Lanka need not have continuing and compounding problems for health, agriculture and plantation sectors through environmental pollution.

Certain countries such as France, Japan, India, etc.. do recognize the advantages of nuclear power, and have a continuing program of building more power plants.

Another important factor related to nuclear power is the relative abundance of its fuel Uranium. As Bernard Cohen points out in his book "*The Nuclear Energy Option*", the supply

of Uranium on the planet will run reactors for more than a thousand years.

In the case of coal power, import, storage and maintaining coal stocks for uninterrupted supply of electricity would entail specific logistic problems relates. Reliance on a single source such as coal alone will not be advisable for Sri Lanka due to poor diversity in generation mix. Sri Lanka needs to look forward for other avenues. If Sri Lanka would be able to discover indigenous fossil fuels or natural gas, then the energy picture would be quite different. However, such a discovery and its commercial viability still remains far from reality.

Is Nuclear Safe?

The St. Francis Dam in California collapsed in 1928 and killed about 450 people. The Machu Dam in India ruptured in 1979 and killed about 2,500 people. Comparing on the basis of the amount of electricity produced, hydropower causes 110 fold, coal 45 fold and natural gas 10 fold more deaths than nuclear power. Peter Beckmann shows in his book "*The health hazards of Not Going to Nuclear*", that nuclear power is the safest source of energy in all respects.

Chernobyl (USSR) is the only accident in the history of nuclear power where radiation related fatalities have occurred. The accident occurred in 1986. Chernobyl is unique. The possibility of an accident of the same kind is extremely less in modern day nuclear power plants. All nuclear reactors in operation today are housed in a containment building whereas Chernobyl was not.

The Three Mile Island (USA) reactor accident in 1979 was not as serious as Chernobyl. There the radiation was not released to the atmosphere because of the containment building. There were no injuries or deaths.

The recent nuclear disaster in Japan was not due to any nuclear technology failure; it occurred as a result of a natural disaster.

Nuclear Fuel Resources

Due to increased demand for carbon free energy, accelerated growth of global nuclear power can be foreseen in future. This will demand sustainable use of fuel resources such as Uranium and Thorium. Although Uranium is the mainstay of the present generation of nuclear power plants, with the steep growth in nuclear energy use, it will be necessary to introduce Thorium too, as a fuel. Thorium fuel cycle offers several potential advantages over a Uranium fuel cycle, including greater abundance, superior physical and nuclear properties of fuel, enhanced proliferation resistance and reduced plutonium and actinide production.

Recognizing the potential contribution of the Thorium fuel cycle in nuclear energy, renewed R & D efforts are seen in many countries.

Geologically, Thorium is four times more abundant than Uranium on the earth's crust and economically viable concentrations of Thorium are found in a number of countries. Worldwide Thorium resources are estimated to be about 6 million tonne. Major reserves of Thorium are in Austria, Brazil, Canada, India, Norway, South Africa and USA. It is said that 30% of total reserves are in the South Asian region, but are yet to be explored. The present production of Thorium is mainly as a byproduct of processing heavy mineral sand deposits for Titanium, Zrconium and Tin.

Indian Rare Earths Limited India, an arm of the Department of Atomic Energy, Government of India, is organizing a world congress on Thorium resources in association with the International Atomic Energy Agency (IAEA) this year.

The Government Policy Statement "Mahinda Chinthana" refers to utilization of mineral sand available in the country. Atomic Energy Authority and the Geological Survey and Mines Bureau jointly submitted a proposal to the IAEA for a survey on Thorium. The feedback from the IAEA is positive and the survey may commence in 2012.

Nuclear: A Promising Option for India

It is likely that nuclear power will be increasingly used by our neighbour India. India has a flourishing and largely indigenous nuclear power program and expects to have 20,000 MWe nuclear capacity on line by 2020 and 63,000 MWe by 2032. It aims to supply 25% of electricity from nuclear power by 2050.

India is also developing technology to utilize its abundant resources of Thorium as a nuclear fuel. They are also considering the adoption of

the Thorium fuel cycle. Sri Lanka also can benefit from the Thorium fuel cycle. Recently the Indians have discovered large reserves of Uranium too. It is likely that their external dependence on nuclear fuel will be gradually reduced.

Further, India has announced the possibility of exporting conventional nuclear power reactors.

Sri Lanka's Initiatives towards Nuclear Power

Sri Lanka's hydropower reserves are almost fully exploited. Power generation from petroleum is quite expensive. Mass scale power generation from wind and solar have more practical barriers to overcome. How are we planning our future power requirements? Are we going only for more coal developments?

It is in this context that nuclear energy could play a vital role in long term planning. Based on a government decision, Sri Lanka has submitted a request to the IAEA for a pre-feasibility study on using nuclear power. Sri Lanka's interest was conveyed to the IAEA in 2010 by the Honorable Minister of Power and Energy. Future direction with regard to nuclear energy for Sri Lanka will depend on the conclusion of the pre-feasibility study. If results are found to be feasible, a Nuclear Energy Planning and Implementation Organization (NEPIO) will be established and it should be separated as an independent nuclear power regulatory organization.

Planning, design, construction, commissioning, operation and decommissioning of a nuclear plant have an average time frame of a minimum of sixty years. Invariably, several generations should participate in the whole process. A proper knowledge transfer program and establishing strict discipline will be essential. The estimated human resource requirement would be around 500 – 700 national experts engaged in regulation and operation activities of nuclear power.

CEB has been nominated as the focal point for the pre-feasibility study and a group of young engineers are been appointed to be associated with the study. IAEA will commence the study in 2012. IAEA will provide experts and software required for the pre feasibility study. The proposal to IAEA has a component for human resource development as well.

Are We Free from all Risks?

In the years to come, we would witness the construction and commissioning of the Kudankulan nuclear power plant of 4,000 MW, just across the Mannar basin. Kudankulan is a place close to the city of Thiruvananathapuram, in India. India will have new reactors in other states such as Rajasthan and Tamilnadu in close proximity to Western and the Eastern coast of the Indian sub continent. Risks of nuclear power faced by Sri Lanka needs to be assessed in this context.

It is often heard that Sri Lanka is a small country and nuclear option is not suitable. We have to bear in mind that nuclear power is and will be used in India. Calculation of associated risks is left to experts. However, the situation is that regardless of whether we have nuclear power plants within our territorial limits or not, Sri Lanka will face the same risks.

Our Dedication

Power is the backbone for economic development of any country today. In this context, SLEMA as a pioneer gathering of energy managers should reflect the provision of reliable and 'relatively' safe supply of electricity and on the strategic energy mix for the future.

Above all, SLEMA should dedicate itself to find ways to provide electricity in sufficient quantity and quality. Providing electricity at an affordable price to consumers while minimizing the burden on the tax payer is the corporate social responsibility of the energy sector professionals.

Energy Price Check

The following are the electricity prices announced by the Public Utilities Commission of Sri Lanka, and effective since 1st January 2011.

Customer Category and Consumption per month	Energy Charge (Rs/kWh)	Fixed Charge (Rs/ month)	Maximum Demand Charge per month (Rs/kVA)
Domestic (D)			
0-30	3.00	30	-
31-60	4.70	60	-
61-90	7.50	90	-
91-120	21.00	315	-
121-180	24.00	315	-
>180	36.00	315	-
Religious (R)			
0-30	1.90	30	-
31-90	2.80	60	-
91-120	6.75	180	-
121-180	7.50	180	-
>180	9.40	240	-
Street lighting	15.60	-	-

Customer Category and the time interval, if applicable	Energy Charge (Rs/kWh)	Fixed Charge (Rs/ month)	Maximum Demand Charge per month (Rs/kVA)
Industry (I)			
I1	10.50	240	-
I2			
Day	10.45	3,000	850
Peak	13.60		
Off-peak	7.35		
I3			
Day	10.25	3,000	750
Peak	13.40		
Off-peak	7.15		
Hotel (H)			
H1	19.50	240	-
H2			
Day	13.00	3,000	850
Peak	16.90		
Off-peak	9.10		
H3			
Day	12.60	3,000	750
Peak	16.40		
Off-peak	8.85		
General Purpose (GP)			
GP 1	19.50	240	-
GP 2	19.40	3,000	850
GP 3	19.10	3,000	750

Notes on tariffs below are provided for information

1. "Month" means a 30-day billing period.
2. Hotels which presently pay either the Industrial rates or General Purpose rates are unified into a single customer category identified as Hotels.
3. Customers in I2, I3, H2 and H3 would pay the energy charges on the basis of mandatory Time of Use (TOU) tariffs. Time intervals applicable shall be as follows.

Interval Description	Interval (hours)
Day	0530 to 1830
Peak	1830 to 2230
Off-peak	2230 to 0530

Petroleum Prices announced to be effective from 30th October 2011

Products	Price (Rs/litre)
Lanka Petrol 90 Octane	137.00
Lanka Petrol 95 Octane	155.00
Lanka Auto Diesel	84.00
Lanka Super Diesel	106.30
Lanka Kerosene	71.00
Lanka Industrial Kerosene	76.00
Lanka Furnace Oil 800	52.20
Lanka Furnace Oil 1500	50.00
Lanka Furnace Oil 3500	50.00