

The Prospects of Nuclear Power in the Bangladesh

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1.0 Introduction:

The consumption of electric energy in Bangladesh has grown notably in the last few decades and the gap between demand and production of this energy is increasing day by day. The country is facing a major challenge to meet up the demand. According to Bangladesh Power Development Board, in the year 2013 against a peak electricity demand of 8349 MW, the maximum production of electricity was only 6675 MW.[1] Such production shortages in every year are greatly affecting the growth of GDP and overall development of this country.

With a power sector which is almost dependent on natural-gas fired generation, the country is confronting a simultaneous shortage of natural gas and electricity. According to Ministry of Power, Energy and Mineral Resources nearly 800 MW of power could not be availed from the power plants due to shortage of gas supply. Other fuels for generating low-cost, base-load electricity, such as coal, or large hydropower, are not readily available and thus these primary resources are no more a dependable source of electricity production.

The present system of electricity production is not only inadequate but also the harm to the nature is more from this system. Burning of fossil fuel produces a heavy amount of greenhouse gases which damage the equilibrium of nature. These gases cause the temperature of the earth to increase which leads to the melting of polar ice. Thus the sea level rises and more and more land goes under water.

So it is time to go beyond the traditional lines of production of electric energy and bring about a significant change in its production. To keep pace with the increasing demand it needs a source that can produce much more electricity than the present production. Such a breakthrough in electricity production can only be achieved through the introduction of Nuclear Power Plant in power generation system of Bangladesh.

Nuclear energy is produced by fission reaction of radioactive metals in a nuclear reactor. The amount of energy produced from nuclear reaction is gigantic compared to the energy produced from other primary resources. Nuclear power plants also have a higher rate of efficiency compared to other primary energy based power plants. On the other hand, a nuclear power plant produces very little amount of greenhouse gases, so it is much safer.

2.0 Present Electricity Scenario in Bangladesh:

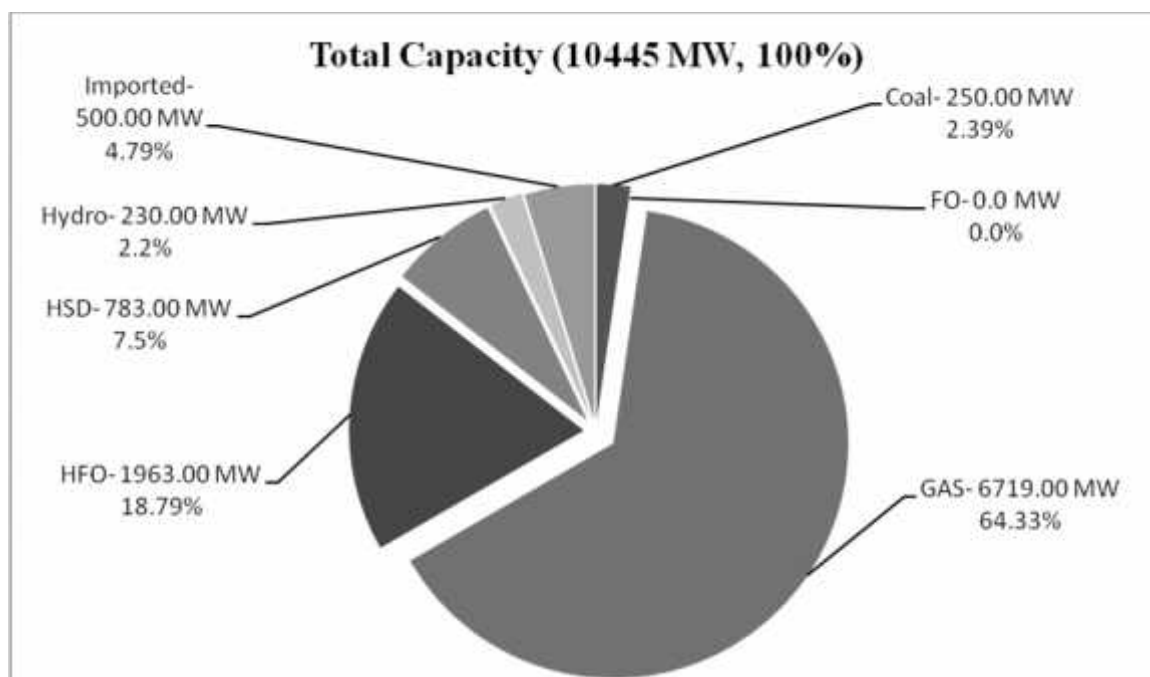
At present the demand of electricity is very high in Bangladesh and it is increasing day by day. In this country only 68% people are now being facilitated with electric supply, leaving the rest 32% people into darkness. To keep the wheel of development rolling and active, this large mass needs to be brought under electric coverage. Power Plants are being commissioned on a regular basis to meet up demands, but with the booming population and the hard endeavor for industrialization the need for electricity is also booming.

According to Power Division of Ministry of Power, Energy and Mineral Resources, Government of the People's Republic of Bangladesh, Plants Commissioned During 2009 – December 2013 (MW) are as follows:

YEAR	2009	2010	2011	2012	2013	TOTAL
Public		255	800	607	587	2249
Private	356	520	963	344	76	2259
Power Import					500	500
Total	356	775	1763	951	1163	5008

[2]

The net production capacity of Electric Power Plants of this country has reached 10445 MW in the year 2014 but the maximum power generation in 2014 (as on 18 July, 2014) is 7418.00 MW. The installed capacity of BPDB (Bangladesh Power Development Board) Power Plants as on November 2014 is-



[3]

3.0 Problems with present electricity scenario:

3.1 Production shortage:

The production curve has always lagged behind the demand curve of electricity in Bangladesh. The insufficient electricity production of this country has always pulled back this developing country. The demand and production data of the past few years describes the scenario best. [4]

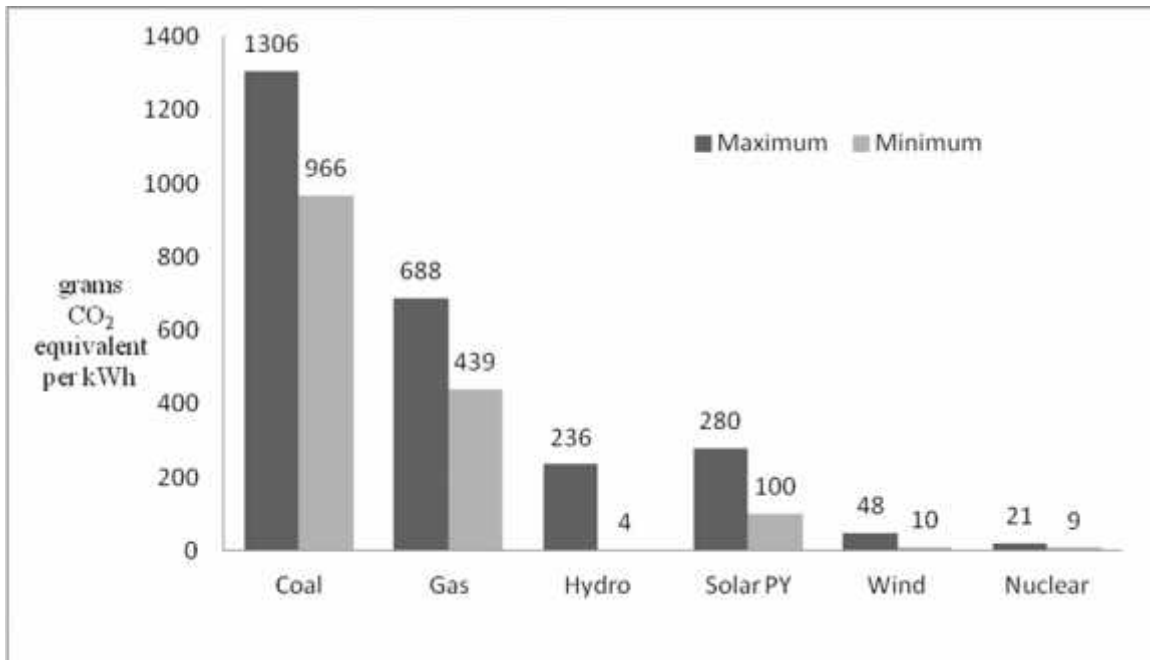
Fiscal Year	Peak Demand (MW)	Maximum Generation (MW)
2010	6,454.00	4,698.5
2011	6,765.00	5,174.00
2012	7,518.00	6,350.00
2013	8,349.00	6,675.00

3.2 Decreasing stock of primary resources:

Bangladesh has very few natural resources which are being used to produce electricity, such as- coal, natural gas, furnace oil, diesel and hydro. Coal is harnessed from coal mines situated in the northern portion of Bangladesh and there are several gas fields lying all around the country. But it is not possible to harness enough coal from the mines because of negative effects of it on nature and gas fields have limited balance of gas left in them. Bangladesh has to import furnace oil and diesel from abroad. At the current rate of natural use in Bangladesh the current estimated proven reserves would last 45 years. Even if the present rate of use increased at 10% per year, these reserves would last about 17 years (source: Wikipedia). Power sector ranks the highest (44%); fertilizer sector ranks the second (28%); and industry, domestic, commercial and other sectors together rank third (22%) in gas consumption. Currently 12 gas fields under public and private sectors are in production with gas supply between 900 and 930mmcfg per day. [5]

3.3 Negative impact on environment:

These days one of the biggest concerns of the world is the greenhouse gas emission. The burning of fossil fuel emits harmful gases like carbon di-oxide, carbon monoxide, sulphur di-oxide, sulphur tri-oxide, etc. in the atmosphere altogether known as the greenhouse gases. These gases raise the temperature of the atmosphere trapping the heat radiated from the earth making the world a vulnerable place to live in. The chart below demonstrates the emission of greenhouse gases from production of electricity from different raw materials –

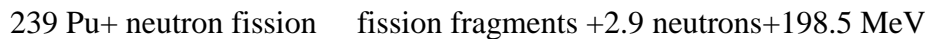


[6]

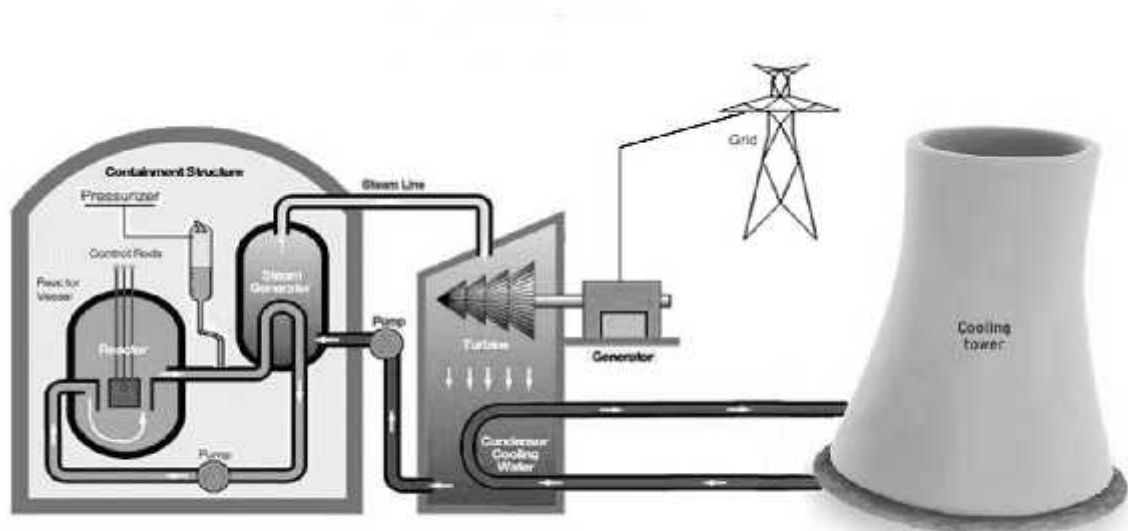
As the chart demonstrates, average greenhouse gas emission from coal based electricity production is about 1100 grams of CO₂ per kWh and from nuclear power plant it is about 15 grams of CO₂ per kWh. So nuclear power plants are much healthier for the earth.

4.0 The Alternative:

With such a sharp increase of demand and a decrease in the reserves of primary resources for electricity production, the perfect alternative is the introduction of nuclear based power production. Nucleus, one of the fundamental particles inside an atom releases energy when some special atoms are combined together to form large atom or some special large atoms are split to form smaller ones. In nuclear fission, atoms are split apart to form smaller atoms, releasing energy. Nuclear power plants use nuclear fission reaction to produce electricity. Usually in commercial production of nuclear energy, special isotopes of Uranium and Plutonium are used. The general reaction is figured out below-



This massive energy is not produced in open places like the burning of fuels. This production needs an isolated and controlled environment. A nuclear power plant has its own cooling system and such a facility is generally established near big natural water reservoirs. The typical components of a nuclear power plant are shown below.



5.0 Advantages of Nuclear Based Energy Production:

5.1 Production Capacity:

This country needs a stable and powerful source which will be able to supply energy continuously for a very long period of time. Here Nuclear Energy can be the best solution to this problem. Primary sources of energy can't provide that much of energy as Nuclear Energy. Also the lifespan of a typical nuclear power plant is much higher than any other plant.

A comparison between heating values of different fuels are given below.

Type of fuel	Heat Value (MJ/kg)
Firewood	16
Brown Coal	9
Black Coal (low quality)	13-20
Black Coal	24-30
Natural Gas	39
Crude Oil	45-46
Natural Uranium in light water reactor	500000

[7]

It is seen that the source of nuclear energy- natural uranium can provide about 10000 times more energy than crude oil- the second highest heat value provider. The difference in the heat value of uranium compared with coal and other fuels is important since it directly affects the amount of wastes that each fuel produces. For instance, a single 1000 MW coal-fired plant produces over 300,000 tons of ash, 44,000 tons of sulphur di-oxide, 22,000 tons of Nitrous Oxide and 6 million tons of carbon. In contrast, a 1000MW of nuclear power plant produces a mere 3 cubic meters of wastes after reprocessing the spent fuel, 300 tons of radioactive wastes and 0.20 tons of plutonium. There are also different transport requirements for both nuclear fuel and fossil fuels in the context of Bangladesh. Transportation costs are higher for coal and oil systems at 20000 train cars or 10 super tankers, in relation to a nuclear plant at just 3-4 trucks. Around the world, there is projected to be around 860 nuclear power plants generating over 800,000 MW. [7]

5.2 Fulfilling Future Demand:

To make a proper power generation master plan, it is required to make a proper speculation of the speed at which the demand is increasing. According to the Power System Master Plan (PSMP) 2010, demand forecast made by Government of the People's Republic of Bangladesh based on 7% GDP growth rate is as follows:

Fiscal Year	Peak Demand (MW)
2014	9,268
2015	10,283
2016	11,405
2017	12,644
2018	14,014
2019	15,527
2020	17,304
2021	18,838
2022	20,443
2023	21,993

2024	23,581
2025	25,199
2026	26,838
2027	28,487
2028	30,134
2029	31,873
2030	33,708

[4]

This speculation is made on the basis of a fixed GDP. So an increasing GDP will definitely increase the demand much more. To fulfill such a great demand of electricity in the future present production needs to be incremented greatly which can only be done with nuclear power plants.

5.3 Effect on Environment:

Nuclear reaction does not produce greenhouse gases during production of energy. Though small amount of greenhouse gases are produced in a nuclear power plant due to the use of supporting machineries like turbine and cooler, it is far less compared to the produced greenhouse gases in other power plants. Thus a nuclear power plant saves the earth from the harmful effects of these toxic gases.

5.4 Safety Features:

In the past, the disposal of radioactive waste was difficult and harmful to the nature to some extent. Besides, operating nuclear power plant machineries and the cooling procedure were very difficult. But presently due to the improvement of the power plant up to 3rd Generation, the use of pressurized water reactor and the fully automated power plants make the nuclear based power production very secured. Besides the in-built safety features reduces the chances of accidents significantly. These safety features consist of multiple layers of protective walls and emergency core cooling system.

6.0 Advancements regarding Nuclear Energy in Bangladesh:

In 1963 the Ruppur site was selected for the establishment of the first nuclear power plant of this country. In 2001 Bangladesh adopted a national Nuclear Power Action Plan. On 24 June 2007, Government of People's Republic of Bangladesh announced plans to build a nuclear power plant to meet electricity shortages. In May 2010, Bangladesh signed a civilian nuclear agreement with the Russian Government. Bangladesh also has framework agreements for peaceful nuclear energy applications with the US, France and China. In February 2011, Bangladesh reached an agreement with Russia to build the 2,000 megawatt (MW) Nuclear Power Plant with two reactors, each of which will generate 1,200 MW of power. The nuclear power plant will be built at Ruppur, on the banks of the Padma River, in the Ishwardi sub district of Pabna, in the northwest of the country. The RNPP (Ruppur Nuclear Power Plant) is estimated to cost up to US\$2 billion, and start operating by 2021. The inter-governmental agreement (IGA) was officially signed on 2 November 2011. On May 29, 2013 honorable Prime Minister of Bangladesh declared that a second nuclear power plant will be constructed in an inland river island in southern region of the country. [8]

The information of these nuclear power plant projects are summarized below-

Station/ Project Name	Type	Capacity	Expected Construction Start Year	Expected Commercial Year
1. Ruppur Nuclear Power Plant (Unit- I)	VVER	1000~1250 MWe	By 2016	By 2021
2. Ruppur Nuclear Power Plant (Unit- II)	VVER	1000~ 1250 MWe	One year after the first unit built	-----

[9]

7.0 Summary:

Nuclear energy these days are safe, reliable and on the context of Bangladesh capable of reducing the gap between demand and production significantly. The 3rd Generation Pressurized Water Reactors with automated and in-built safety features make Nuclear Energy a reliable source of massive electricity production. On the basis of present energy scenario of Bangladesh nuclear energy based power production should be the best solution to the overall energy crisis.

8. References:

1. Bangladesh Power Development Board- <http://www.bpdb.gov.bd>
2. <http://www.powerdivision.gov.bd/user/brec/112/58>
3. Ministry of Power, Energy and Mineral Resources, Government of the Peoples' Republic of Bangladesh-
http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=150&Itemid=16
4. <http://www.bpdb.gov.bd/download/PSMP/PSMP2010.pdf>
http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=12&Itemid=126
5. Banglapedia
6. IAEA 2010
7. Applied Reactor Technology by Henryk Anglart, 2011 edition
8. Wikipedia
9. http://pub.iaea.org/MTCD/Publications/PDF/CNPP2013_CD/countryprofiles/Bangladesh/Bangladesh.htm