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Discovering Nuclear Energy for Justifying Bad Deal

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We are having a discussion in the country of the importance of nuclear energy to our energy basket only in the context of the India US nuclear deal. The Government and the Prime Minister has gone in an overdrive in order to sell the India US nuclear deal, stressing on its importance for India's energy security. If indeed nuclear energy were so important to India's future, why is it that no serious techno-economic study has ever been presented impressing upon us the vital importance of nuclear energy?

Currently, nuclear energy stands at 4,120 MW, which is a little less than 3% of our installed capacity of power plants. A part of the reason has been the nuclear isolation we have faced and therefore the much slower development of our program. However, this is only a part of the reason. The other part is the techno-economics of nuclear power and its relatively high cost.

The key issue is what is the total amount of power that can be added using the nuclear route and what will be its cost? We have dealt with the techno-economics of nuclear power later, but let us take up first the possible proportion of nuclear energy, both in terms of its contribution to electricity generation and as a proportion of the primary energy basket.

If we assume that we need to add about 100,000 MW in the next 10 years, as the Ministry of Power is asserting, what is the best-case scenario for nuclear power? According to the Planning Commission's study (Integrated Energy Policy, 2006, Planning Commission), taking the most optimistic scenario, it is 15,000 MW by 2015 and 29,000 MW by 2021 (Table 1 below). These targets include 8,000 MW of imported reactors. Even though these targets have already been admitted as quite ambitious by the Planning Commission (Planning Commission calls it the Optimistic Scenario), let us assume for the sake of argument, that they can be met. Even then, nuclear energy will only add up to about 7% of our total installed capacity. And if we take the even more ambitious figures that the Government is now bandying about – 40,000 MW by 2020 – this will still be less than 9% of our total installed capacity. Figures such as 40,000 MW by 2020 have no relation to the actual capabilities on the ground, or the need for huge amounts of capital for such a program, or the cost of such power if these plants are set up. However, even by these "optimistic" of scenarios, it is clear that that nuclear power is going meet only a small part of our electricity needs. And as the techno-economics will show, going ahead with such an ambitious nuclear electricity program will come at a high cost and will dry up investments in other sectors.

Table 1: Planning Commission's Optimistic Nuclear Power Scenario

Items	2006	2016*	2021*
Total Installed Capacity in GW	134.7	303	445
Nuclear Capacity	4.12	15	30
Nuclear as a % of total	3.06%	4.95%	6.74%

Note: * Integrated Energy Policy, Planning Commission, August, 2006,

Table 2: Govt's Current Optimistic Nuclear Power Scenario

Items	2006	2016	2021
Total Installed Capacity in GW	134.7	303	445
Nuclear Capacity	4.12	20	40
Nuclear as a % of total	3.06%	6.60%	8.99%

In the '60's and '70's, there was a lot of euphoria about nuclear power. By the 80's, it became clear that nuclear power was expensive. In the West, nuclear plants routinely overshot their budgets and the time required to erect them. With discovery of gas in large quantities and increased efficiency of thermal power plants, nuclear plants were perceived to be too expensive. This was quite independent of the debate regarding the potential hazards, de-commissioning costs, and the problem of storing nuclear wastes.

The India experience is this regard has been no different. Nuclear power plants are about 25%-30% more expensive, even when using domestic technology and equipment. However, as they take a long time to build, before the plant starts producing power, a large amount of capital is locked up during construction. If the plant is built using a mix of equity and debt, this cost of locking up money is known as Interest During Construction (IDC); the capital cost of building a plant, without taking its IDC into account, is called "overnight" costs. This is the way that all conventional power plants are built and is also the way NPC is proposing to build plants in the future Taking IDC for both thermal and nuclear plants, the capital cost of nuclear power plants would be twice that of coal-based thermal power plants -- about Rs. 8.1 crore per MW (about Rs. 6 crore as overnight costs and 8 years to construct the plants) for nuclear plants, as against Rs.3.73 crore per MW (Rs. 3.2 crore as overnight costs and 4 years time for construction) for coal fired plans. That means that the cost we incur to put up nuclear plants that will generate 10,000 MW of nuclear power is far greater; with the same amount of money we can put up 20,000 MW of coal-fired plants.

If imported reactors for nuclear power are considered, the situation becomes even worse. The cost of nuclear plants, as overnight costs is Rs. 9 crore per MW. A number of studies have taken this as the base cost of nuclear power plants. Though the nuclear plant suppliers have claimed a lower figure, all existing plants have cost more than $2,000 per KW and therefore this is a reasonable base for our calculations. Taking into account the IDC component , this translates to 12.1 crore per MW or *three times the cost of coal-fired power plants.* In other words, with the same amount of money, we could put up 30,000 MW of coal-fired power plants instead of 10,000 MW of imported nuclear plants. For a 40,000 MW nuclear power program, it would mean importing 20,000 MW of imported reactors with 20,000 MW of indigenous reactors. This means an investment of Rs. 400,000 crore, which is equal to the total amount of investment we have planned for the entire 100,000 MW in the next 10 years. Incidentally, India's total capacity addition in the last 10 years has been less than 40,000 MW, the figure that is now being proposed for nuclear power alone.

Table 3: Comparison of Capital Costs and Tariffs Coal vs Nuclear

Item	Coal 2*500 MW	Nuclear 2*500 MW (Domestic)	Nuclear 1000 MW (Imported)
Capital Cost/MW –without IDC (Rs. Crore)	3.2	6.0	9.0
Capital Cost/MW –with IDC 4 years (Rs. Crore)	3.73	8.1	12.1
Capital Cost – Plant without IDC (Rs. Crore)	3,200	6,000	9,000
Capital Cost – Plant with IDC 8 Years (Rs. Crore)	3,733	8,092	12,138
Tariff per unit (Rs.)	2.51	3.89	5.47

http://www.uic.com.au/nip08.htm for nuclear fuel costs.

Table 4: Cost of Nuclear and Coal Based Power Stations

Item	Capital Cost of Coal Fired Plant (Rs. Crore)	Capital Cost of Nuclear Plant with Domestic PWR Reactors (Rs. Crore)	Capital Cost of Nuclear Plant with Imported LWR Reactors (Rs. Crore)
1 MW	3.73	8.1	12.1
10,000 MW	37,300	81,000	121,000
40,000 MW	149,200	324000	484,000

The cost of power from nuclear plants, as compared to that from coal-fired plants, is also quite a bit higher. Coal-fired plants today produce electricity at the plant end (not as delivered to the consumer) cost about Rs. 2.50 depending on the coal cost at the location. For nuclear plants with domestic reactors, the cost is about Rs. 3.90 per unit. For imported reactors, it is about Rs. 5.50 per unit.

Not only is nuclear power more expensive, it will also have adverse effects on the entire electricity sector. Going in for huge investments for imported nuclear power plants – three times the cost of similar coal fired units -- would mean starving the Indian economy of other investments. It would mean either giving up much larger investments in the power sector or starving other infrastructure sectors.

For those familiar with Enron, there is a sense of history repeating itself. First, there is a political decision to give Enron a 2,000 MW project, then the fuel policy and power policies are changed to suit Enron. The liquid fuel policy of using naphtha as fuel for power plants came out of the need to accommodate Enron. Today, it is clear that such a policy, decided without application of mind and the techno-economics of the sector, has resulted in a major crisis for Maharashtra State Electricity Board and idling of plants using naphtha. Unfortunately, a similar exercise is underway with respect to nuclear energy. In order to justify the India-US nuclear deal, we are now talking about 40,000 MW of nuclear energy, without taking into account its capital cost or the price of electricity from such plants. If the MSEB crisis was the result of adding a 2,000 MW Enron plant, we can only imagine what would be the impact of introducing 40,000 MW and its high cost power.

The talk of using imported nuclear reactors for providing energy security is also misleading. Unlike the three-phase nuclear cycle, which envisages the use of enriched uranium in Pressurised Water Reactors (PWR), then using reprocessed plutonium of the PWR's in Fast Breeder Reactors (FBR), and finally plutonium and thorium mix in Advanced Heavy Water Reactors (AHWR), the imported

Light Water Reactors (LWR) plants use only enriched uranium. In such a cycle, the requirements of uranium are much higher, and we would need continuous imports of large amounts of uranium. If we concentrated, instead, on the FBR and AWHR route, this would require much smaller amounts of uranium and would provide much greater fuel security than the imported reactor route that the Government is currently pushing.

Table 5: The Approximate Potential Available From Domestic Sources for Nuclear Energy

Particulars	Amount (Tonnes)	Electricity	
		Electrical Energy (GWYr)	Power (MW)
Uranium-Metal	61,000		
In PWR		330	10,000
In FBR		42,200	500,000
Thorium-Metal (In Breeders)	2,25,000	1,50,000	Very Large

Source: Department of Atomic Energy quoted in Integrated Energy Policy, 2006, Planning Commission, P 36

Electricity is only a part of our total energy needs. We need fuel for transport and also for manufacturing fertilisers and petrochemicals. The requirements of primary fuels would of course also depend partially on what kind of fuel we use for electricity generation. However, it is clear that in any scenario, the bulk of India’s electricity needs – from 91% as the best-case scenario to 95% as per current plans -- would have to come from non-nuclear sources. For the foreseeable future, nuclear option is going to have little impact on our need for other sources of energy.

Oil has been used in India primarily for transport and industry. The Tenth Plan has this to say about the growth of hydrocarbon demand: “The share of hydrocarbons in the primary commercial energy consumption of the country has been increasing over the years and is presently estimated at 44.9 per cent (36.0 per cent for oil and 8.9 per cent for natural gas). The demand for oil is likely to increase further during the next two decades. The transportation sector will be the main driver for the projected increase in oil demand. Consequently import dependence for oil, which is presently about 70 per cent, is likely to increase further during the Tenth and Eleventh Plans.”

It has been estimated that by 2015, Indian demand for crude oil would be around 4.25-4.5 million barrels/day (mb/d) and it would be importing about 80% of this, almost entirely from the West Asian region. The important issue here is that if we look at the power sector demand, oil does not figure in this. So nuclear energy, which can be used to produce electricity, is not a substitute for oil under any circumstance. While India account for only about 2% of world's oil consumption, it is already amongst the 10 largest importers of oil in the world. With increasing oil consumption, this trend is likely to continue with India and China emerging as major importers of oil accounting for at least 15% of world's oil demand. As there is no way nuclear energy can go into trucks, buses and cars, the transport sector will continue to be heavily dependent on imported hydrocarbons.

If we take nuclear energy as a fraction of the total primary energy needs of the country, we find that this is not more than 3%-5% of our total primary energy basket (the 5% to 9% of the electrical energy translates to 3%-5% in primary energy terms). If we look at oil and gas, even with an ambitious nuclear energy program, they will constitute more than 30% and 10% respectively, and together more than 40% of our future energy needs. More than 40% of our energy needs in the future is going to come from oil and gas -- and this, independent of our nuclear energy program.

Therefore, the nuclear deal that has been signed between India and the US will help us only marginally address our primary energy needs. The argument that nuclear energy is the energy for the future is not backed up by either an analysis of India's energy needs nor does it take into account that nuclear energy is an option very few countries are exercising today. We need to keep the nuclear option open, looking at possible long-term needs; but to present this as a panacea for our current energy needs flies in the face of reality. If India has to take measures for its energy security, its primary concern must be to secure oil and gas supplies. It is in this context that peace and stability in West Asia is of such vital concern for India; its delight in being seated at the international high table, courtesy the US of A, is just a diversion, and a harmful one that is against the country's national interests.