

## **Is there an alternative to Kudankulam?**

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In the ongoing opposition to the Kudankulam Nuclear Power Project, some people have suggested that we should explore all alternatives to nuclear power that may be feasible. Some people have proposed that we could convert the KKNPP to a gas burning power station, on the analogy of such a change to the Shoreham nuclear plant in the USA. It is well known that India does not possess large deposits of natural gas. Our largest deposit, discovered so far, in the Krishna-Godavari basin is yielding far less gas than expected earlier. The first preference for use of natural gas is as a feedstock for producing fertilizers or petrochemicals. The second priority would be as compressed natural gas (CNG) as fuel for city buses and taxis. We know what a difference CNG makes to the quality of city air, from the experience in Delhi. Some years ago, the Supreme Court ordered that buses and taxis should change over to CNG. Other cities like Mumbai, Chennai, Bangalore, Hyderabad, Trivandrum and so forth would also like to use CNG for vehicles if gas supply could be made available.

Krishna-Godavari gas will not be available for power generation in South India. Gas available in the Kaveri basin is very limited in quantity and is now supporting a small generation capacity. The only gas in South India can be liquefied natural gas (LNG), which can be imported from the Middle East, Australia, Indonesia or Malaysia. The international price of LNG is indexed to the price of crude oil. The present price of LNG is about \$ 8 to 9 per million BTU (British Thermal Units – a unit of energy); this may be compared to the price fixed by the Government of India for K-G gas of \$ 4.25 per million BTU. At \$ 8 to 9 per million BTU, gas based power will be Rs. 6 or more per kWh – more than twice the cost of power from Kudankulam, estimated to be well below Rs. 3/- per kWh.

Some people favour developing more wind power. The initial wind turbines had an output of 1.25 MW. Now, we are installing wind turbines with an output of 2.5 MW. To generate 1000 MW, equal to one Kudankulam reactor, we will need four hundred such units. To replace the two 1000 MW Kudankulam units, we will need 800 units of 2.5 MW size. This will require a very large land area, apart from a large investment. We must note that wind does not blow all the time; normally it is available only for 20 to 25% of the time. So we will need some other form of electricity generation, as a backup, when wind does not blow.

Living in a country endowed with a lot of sunshine, there is a natural desire to find out ways in which solar energy can be harvested in an economic manner to meet our energy needs. Unfortunately solar energy is available only in a diffuse manner. Even the largest solar photo voltaic power plant anywhere in the world is less than 100 MW in capacity. Compare this with 2000 MW of the Kudankulam plant. Cost of power from solar photo voltaics is about Rs. 20 per kWh. Presently available solar cells have an efficiency of less than 15% and hence large collecting surfaces are necessary. Research is going on around the world to design solar cells with much higher efficiency. There are developments where by efficiency close to 50% appears possible by using thin films of various special materials, which at present are very expensive. While India also should join these efforts to evolve more cost effective solar cells, this may take some ten to twenty years before competitive designs are commercially available.

What about the hydro-electric option? The southern states of Tamil Nadu, Kerala and Karnataka (and indeed Andhra Pradesh) have very little available hydro potential that can be developed. What is left will involve submergence of rich tropical rain forests and areas with rich biodiversity. There is opposition whenever any new hydro project is proposed in any of these states. What we can do however is to convert some of the storage type hydro power units to pumped-storage hydro power, using reversible pump-turbines to provide peaking power, provided base load power, generated from coal or nuclear, is available in adequate measure.

Let us now discuss the role of coal in supplying power to the country. We produce some 55 to 60% of the electricity from coal. Indian coals have high ash content and low heat value. They are mined in Jharkhand, Orissa, Bihar, M.P. and U.P, and to a limited extent in Andhra Pradesh (Singareni). There is lignite in Tamil Nadu (Neyveli) and smaller amounts in Rajasthan and Gujarat. Coal stations in south India have to get coal transported over a long rail route, as coastal shipping of coal is relatively undeveloped. In the past couple of months, coal supply to thermal stations in south India has been hit by the Telangana disturbance which has affected supplies from Singareni (Andhra Pradesh) and flooding of coal mines in Orissa due to heavy rains in the tail end of the monsoon. India produces about 400 million tones of coal. Our demand is increasing but there is difficulty in increasing production as new coal mining areas are largely in the forest areas of the country. We are importing coal for use in power stations from Australia, Indonesia and South Africa. Imported coal costs two or three times the price of Indian coal. As we import more coal, our coal fired stations will produce more expensive power than now.

A few years ago, Government of India decided to build a number of large high efficiency thermal power stations using 'super-critical' boilers. Each station is to generate 4000 MW with five units of 800 MW. After a lot of tendering work, only two projects have got going; one is at Mundra in Gujarat using imported coal, and another at Sasan in M.P. Delays in proceeding with other such projects, called 'Ultra Mega Power Projects' are largely due to uncertainties due to coal linkages. While in the near terms India has to increasingly depend on coal based power, this will make it difficult to reduce its carbon emissions, which it may be called upon to do to reduce the threat of 'global warming'. A lesser known fact about coal based power is that fly ash from these stations also spreads radioactivity into the surrounding area, because often coal has some uranium bearing rocks mixed in it. Furthermore if we look at health hazards of the coal industry, black lung disease among coal miners and accident in coal mines both contribute to high adverse impact when calculated on a per kWh basis. In fact nuclear comes out much better in such comparisons.

We may now look at the nuclear option. There are about 430 nuclear power units in operation in different parts of the world. The accident at Three Mile Island in the U.S in 1979 did not result in any fatality or escape of radiation to the environment. But the utility concerned suffered a huge financial loss. The Chernobyl accident in 1986 in present day Ukraine (formerly Soviet Union), resulted in some deaths among the plant operators and among those who were sent to fight the fires. A nearby town housing the plant personnel was evacuated completely and remains unoccupied. Many lessons were learnt from these two accidents and the nuclear industry world wide set up the World Association of Nuclear Operators (WANO) to exchange freely all operational experience. This resulted in greatly enhanced safety and reliability of all nuclear plant, worldwide. The Fukushima disaster happened because of an unusual combination of a very high intensity earthquake and a severe

tsunami. These natural forces combined with inadequacies in design of an earlier time (1960's) and resulted in the very serious partial melt down of three reactors.

Following the Fukushima accident, the Prime Minister ordered a safety review of all nuclear units operating in India. The results of these reviews have been placed in the public domain. The World Association of Nuclear Operators carried out a peer review of Kudankulam and is satisfied about the design provisions, quality of workmanship and the competence of our operations and maintenance personnel. The Atomic Energy Regulatory Board has carried out safety audits during design, construction, installation and commissioning phases. It will issue licenses to load the nuclear fuel and start the reactor only after it is satisfied about all aspects of safety of the plant. As and when additional information from Fukushima becomes available, the Nuclear Power Corporation of India and the Atomic Energy Regulatory Board will suggest further augmentation of equipment or procedures or both. This is the standard procedure in managing all nuclear power stations world wide.

When the southern region as a whole is suffering from acute shortage of power, to delay the start up of Kudankulam based on imaginary fears is most unfortunate. The country should place its confidence on its nuclear engineers and scientists who have demonstrated their competence by operating twenty nuclear power units, the earliest two of which have been safely in service for over forty years. What we should ensure is that our nuclear power units are built to the highest standards of safety and operated in the best possible manner. We should have confidence in our scientists and engineers and not be misled by vested interests who may have their own agendas. India's economic progress depends vitally on electricity being made available to our farms, factories, homes, railway systems and other infrastructure. If economic progress slows down, our efforts to eliminate poverty in the country will also slow down. The historic developmental deficits will continue to plague the well being of our people.