# N-plants best power option before country

by **Ratanmani Lal**

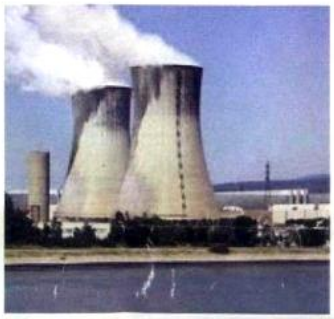
India is a nation in transition. Considered an "emerging economy," its increasing GDP is driving the demand for additional power and transport fuel. Rapid economic growth has led to the rising need for reliable supplies of electricity, gas and petroleum. The country's energy demand has grown an average of 3.6 per cent per annum over the past 30 years. In August 2011, its installed capacity stood at 181.558 GW and per capita energy consumption at 787kWh. And its annual energy production increased from about 190 billion kWh in 1986 to more than 837 billion kWh in 2010.During peak load, the demand was for 122,287 MW against the 110,256 MW available— a shortfall of 12,031 MW that is about 9.8 per cent. Electricity losses here during transmission and distribution are high. Due to the shortfall, power cuts are common around the country, badly affecting its economic growth.

A prominent resource is the sunlight that reaches earth. The energy sources represent 3 categories: fossil fuels and renewable and nuclear power. The fossil fuels are coal, petroleum and natural gas. The renewable sources are solar, wind, hydroelectric, biomass and geothermal power. The nuclear-powered sources are fission and fusion.

About 65.34 per cent of the electricity consumed here is generated by thermal power plants, 21.53 per cent by hydroelectric plants, 2.70 per cent by nuclear power plants and 10.42 per cent by renewable energy sources. More than 50 per cent of the commercial energy demand is met through the country's vast coal reserves. It has also invested heavily in recent years in renewable energy, especially wind energy.

India does not have sufficient fossil fuel resources to cope with the increasing power demand. Moreover, the burning of fossil fuel leads to emission of a large amount of carbon dioxide into the atmosphere. Carbon dioxide is a greenhouse gas and, in the atmosphere, it absorbs heat and contributes to the green house effect. When the percentage of carbon in the atmosphere increases, it leads to an elevation in the average temperature of the earth's surface. This is known as global warming and it has several adverse effects on our environment. Fossil fuels also give out sulfur dioxide into the air which, after reacting with moisture, produces sulphuric acid and leads to acid rain. Acid rain causes severe damage to living as well as non-living matter on earth. Also, the mining of coalfields results in large areas being degraded beyond use for any other purpose. Fossil fuels are a non-renewable source of energy that is being used up very fast. As a result, there will be more demand and less supply of these fuels in the future. This is likely to increase the price of fossil fuels manifold.

Oil is often transported from one place to another by the sea route. During this time, oil spills occur in the ocean, causing severe harm to marine life. Search for newer oil reserves is a highly expensive process with a very low success rate. Consequently, large amounts of money are wasted.



Hydroelectricity is generated using flowing water, or water that is stored in a reservoir. It is the most widely-used renewable energy as compared to other energy forms such as solar, tidal and wind. In terms of reliability and consistency, hydroelectricity is way ahead of its other renewable energy counterparts. The operational cost is quite low and it is also a clean way of producing energy. Also, the water can be re-used for agriculture, irrigation and civic purposes, which is to say that its wastage is minimal.

One negative aspect of hydroelectricity generation is the need for a large enough reservoir. Constructing one is a major challenge, both in terms of time and money. Also, it often involves relocation of resident families from the area approved for its construction. In some cases, constructing a reservoir or damming a river at a certain location may badly affect its immediate surroundings. And droughts can seriously impact hydropower generation itself.

Renewable energy is generated from natural sources such as sun, wind, rain and tides—conceptually a perennial resource. Solar and wind plants have relatively low capacity factors. This makes wind and solar availability factors much lower if periods when sunlight or wind is not available are taken into account. It is not easy to set up a plant as the initial costs are quite steep. Solar energy can be harnessed during daytime and not during night or the rainy season. Geothermal energy to generate electricity can bring toxic chemicals from beneath the earth's surface onto the top, causing environmental changes. For using wind energy, strong air currents are required, calling for high-wind sites to be chosen.

A solar power plant generating as much energy as a 1,000-megawatt nuclear plant would cover 127 sq miles with mirrors that would have to be washed weekly to keep them working. Besides, they require significant federal funding to make them economically feasible. That it would take as many as 3000 windmills, scattered over 300 sq miles to equal a single nuclear plant in output, is due to its low availability factor. Also, they can affect the bird population as they are quite high; just one windmill farm near San Francisco has killed 8 times as many bald eagles in one year as the entire Exxon Valdez oil spill in Alaska.

Nuclear power through sustained nuclear fission is used to generate heat and do useful work. Nuclear plants provide about 13–14 per cent of the world's electricity, with the U.S., France and Japan together accounting for about 50 per cent of the nuclear energy. In October 2011, the International Atomic Energy Agency reported there were 432 nuclear power reactors in operation in the world.

Nuclear power's positives far outweigh its negatives. The 3 main advantages of this energy resource are economic, environmental and its productivity per unit area/volume. There are large reserves of uranium, and new breeder reactors can produce more fuel than they use. Nuclear power plants need little fuel, so they are less vulnerable to shortages because of strikes or natural disasters. Nuclear power is one of the safest methods of producing energy.

There are a number of safety mechanisms that make the chances of reactor accidents very low. A series of barriers separates the radiation and heat of the reactor core from the outside. The reactor core is contained within a 190mm thick steel pressure vessel. The pressure vessel is surrounded by a thick concrete wall. This is inside a sealed steel containment structure, which itself is inside a steel-reinforced concrete dome up to 1.2 metres thick. The dome is designed to withstand extremes such as earthquakes or a direct hit by a crashing airliner. There are a large number of sensors that pick up increases in radiation or humidity. An increase in radiation or humidity could mean there is a leak. There are systems that control and stop the chain reaction if necessary.

As for the negatives, a nuclear power plant needs a continuous supply of water for the fission reactor, otherwise the rods would overheat. The rods that contain the uranium fuel pellets would dissolve, leaving the fuel exposed. In modern nuclear plants like the one in Tamil Nadu's Kudankulam, a core catcher is provided to collect the molten mass. This is a worst case scenario, as there are many precautions taken to avoid this. Emergency water reservoirs are designed to immediately flood the core in case of sudden loss of coolant. There are normally multiple sources of water to draw from, as the low pressure injection pumps, containment spray system and water tanks are all potentially available, and all access different water sources. Also, a passive heat removal system (as in Kudankulam) which works on natural air cooling is provided in modern nuclear power plants.

The byproducts of the fission of uranium-235 remain radioactive for many years, requiring their safe disposal away from society until they lose their significant radiation values. But storage facilities at power plant sites are sufficient to store the world's nuclear waste.

Low operating costs make nuclear electricity tariffs more stable and less sensitive to swings in fuel prices than other energy sources. All in all, except for some problems like residual heat and radiation release, which can be taken care of by safety systems, the best option available with us is nuclear power plants. India has committed massive funds for the construction of various nuclear reactors which would generate at least 30,000 MW.

*(The writer is a veteran journalist.)*

# Plan to expand N-power programme in a big way

by **Ratanmani Lal**

The nuclear story in this country began with the Atomic Energy Establishment that was set up at Trombay, near Mumbai, in 1957. It was renamed Bhabha Atomic Research Centre (BARC) in 1967. Plans for building the first pressurised heavy water reactor (PHWR) were finalised in 1964, and it was built as a collaborative venture between Atomic Energy of Canada (AECL) and the Nuclear Power Corporation of India (NPCIL), started in 1972.

The Indian Atomic Energy Commission (AEC) is the country's main nuclear policy body, while NPCIL is responsible for design, construction, commissioning and operation of N- power plants.

The 1962 Atomic Energy Act prohibits private control of nuclear power, though it allows for minority investment. As of late 2010, the Government had no intention of changing this to allow greater private equity in nuclear plants.

Per capita consumption of power in the country as late as 2005-06, as calculated by the Central Electricity Authority, had been about 631 kilowatt hours (kWh).The rates of consumption in some developed countries in the same period were way ahead. For example, in kWh terms, Canada accounted for 17179; the US for 13338; Australia for 11126; Japan for 8076; France for 7689; Germany for 7030; the UK for 6206; Russia for 5642; and Italy for 5644.

A total of 830 billion kWh was produced in 2008. The sector-wise share of generation is as follows:

Coal represents 68 per cent; hydro 14 per cent; gas 8 per cent; nuclear 3 per cent; and wind, solar, biogas together 7 per cent.

India faced a power shortage of 8.5 per cent in 2010-11.

As far as nuclear power is concerned, the present generation level is 4780 MW, while an enhanced output of 63,000 MW is proposed by 2032. The goal is to supply nuclear power comprising 25 per cent of the total electricity requirements by 2050.

There are 20 power plants in operation at 6 locations in 6 States—Tarapur (1-2, 3-4) in Maharashtra; Rawatbhata (1,2,3,4,5,6) in Rajasthan; Kalapakkam (1,2) in Tamil Nadu;Narora (1,2) in Uttar Pradesh; Kakrapar (1,2) in Gujarat; and Kaiga (1,2,3,4) in Karnataka. As for nuclear safety, proactive new-generation features are incorporated in multiple redundant systems. Scientific studies are conducted for each nuclear plant location before deciding their grade level.

No 'shroud of secrecy' is kept around the civilian nuclear energy programme.

One nuclear fuel bundle has 14 kg of uranium. The fuel to generate 1 million units of electricity is 2 bundles (equivalent to about 700 tonnes of coal).

After being discharged from the reactor, the uranium fuel pellets are put inside zircolly (zirconium alloy) tubes sealed at both ends. Many such tubes containing pellets are bound together to give a fuel bundle.

The spent fuel is stored underwater in large tanks. It produces some heat and the water is circulated to remove that. After storage, which extends to 5 years or more, the fuel is delivered to a central facility and reprocessed to recover useable products.

India has been operating waste management facilities for the entire nuclear fuel cycle for the past 3 decades. Low- and intermediate-level liquid waste generated in nuclear facilities is treated by chemical process. At an inland site, this waste is concentrated by solar evaporation. Solid radioactive waste is reduced by compacting and incinerated. Solid waste, depending on its contents, is disposed of in underground engineered trenches.

Gaseous waste is treated at the source itself. A multi-barrier approach is followed in disposing of this waste.

Periodical tests are conducted on the disposal system.

Radiation from a nuclear power plant is far less dangerous than radiation from a thermal plant! It is because fly ash emitted by a power plant—a byproduct from burning coal for electricity—carries into the surrounding environment 100 times more radiation than a nuclear power plant producing the same amount of energy.

The reason: coal contains trace amounts of uranium and thorium, which are concentrated in the ash. This exposes people living around coal plants to higher doses of radiation than those living near nuclear plants. Regulations for disposing of fly ash are far weaker than rules concerning low-level nuclear waste.

The number of nuclear reactors in the world is growing day by day, with acceptance of this newest and cleanest form of energy. Currently, world-wide there are 441 operating reactors, while 60 are under construction and 150 are already planned and approved. India ranks 6th with 20 operational plants in addition to the 24 more that have been planned of which 4 are under construction.

All active nuclear power plants have to be listed with the International Atomic Energy Agency (IAEA) before they function. It is notable that of the 30 nuclear countries, only France uses its reactors as a primary source of electricity generation.

India is aiming to expand its nuclear power programme in a big way by taking it to 10,080 MW by 2017-18 from the present level of 4780 MW and to ensure that it proves to be of multi-utility. With the discovery of uranium in Andhra Pradesh, this goal has just become more achievable.

*(Data sources: International Energy Agency, 2006; Nuclear Power Corporation of India; Waste Management Division, Bhabha Atomic Research Centre, Mumbai; and The Scientific American, a journal)*

# Kudankulam protests: Foreign rivalry at work?

On 12 Nov, 2011, Union Minister of State Narayanaswamy said in Chennai that there would be an enquiry about how the Kudankulam protesters get funds for their sustained agitation against the nuclear plant there.

Already there are allegations that Western powers are behind the protesters through the local churches. The suggestion is of a ploy to put roadblocks against the pursuit of business deals in India by Russia which is competing with its Western rivals for contracts to construct nuclear power plants here.

Local funding of the agitation is also alleged. An area of 5 km around the plant is declared a no-habitation zone where there can be no activity. This affects the mineral extraction units there. That is why it is suspected that the sand mafia are funding the protesters to make the Kudankulam plant inactive.

The protests are allegedly funded by the green movement abroad, said to be working for the nuclear industry in the US, France, Australia or Germany. The Kudankulam plant is to have a Russian reactor. As a result, there appear to be West European and US concerns over Russia getting this huge contract. The power project, comprising 2 units of 1000 MW each and on which work started in 2005, entails a total cost of Rs 13000 crores.

The agitation is being spearheaded by SP Udaykumar at the Idinthakarai village church. Udaykumar, who stays with the parish priest Father Jaikumar, uses the church's computer to send emails to newspapers about the protests.

Many have raised the question as to why the church is so actively involved in the agitation against the nuclear plant, and there are allegations that this involvement is being funded from America.

Fr Jaikumar is openly hostile to the nuclear plant. However, most people feel that the local fishermen are protesting because they say the parish priest has asked them to do so.

Former President A.P.J. Abdul Kalam's visit on 6 November to the Kudankulam nuclear plant and his 10-point development programme for the area has brought about a change of hearts among the protesters, says S.S. Ramasubbu, the Congress MP from Tirunelveli constituency of Tamil Nadu.

However, one can only wonder why the fishermen are so opposed to the power project, claiming it would hamper their livelihood when the people of Kalpakkam (70 km south of Chennai) and its surrounding villages have co-existed with a highly secure nuclear plant for nearly 30 years; how is it that down south on the same coast and in the same State there is so much apprehension about the project. **(RL)**