Why nuclear when India has an 'ocean' of energy

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"Though the 'highly harmful' source is regarded as saviour on certain counts, the country has a better option under the seas."

If it is right that nothing can stop an idea whose time has come, it must be true the other way too — nothing can hold back an idea whose time has passed.

Just blow the dust off, you'll see the writing on the wall: nuclear energy is fast running out of sand, at least in India. And there is something that is waiting to take its place.

India's 6,780 MW of nuclear power plants contributed to less than 3% of the country's electricity generation, which will come down as other sources will generate more.

Perhaps India lost its nuclear game in 1970, when it refused to sign – even if with the best of reasons – the Non Proliferation Treaty, which left the country to bootstrap itself into nuclear energy. Only there never was enough strap in the boot to do so.

In the 1950s, the legendary physicist Dr. Homi Bhabha gave the country a roadmap for the development of nuclear energy.

Three-stage programme

In the now-famous 'three-stage nuclear programme', the roadmap laid out what needs to be done to eventually use the country's almost inexhaustible Thorium resources. The first stage would see the creation of a fleet of 'pressurised heavy water reactors', which use scarce Uranium to produce some Plutonium. The second stage would see the setting up of several 'fast breeder reactors' (FBRs). These FBRs would use a mixture of Plutonium and the reprocessed 'spent Uranium from the first stage, to produce energy and more Plutonium (hence 'breeder'), because the Uranium would transmute into Plutonium. Alongside, the reactors would convert some of the Thorium into Uranium-233, which can also be used to produce energy. After 3-4 decades of operation, the FBRs would have produced enough Plutonium for use in the 'third stage'. In this stage, Uranium-233 would be used in specially-designed reactors to produce energy and convert more Thorium into Uranium-233—you can keep adding Thorium endlessly.

Seventy years down the line, India is still stuck in the first stage. For the second stage, you need the fast breeder reactors. A Prototype Fast Breeder Reactor (PFBR) of 500 MW capacity, construction of which began way back in 2004, is yet to come on stream.

The problem is apparently nervousness about handling liquid Sodium, used as a coolant. If Sodium comes in contact with water it will explode; and the PFBR is being built on the humid coast of Tamil Nadu. The PFBR has always been a project that would go on stream "next year". The PFBR has to come online, then more FBRs would need to be built, they should then operate for 30-40 years, and only then would begin the coveted 'Thorium cycle'! Nor is much capacity coming under the current, 'first stage'. The 6,700 MW of plants under construction would, some day, add to the existing nuclear capacity of 6,780 MW. The government has sanctioned another 9,000 MW and there is no knowing when work on them will begin. These are the home-grown plants. Of course, thanks to the famous 2005 'Indo-U.S. nuclear deal', there are plans for more projects with imported reactors, but a 2010 Indian 'nuclear liability' legislation has scared the foreigners away. With all this, it is difficult to see India's nuclear capacity going beyond 20,000 MW over the next two decades.

Now, the question is, is nuclear energy worth it all?

There have been three arguments in favour of nuclear energy: clean, cheap and can provide electricity 24x7 (base load). Clean it is, assuming that you could take care of the ticklish issue of putting away the highly harmful spent fuel.

But cheap, it no longer is. The average cost of electricity produced by the existing 22 reactors in the country is around ₹2.80 a kWhr, but the new plants, which cost ₹15-20 crore per MW to set up, will produce energy that cannot be sold commercially below at least ₹7 a unit. Nuclear power is pricing itself out of the market. A nuclear power plant takes a decade to come up, who knows where the cost will end up when it begins generation of electricity?

Nuclear plants can provide the 'base load' — they give a steady stream of electricity day and night, just like coal or gas plants. Wind and solar power plants produce energy much cheaper, but their power supply is irregular. With gas not available and coal on its way out due to reasons of cost and global warming concerns, nuclear is sometimes regarded as the saviour. But we don't need that saviour any more; there is a now a better option.

Ocean energy

The seas are literally throbbing with energy. There are at least several sources of energy in the seas. One is the bobbing motion of the waters, or ocean swells — you can place a flat surface on the waters, with a mechanical arm attached to it, and it becomes a pump that can be used to drive water or compressed air through a turbine to produce electricity. Another is by tapping into tides, which flow during one part of the day and ebb in another. You can generate electricity by channelling the tide and place a series of turbines in its path. One more way is to keep turbines on the sea bed at places where there is a current — a river within the sea. Yet another way is to get the waves dash against pistons in, say, a pipe, so as to compress air at the other end. Sea water is dense and heavy, when it moves it can punch hard — and, it never stops moving.

All these methods have been tried in pilot plants in several parts of the world—Brazil, Denmark, U.K., Korea. There are only two commercial plants in the world—in France and Korea—but then ocean energy has engaged the world's attention.

For sure, ocean energy is costly today.

India's Gujarat State Power Corporation had a tie-up with U.K.'s Atlantic Resources for a 50 MW tidal project in the Gulf of Kutch, but the project was given up after they discovered they could sell the electricity only at ₹13 a kWhr. But then, even solar cost ₹18 a unit in 2009! When technology improves and scale-effect kicks-in, ocean energy will look real friendly.

Initially, ocean energy would need to be incentivised, as solar was. Where do you find the money for the incentives? By paring allocations to the Department of Atomic Energy, which got ₹13,971 crore for 2019-20.

Also, wind and solar now stand on their own legs and those subsidies could now be given to ocean energy.

India's Nuclear Energy Policy

Introduction

- In order to make policies for the use of atomic energy in peaceful manner, the Atomic Energy Commission was established in 1948.
- In order to execute these policies, the Department of Atomic Energy (DAE) was established in 1954.
- **There are five research centers in the Department of Atomic Energy-** (i) Bhabha Atomic Research Center (BARC) - Mumbai, Maharashtra. (ii) Indira Gandhi Center of Atomic Research (IGCAR) - Kalpakkam, Tamilnadu (iii) Center for Advanced Technology (CAT) - Indore (iv) Variable Energy Cyclotron Center (VECC) - Kolkata. (v) Atomic Minerals Directorate for Exploration and Research (AMD) - Hyderabad.
- The Department of Atomic Energy also provides financial assistance to seven national autonomous institutions, namely- (i) Tata Institute of Fundamental Research (TIFR) - Mumbai. (ii) Tata Memorial Center (TMC) - Mumbai. (iii) Saha Institute of Nuclear Physics (SINP) - Kolkata. (iv) Institute of Physics (IOP) - Bhubaneswar. (v) Harishchandra Research Institute (HRI) - Allahabad. (vi) Institute of Mathematical Sciences (IMSs) - Chennai and (vii) Institute of Plasma Research (IPR) - Ahmedabad.
- **Nuclear Power Program** - During the 1940s, a three-phase nuclear energy program was formed to use the country's uranium and the use of thorium resources in large quantities.
- In the ongoing first phase of the program, natural uranium fueled pressurized heavy water reactors are being used for the production of electricity. When the fuel used is processed again, it produces plutonium, which is used in the second phase as a fuel with natural uranium in a fast breeder reactor.
- The second stage uses more plutonium and uranium-233 when the fuel is re-processed, when the thorium is used as a cover. The third phase of reactor will use uranium-233
- **Heavy Water Production -** Heavy water is used in PHWR as a moderator and coolant.
- **Nuclear Fuel Production** - Hyderabad's nuclear fuel complex prepares essential fuel elements for pressurized heavy water reactors.
- It also produces elements of uranium fuel enriched with imported uranium hexafluoride for Tarapur's boiling water reactor.

Expected Questions (Prelims Exams)

1. Consider the following statements-

1. The first stage of nuclear energy programme uses natural uranium as fuel for electricity production.
2. During 1940, three stage nuclear energy programme was formed for using uranium and thorium resources in India.

Which of the above statements is/are correct?

(a) Only 1 (b) Only 2

(c) Both 1 and 2 (d) Neither 1 nor 2

Expected Questions (Mains Exams)

Q. Can ocean energy be used as an alternative to nuclear energy in future? Analyse. (250 Words)

Note: Answer of Prelims Expected Question given on 29 June. is 1(c).