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EDITORIAL

INDIA'S NUCLEAR POWER: A GREAT LEAP AHEAD

There is a problem in this country—sometimes suicidal. People, in many cases look at things through myopic visions of politicians. Result: occasionally growth in different sectors becomes under-understood, or rather misunderstood. Country's nuclear power programme is one of such sectors.

Backed up by our army of talented scientists and technologists, the nuclear power programme was flagged off on May 8, 1964 with an agreement with General Electric, USA for construction and commissioning of two Boiling Water Reactors (BWRs) of 210 MWe each at Tarapur in Maharastra. The first unit was synchronized to the grid on April 1, 1969 heralding a new era of nuclear power generation in the Asian sub-continent. The second unit was synchronized to the grid on May 8, 1969. The units were of silent emergence, very little known to public. But it's a grand success, equipped with, frankly speaking, meager support of indigenous industries. It was, as if, a journey from 'log cabin to the White House'.

Since inception, during the last 40 years many modifications have been carried out on both the units for safe and efficient operation. Review of the safety upgradation, operating experience, design and safety analysis was carried out in 2005 to ascertain safety to international standards. It is noteworthy that such a challenging job of modification and upgradation was accomplished by indigenous developments.

Meanwhile, something more happened at Tarapur. In the vicinity of Tarapur Atomic Power Station Units (TAPS – 1 and 2), two more units 3 and 4 of 540 MWe each with Pressurised Heavy Water Reactors (PHWRs) were set up. These units were totally indigenous, in which country's big industries like L & T, were involved. The construction of these units began on March 8, 2000, and within a record time of five years the work was complete. Unit 3 achieved first criticality on March 6, 2005. It was commissioned eight months ahead of schedule, and synchronized with the grid on June 4, 2005. Commercial operation started from September 12, 2005. Unit 4 reached the first criticality on May 21, 2006 and was synchronized with the grid on June 15, 2006. From August 18, 2006 it started its commercial operation.

Recently our Editor-in-Chief, Professor S. C. Roy and I visited the two 540 MWe reactors at Tarapur. The giant machines are so intricate that one cannot dream of. We saw the huge turbo-generator which was brought to tuning gear much ahead of the schedule, spectacular fuel machine head, and puzzling reactor building pump room with several kilometers long piping arranged in a zigzag way and huge generators producing deafening noise, for which we had to keep our ears plugged to enter into that area.

We were told that conceptual design of 540 MWe reactor has been evolved from its predecessor 220 MWe PHWR design. Important changes, as compared to the 220 MWe units, came from the advancement in reactor physics. In addition many design innovations in the 540 MWe have been introduced; these include use of two-tier reactivity device that control the reactor power, self-powered neutron detectors used for in-core flux monitoring for regulation, protection and flux mapping and introduction of liquid-zone control system for regulation of comparatively larger nuclear core than that of a 220 MWe unit. The improvements also include a primary heat transport system split vertically into two separate, independent and identical loops with a provision of pressure for steady and enhanced safe-operation, a new design of fuelling-machine using rack-and-pinion arrangement, fuelling machine air-lock system for movement of fuelling machine from both reactors to a common place for ease in maintenance; gas insulated switchyard to minimize the adverse effect of saline environment (since the units are situated very close to the Arabian sea), and all other required safety norms including the buildings qualified to withstand seismic effect. Similar modification, upgradation and increase of efficiency and safety measures with innovation are being implemented for other units with support of indigenous expertise and Indian industries. In fact some of our nuclear power technologies have proved not only at par, but above par in comparison with technologies elsewhere.

The entire country now needs a huge amount of electricity. Electricity—for expanding industries, for electric locomotives, housing and what not. Rural areas in particular need bulk of powers. Not only for lighting, but more importantly for micro-scale industries that are growing very fast.

According to the Annual Report: 2008 – 2009 of the Department of Atomic Energy (DAE) Government of India, the Nuclear Power Corporation of India Ltd. (NPCIL), a public sector undertaking of DAE, operates seventeen reactors with a total capacity of 4120 MWe, and is engaged in the construction of five nuclear power reactors at three projects sites, totaling 2660 MWe capacity. NPCIL initiated activities for new projects at Kakarapur in Gujrat for two 700 MWe PHWRs, at Kudankulam in Tamil Nadu for two 1000 MWe Light Water Reactors (LWRs), and at Jaitapur in Maharastra for two 1000 MWe LWRs. The work on Kudankulam Project, being implemented with Russian cooperation, achieved substantial progress. Nuclear fuel bundles for unit -1 have been received.

It is encouraging that work on mining, milling and processing of uranium ore, and fabrication of fuel by our experts are commendable. Heavy water is an important requirement for PHWR units. For this purpose heavy water production units have been installed and the utilization of it exceeded our expectations. Interestingly, the Heavy Water Board bagged three export orders for supplying of 27 MT of heavy water to a Korean firm for their PHWR and to M/S Spectra Gasses, USA and M/S Cambridge Isotope Laboratories, USA for deuterated compounds. Country, however, depends on uranium fuel. Although there was much political controversy about it, the matter has been sorted out. As, Prime Minister Manmohan Singh has recently said: “The speed with which we can develop nuclear power is constrained by the availability of uranium. The initiative to open civil nuclear trade with the international community is a step towards accelerating the development of nuclear energy in the service of our country. This initiative will have far reaching effects on the growth of nuclear energy in India and I can say that it is a period of transition in our programme . … We have now removed the restraints that have hindered the atomic energy programme in the past. If we show the same wisdom, pragmatism and foresight that Dr. Homi J. Bhabha did, I have no doubt that we will move ahead purposefully and substantially to realize the grand vision”.

It is not just an optimistic statement of Dr. Singh. He is right that we are passing through a stage of ‘transition’. India is now going to set up another stage of her firm activity in the arena of nuclear power generation. Our country has the second largest source of Thorium (Th) in the world. At Indira Gandhi Centre for Atomic Research (IGCAR) at Kalpakkam speedy activities have been undertaken to use Thorium-232 to convert into Uranium-233 (U-233) which is fissile, and then to use U-233 to produce nuclear energy. The work is progressing very fast and it is very much encouraging. Scientists and technologists are confident in harnessing power commercially from thorium in near future, and in larger extent. When this is done, India need not have to depend much on the import of uranium. Thanks to our industries for their support in this regard which is also unique.

True, after the detonation of the 'Little Boy' and the 'Fat man' on Hiroshima and Nagasaki, the word 'nuclear' created fear psychosis in millions and millions of people. Immediately after that strong campaigns were organized in many countries against nuclear activities. Among many leaders of repute, there were Nobel-scientists like Linus Pauling and George Wald. I remember, during a personal conversation with Wald, Wald told : "I am antinuclear, even against the peaceful nuclear activities. That includes also nuclear power production. Because the latter can produce plutonium, which can be pirated and shipped in plastic bags preventing rediation hazard and can be used to make piggy atom bombs by terrorists, which they can throw at their largest by ordinary rocket launchers".

However, with time gone by, strong international consensus has been established in regard to tight security measures for nuclear activities, and under the circumstances such chances are now remote.

Regarding nuclear power plants, critics in the country often ask two major questions: 1. How safe are our nuclear power reactors ? 2. Economically how much conducive ?

Firstly, there were few accidents in power reactors, like Chernobyl, Three Miles Island, etc. but Indian power reactors have been found to be quite safe so far (except a few minor anomalies).

Secondly, lands acquired for our nuclear power plants are mostly unproductive or underproductive (as at Tarapur). It is seen that after the plants coming up, the lands are developed, new townships have been brought up with various socio-economic supports, such as good housing, school and colleges, medical centres, facilities of shopping and recreation. Also, ancillary industries creating employment potential.

It is expected, while addressing the public on the establishment of the third frontier of energy (nuclear), all these aspects with pros and cons, should get priority, not just narrow political jargons. If it is done, people at large only then can feel about the positive implications of nuclear power plants and enable them to be invovled in the affairs of the nuclear power programme of the country. This is what is now needed most.

Needless to say, the entire country now needs a huge amount of electricity. Electricity— for expanding industries, for electric locomotives, housing and what not. Rural areas in particular need bulk of powers. Not only for lighting, but more importantly for micro-scale industries that are growing very fast. The latter is very important for socio-economic growth of rural folk, which has been very much neglected. Thermal and hydro power alone cannot meet the requirement. Under the circumstances, nuclear power can be the only alternative. Moreover, nuclear power is clean. It does not produce greenhouse gases and helps to keep our planet cooler. So its growth must not be undermined. Any political undergame in this regard can be suicidal and will be against the interest of the nation.

Nuclear power can be the only alternative. Moreover, nuclear power is clean. It does not produce greenhouse gases and helps to keep our planet cooler. So its growth must not be undermined. Any political undergame in this regard can be suicidal and will be against the interest of the nation.

More about the nuclear power and overview of other scientific, technological and societal activities of the Department of Atomic Energy has been presented in the Cover Article of this issue. ❐

Samarjit Kar

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INDIAN SCIENTISTS VS. SCIENCE AND RELIGION

In an excellent article Swami Sarvabhutananda shows that Acharya J.C. Bose's research on the plant physiology was influenced by Indian religion and philosophy.[1] In this context it will be worth to see the cases of : M.N. Saha, S.N. Bose and C.V. Raman.

Once S.N. Bose was asked: Whether he was influenced by Indian philosophy, while deriving Planck radiation law by applying Albert Einstein's concept of light quanta? Bose found it absurd and told, "*so!, Yes, Indian philosophy had taught* him a great dea*l; no, Indian philosophy had* ***not*** *influenced his physics* (emphasis in original)"[2]

M.N. Saha's biographers S. Chatterjee and E. Chatterjee wrote that a gentleman wanted to know about Saha's research work. When he started explaining, he was interpreted again and again with the comment. "*But this is nothing new, we have all this in the 'Vedas'."* However, the gentleman, was unable to tell Saha, in which parts of the *Vedas* is the theory of ionisation. Such statements irritated Saha,[3] whose scientific work was influenced by Agnes Mary Clerke - who wrote books on astronomy.[4]

Indian's Nobel Laureate C.V. Raman once disclosed that *The Sensations of Tone* by the Germany scientist H. Helmholtz, profoundly influenced his intellect. From that he learnt what research means and how to undertake it.[5] Raman was a progressive believer. In one of his speeches he said that "*There is no Heaven, no Swarga, no Hell, no rebirth, no reincarnation and no immortality. The only thing that is true is that a man is born, he lives and he dies. Therefore, he should live his life properly*" (Document No. RP-6.15, Courtesy Archive Raman Research Institute, Bangalore). What meant God for Raman is reported as follows: "*If there is a God, we must look for Him in the universe. If He is not there, He is not worth looking for.*"[6]

From the forgoing discussion, it can be said that contrary to J.C. Bose, the scientific works of S.N. Bose, C.V. Raman and M.N. Saha were not influenced by the Indian religion and philosophy. However, my result cannot be interpreted as the final statement as it is based on "only three case studies". In order to arrive a general conclusion on the topic a detail study is suggested.

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