Patentmatics Monthly Bulletin, May 2018.

Focus Area: Indian nuclear power program.

1. Recently Indian Express has written an important article on the Indian nuclear program as described below.

Boost to nuclear-power: Two Australian firms in talks to export uranium to India.

A steady supply of uranium is good news for the country's nuclear power sector, something that is expected to boost the performance of Indian nuclear power plants, as well as of several fuel cycle facilities.

Written by Anil Sasi | Indian Express, New Delhi , May 2, 2018

Two Australian companies BHP Billiton, the world's biggest mining company, and Heathgate Resources, an affiliate of US company General Atomics, are in discussions with the Department of Atomic Energy (DAE) for exporting uranium to India.

A sales contract for enabling the transfer, which is part of the ongoing commercial negotiations between Australian uranium vendors and India's DAE on fuel contracts for civil nuclear-power generation, is currently under discussion, officials indicated.

Once the contract is wrapped up, Australian companies could potentially join utilities from four other countries that are already supplying nuclear fuel to India.

Incidentally, in July 2017, Australia had sent its first

uranium shipment to India but that was "a small sample of uranium" transferred "purely for testing purposes," according to a statement by the Australian government.

Imported uranium from Australia, as and when despatches start, would be used to meet fuel requirements of Indian nuclear reactors that are under International Atomic Energy Agency (IAEA) safeguards, as is the case with fuel imports that have come in so far from Russia's JSC TVEL Corp, Kazakhstan's JSC NAC KazatomProm, France's Areva and Canada's Cameco.

In India, there are currently 22 reactors with an installed capacity of 6,780 MWe (mega watt electrical), of which, eight reactors with aggregate capacity of 2,400 MWe are fuelled by indigenous uranium while the remaining 14 with a capacity of 4,380 MWe are under IAEA Safeguards and qualify to use imported uranium.

A steady supply of uranium is good news for the country's nuclear power sector, something that is expected to boost the performance of Indian nuclear power plants, as well as of several fuel cycle facilities.

Former Australian Prime Minister Tony Abbott had signed an agreement with Prime Minister Narendra Modi for civil nuclear cooperation in September 2014, clearing the way for uranium sales. Australia's current PM, Malcolm Turnbull, had said in April last year that he was looking forward to exporting uranium to India "as soon as possible" after holding talks with the Indian PM.

Ongoing discussions with Melbourne-based BHP and Adelaide-based Heathgate Resources are aimed at formalising commercial contracts to enable uranium

shipments to India.

During the first nine months of FY'18, over 1,900 metric tonnes (MT) of uranium ore concentrate had been shipped into India from Kazakhstan and Canada, or nearly 80 per cent of the record 2,419 MT that was imported the previous fiscal.

While uranium supplies holding up is a positive trend, coming alongside plans outlined by the DAE to ramp up domestic uranium production ten-fold over next 15 years (by 2031-2032), nuclear generation has faltered marginally.

During the current fiscal, upto December 2017, the capacity factor — the ratio of the net electricity generated, for the time considered, to the energy that could have been generated at continuous full-power operation during the same period — was recorded at 67 per cent. While this is data for nine months and not for the full year, the capacity factor was down to a nine-year low.

The reasons include tepid demand in the wake of a delayed industrial recovery and subdued demand on account of domestic load.

Under the "separation plan" announced by the government in March 2006, negotiated after the July 2005 nuclear deal with the US, India was required to bring 14 reactors under IAEA safeguards in a phased manner. Thirteen of these reactors, including RAPS 2 to 6 at Rawatbhata, Rajasthan; KAPS 1 and 2 at Kakrapar, Gujarat; NAPS 1 and 2 at Narora, Uttar Pradesh; TAPS 1 and 2 at Tarapur, Maharashtra; Kudankulam 1 and 2

in Tamil Nadu; are already under IAEA safeguards, and eligible to run on imported fuel.

Officials of Nuclear Power Corporation of India Ltd (NPCIL), which runs the country's nuclear power plants, said the other reactors, KGS 1 to 4 at Kaiga, Karnataka; MAPS 1 and 2 at Kalpakkam, Tamil Nadu; and TAPS 3 and 4 at Tarapur, Maharashtra, continue to use uranium sourced within the country.

Official sources said that the Department of Atomic Energy reckons the annual fuel needed for operating the indigenous pressurised heavy water reactors (PHWRs) at 85 per cent capacity is about 45 tonnes of uranium dioxide for the older 220 MWe units, 100 tonnes for the 540 MWe units and 125 tonnes for the new 700 MWe units.

In contrast, the need of low-enriched uranium for operating imported light water reactors (LWRs) at 85 per cent capacity factor are six tonnes for the older 160 MWe Tarapur units and 27 tonnes for 1,000 MWe units such as the twin Russian-built VVER-1000 reactor units at Kudankulam.

The total installed capacity is targeted to go up to 9,980 MWe, with seven new reactors getting progressively commissioned. These include the imported LWRs of Russian design, four indigenous PHWRs, and one indigenous prototype fast breeder reactor (PFBR).

In May 2017, the Union Cabinet gave its approval for the construction of 10 units of the new indigenous 700 MWe PHWRs. The addition of 7,000 MWe is more than the combined present installed capacity of 6,780 MWe.

The new reactors are of significantly higher capacities

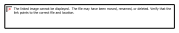
compared to the PHWRs currently under operation — the standard PHWR being used in India is of 220 MWe though two 540 MWe reactors were installed in Tarapur in 2005 and 2006.
The ten reactors will be installed in Kaiga in Karnataka (Unit 5 and 6), Chutka in Madhya Pradesh (Unit 1 and 2), Gorakhpur in Haryana (Unit 3 and 4) and Mahi Banswara in Rajasthan (Unit 1, 2, 3 and 4). Alongside this, eight LWRs based on international cooperation — with Russia, France and the US — adding up to a capacity of 10,500 MWe, are slated to be taken up for execution".

3. Knowing by previous experience, one has serious reasons for pessimism. Countries like Japan, Australia and so on are not satisfied with our not signing the NPT yet. In essence India may have to be satisfied with the existing suppliers from the erstwhile Soviet Union and other more friendly countries only for its otherwise totally self-reliant nuclear power program! The present level has been attained, thanks to the Growing Science strategy enunciated by its founder chairman, Homi Bhabha. His strategy was elucidated lucidly in an earlier article by this author in Financial Express which is reproduced below.

Atomic Energy Act, Patent Act & India's Nuclear Self Reliance

Immediately after the earthquake in Gujarat, there were reports that the 440MW Kakrapara Atomic Power Station, a few hundred kms from Bhuj, the epicentre of

the massive earthquake, continued to function normally; so also all the 14 other stations (total capacity 3000MW), these having in-built safety features designed especially to withstand severe earthquakes. This, along with what were demonstrated earlier at Pokran, adequately show the high-level indigenous expertise of the nation in nuclear and allied technology achieved over the past three/four decades. These achievements were possible due to the farsighted strategy pioneered by its founder-leader Dr Homi Bhabha and the able team around him.

A brief description of Dr Bhabha is in order. 
Let me quote his brother JJ Bhabha:

His immense latent talents blossomed soon after he joined Gonville and Cais College in Cambridge in October 1927 to take the Engineering Tripos. So great, however, was the impression made on him by the brilliant physicists and mathematicians working with Lord Rutherford at the Cavendish Laboratory that within a year he pleaded with his father to be permitted to switch from engineering to the Mathematics Tripos. He wrote with the passion of a boy of 18 thus: "I seriously say to you that business or a job as an engineer is not the thing for me. It is totally foreign to my nature and radically opposed to my temperament and opinions. Physics is my line...I am burning with a desire to do physics. I will and must do it some time. It is my only ambition, I have no desire to a 'successful' man or the head of a big firm. There are other intelligent people who like that and let them do it (referring to the invitation from his uncle Sir Dorab Tata,

then chairman of Tata Sons Ltd, to join Tisco). Dr Bhabha got a first class in engineering as promised to his father and then went for Mathematics Tripos with support from his father. In 1934 he explained to a friend on his philosophy of life thus: "I know quite clearly what I want of life. Life and my emotions are the only things I am conscious of. I love consciousness of life and I want as much of it as I can get. What comes after death no one knows. Nor do I care. Since therefore I cannot increase the content of life by increasing its duration, I will increase it by increasing its intensity... Nothing is irreversible except death. This is my philosophy of life." Returning home as an accomplished engineer-scientist, he chose to work for India as a conscious choice at the Indian Institute of Science at Bangalore. The letter which he wrote in March 1944 to the Tata Trust on the need for an advanced nuclear research centre is too well known. He wrote thus: "When nuclear energy has been successfully applied for power production, in say a couple of decades from now, India will not have to look abroad for its experts but will find them ready at home."

Thus was born TIFR, the cradle of our nuclear energy programme.

In his famous lecture on 'Science and the Problem of Development' delivered on January 7, 1966, before the International Council of Scientific Unions, Dr Bhabha elaborated his concept of 'Growing Science' and said: "An important question which we must consider is whether it is possible to transform the economy of a

country to one based on modern technology developed elsewhere without at the same time establishing modern science in the country as a live and vital force. If the answer to this question is negative, and I believe our experience will show that it is so, then the problem of establishing science as a live and vital force in society is an inseparable part of the problem of transforming an industrially underdeveloped country to a developed society."

Dr Bhabha had no difficulty in accepting the need for technology import. He said: "When a strong scientific and technological base has already been laid (as was done at the Trombay establishment), foreign collaboration can certainly lead to a quicker take-off."

But then he warned: "The relative roles of indigenous science and technology and foreign collaboration can be highlighted through an analogy. Indigenous science and technology plays the part of an engine in an aircraft, while foreign collaboration can play the part of a booster. A booster in the form of foreign collaboration can give an assisted take-off, but it will be incapable of independent flight unless it is powered by engines of its own. If Indian industry is to take-off and be capable of independent flight, it must be powered by science and technology based in this country."

Elaborating the theme to a major sector such as steel, he said: "The steel industry has existed in India since the First World War, and one of the two steel plants was

among the largest in the British Commonwealth in the early twenties — the construction and operation of a number of steel plants (as happened during the subsequent period) has not automatically generated the ability to design and build new plants. Unless powerful scientific and engineering groups are established during the construction and operation of existing steel plants as a matter of deliberate policy, the dependence on foreign technical assistance will continue and the steel industry will not reach a stage of technical self reliance. A similar situation exists in almost every other industry."

The strategy worked out by Dr Bhabha for nuclear technology was based on his own 'growing science' approach. It had the following major elements:

*** Evaluation of the technology gap in the field between India and advanced countries in all aspects, including the nature of IPRs related to it;**

*** Importation of appropriate technology wherever feasible and thereby utilising the opportunity to get a quick 'assisted take-off';**

*** Systematic development of the appropriate indigenous science and technology (S&T) infrastructure to assimilate the 'know-how and know-why' of designs, equipment and systems; and**

*** Providing adequate legal/administrative policy support for implementing the indigenous development programme, including support measures to overcome**

issues connected to IPRs.

As part of such an S&T strategy, the department of atomic energy (DAE) undertook the following tasks. Establishment of the Trombay nuclear reactor as the main R&D centre, to be followed by others dealing with the differing aspects of the nuclear programme, construction and operation of CIRUS research reactor at Trombay and the CANDU Power Reactor at Rajasthan based on technology import from Canada, enactment of the Atomic Energy Act, 1962 , defining the nature and scope of nuclear science and technology in our country and making all items covered under the Act non-patentable and introducing the same provision as Clause 4 in the Indian Patents Act, 1970, and thereby providing adequate legal protection for all S&T programmes related to systematic indigenisation and innovation wherever required.

Thanks to such a farsighted strategy, DAE was able to execute its task with great success, notwithstanding even the non-trade barriers such as embargoes of large number of items from the advanced countries. It is to be noted that the Clause 4 is being retained in the new Patent Bill also. Importantly enough, there were many similar 'protective' clauses in the Indian Patent Act, 1970 which were consciously introduced (as recommended by the celebrated Justice Rajagopal Ayyangar Committee Report) such that they could be utilised by the national S&T and industrial community to develop indigenous capability. Thanks to such provisions and matching

policies of the government, large scale indigenisation/ innovation could be achieved in strategic sectors such as aerospace and defence sectors and in a very limited manner in the area of specialty chemicals including drugs and agrichemicals. The new Bill, however, has replaced these clauses with major TRIPS-compliant modifications, with respect to virtually all but the nuclear sectors. Happily enough, there is lately increasing recognition in our country that the implications could be very serious and far-reaching.

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the controversial Hyde Act dictated US-India Nuclear Agreement of 2005 has not been able to amend the essential elements of our indigenous nuclear program, thanks to the dedicated opposition in all concerned sectors of Indian public opinion!

Let us have trust in ourselves to continue to fight against surrendering even marginally our hard won political and strategic sovereignty!

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