The Insider's View Part 1

Golden opportunities in India's nuclear program

This month Nuclear Exchange is pleased to present the first part of an insightful interview with Mr. Swapan K. Ghosh, Former Director and Outstanding Scientist at Nuclear Power Corporation India Ltd (NPCIL). With over 42 years of experience, he a leading figure in the industry and an expert in both Fast Breeder Reactor and Pressurized Heavy Water Reactor technology. Mr. Ghosh is ideally qualified to explain the bold plans for India's expanding nuclear program and the many opportunities it will offer to suppliers around the globe. He is also able to explain the unique history and technology of this nation which was forced to develop its own indigenous thorium-based nuclear reactor technology to meet its huge energy needs.

By Joanne McIntyre

"India has ambitious nuclear power expansion plans to reach 63000 MW by the year 2032 by setting up nuclear reactors based on both indigenous technologies of Pressurized Heavy Water Reactors (PHWR) and Fast Breeder Reactors (FBR) and also large scale Light Water Reactors (LWR) based on international cooperation," explains Mr. Ghosh. "The plan has been drawn up to realize the vision of reaching 63,000 MW over the next two decades.

Mr. Swapan Ghosh: "We are on the right track to achieve India's mission of energy security."

It envisages 40,000 MW from LWRs based on international cooperation, 14,000 MW indigenous PHWRs (including 7,000 MW based on recycled uranium) and the remaining through Fast Breeder Reactors."

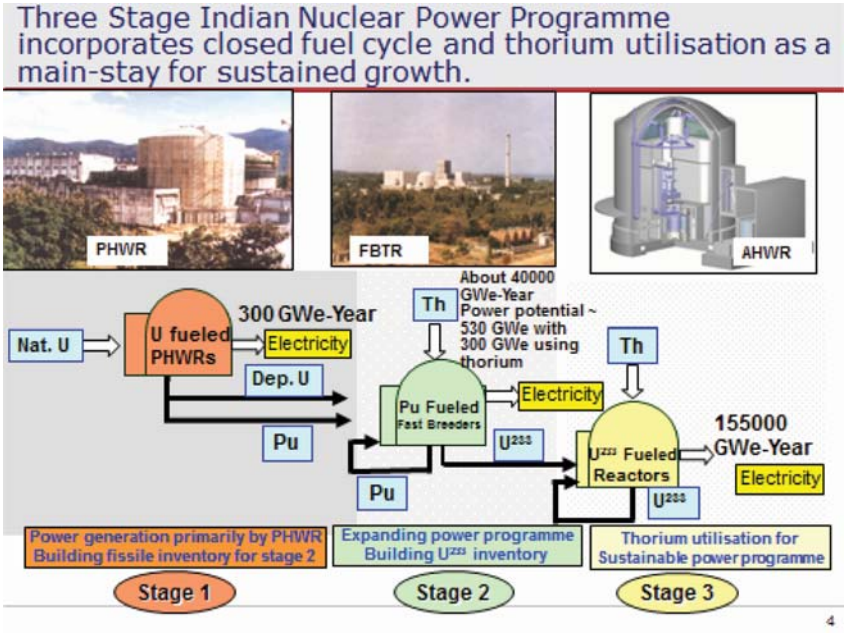
"India is among a few countries in the world that have a large scale nuclear power program planned for the next two decades. Since a large number of nuclear power plants have been planned for implementation with international co-operation in addition to the indigenous PHWR program, it will be a great opportunity for nuclear industry suppliers across the world to participate. It would be very difficult for the Indian nuclear industry to service this large program alone within the projected schedule without significant participation by foreign nuclear suppliers."

Unique indigenous nuclear program

Due to non-signatory of NPT and its non-civilian nuclear program India is outside of the Nuclear Non-Proliferation Treaty, which meant that for 34 years it was largely excluded from the international trade in nuclear technology or materials. This factor and a limited indigenous uranium reserve lead the country to uniquely develop a nuclear fuel cycle to exploit its large reserves of thorium. Following the Nuclear Suppliers' Group agreement which was achieved in September 2008, the scope for the supply of both reactors and fuel from suppliers in other countries opened up. Civil nuclear cooperation agreements have since been signed with many countries including the USA, Russia, France, UK, South Korea and Canada.

"India developed the Three Stage Indian Nuclear Power Program," explains Mr. Ghosh. This comprises Pressurized Heavy Water Reactors (PHWR) in the first stage, Fast Breeder Reactors (FBRs) in the second stage, and thorium-based systems in the third stage. It is a sequential program based on a closed fuel cycle where the spent fuel of one stage is reprocessed to produce fuel for the next stage. This multiplies the energy potential of the fuel and greatly reduces the quantity of waste, and essentially aims to optimally utilize the country's nuclear resources of limited uranium and abundant thorium. It is thus a single-basket solution for meeting the country's energy needs in a sustainable manner, while also securing its energy future in the long term."

Thorium is a fertile material and it needs to be converted into a fissile material - namely U-233 - prior to its utilization in a nuclear reactor. This conversion process can be optimally carried out in Fast Breeder Reactors (FBRs) which is a part



of India's second stage program. As part of the third stage program, Advanced Heavy Water Reactors (AHWR) will soon be launched.

"The fuel to drive AHWRs can be LEU-Th or Pu-Th or U-233-Th and as such we need to produce sufficient fuel for commercial exploitation of thorium based reactors. In order to expedite the third stage of the program, the second stage with commercial FBRs are to be built and operated successfully. In the meanwhile, a prototype 500 MWe FBR is in advanced stage of construction at Kalpakkam, Tamil Nadu. I feel that we are on the right track to achieve India's mission of energy security."

Golden opportunities for foreign suppliers

Consequent to Indo-US Nuclear Deal, the clearance of nuclear commerce with India by the Nuclear Suppliers Group (NSG) in 2008 brought to fruition the efforts of the country to access international cooperation in nuclear energy. This enables India to import fuel and set up large-capacity Light Water Reactors based on technical cooperation to meet the country's growing energy needs. It also enables India to export reactors, equipment and components as well as services to the global nuclear energy market. The Indian PHWR program has evolved and progressed over the years in steps of indigenization, standardization, consolidation and commercialization.

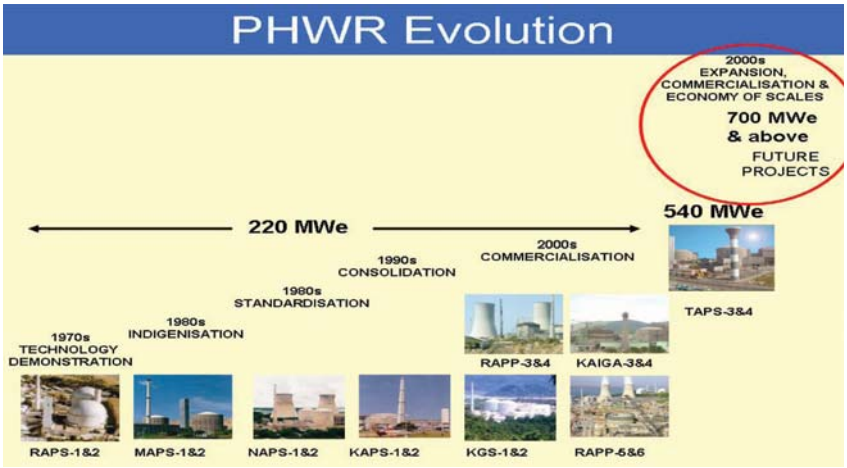
To understand and appreciate the nature of opportunities that will be available, it is important to know the history of nuclear power evolution in India. The first commercial nuclear power reactors in India, two Boiling Water Reactors (BWRs), were launched in 1964 at Tarapur in Maharashtra on a turnkey basis by General Electric. These reactors started commercial operation in 1969. The aim of setting up these reactors was essentially for absorption of the technology and to gain experience in the operation of nuclear power plants. Subsequently, two units of PHWRs of first stage of the three stage program were also launched in technical cooperation with AECL, Canada in 1966 at Rawatbhata in Rajasthan. All foreign cooperation ended abruptly in 1974 when a peaceful nuclear test was carried out and an embargo on the trade of nuclear technology and materials was enforced. The construction of a Fast Breeder Test Reactor (FBTR) in collaboration with CEA, France at Kalpakkam, TamilNadu also ran into difficulties.

"Indian scientists, engineers and our industries took up the challenge and played a very important role in successfully commissioning these reactors," continues Mr. Ghosh.

"India today is recognized as a country with advanced nuclear technologies. Comprehensive indigenous capabilities have been developed in all aspects of nuclear power and associated fuel cycles. It has a large R&D base, qualified human resources and facilities for continual development, industrial capability and capacity and a robust regulatory framework. The performance of Indian nuclear power stations and implementation of projects have been comparable to international benchmarks."

"In view of these factors, the emerging opportunities are not limited to participation in the large Indian nuclear power program but also to utilize the Indian expertise and industrial infrastructure for the progress of nuclear power across the world."

"I feel that being isolated from international nuclear commerce from 1974 until 2008 was a blessing in disguise. Indian engineers, scientists and industries were forced to develop their



Mr. Swapan K. Ghosh
Consulting Engineer, Former Director (HR) & Outstanding Scientist at NPCIL

Mr. Ghosh has over 42 years of experience in nuclear power industry with Fast Breeder Reactor (FBR) technology and Pressurized Heavy Water Reactor (PHWR) technology. As Senior General Manager, Contracts & Materials Management (CMM) Directorate at NPCIL, he was responsible for the total supply-chain management for 220 MWe and 540 MWe PHWR reactors. He contributed significantly to the evolution of contracts and purchase policies with respect to mega EPC contracts which were successfully implemented for the 2 x 540 MWe TAPP Units 3 & 4. For over 14 years he led the CMM functions of NPCIL, finalizing contracts worth several hundred Crores of Indian Rupees. On superannuation from NPCIL and on completion of a contract with Walchandnagar Industries Ltd. as Advisor to MD & CEO, Mr. S.K.Ghosh is now a Consulting Engineer for the nuclear business.

own technology during this technology denial regime, which is now paying a rich dividend to the Indian nuclear program."

"Our technical specifications are mainly based on ASME Section III guidelines with additional mandatory and recommendatory requirements from the knowledge & experience gained during indigenization efforts of nuclear technology. As long as the suppliers meet the technical specification requirements and qualification criteria, the approval to be a part of the supply chain is a routine affair."

the day-to-day operations, while the manufacturers provided their men and machines to manufacture nuclear components. Several development efforts, trials and mock-ups were carried out to achieve the requisite nuclear standard. This special package helped in the development of nuclear industries in India."

"Over the years the Indian industry has matured; today no free-issue materials are being supplied and contracts are awarded on a competitive tender basis. It can be

the technology, documents and drawings were supplied in French, and the French experts were only able to communicate in their own language! All Indian scientists and engineers underwent a comprehensive French language training course for several months and they then translated the technical specifications, documents and drawings into English. Being a member of this team, I felt proud and privileged to learn the French language in 1970s and I continue to cherish that today."

"This is a great opportunity for suppliers around the world to participate in India's nuclear program"

Long history of nuclear development

Looking back over a long and successful career, Mr. Ghosh has witnessed many changes in the nuclear industry, both globally and within India. "During the early days of nuclear power program in India, local industries were not very keen to venture in this business. The Department of Atomic Energy and NPCIL were compelled to evolve a special policy to attract and assist them. All raw materials were supplied as free-issue along with the domain knowledge and technical assistance, and financial assistance was provided to meet the cash-flow requirements. Nuclear engineers were posted at the manufacturer's premise to extend technical help and supervise

said that the special package to help the Indian industries during initial years of 1970s & 1980s has paid a rich dividend for the progress of nuclear power in India."

"During this time the global nuclear business has also progressed and matured," continues Mr. Ghosh.

"I remember back in 1970s when the Fast Breeder Test Reactor (FBTR) project was built in collaboration with France,

"Today NPCIL in collaboration with AREVA, France in planning to build 1650 MWe EPR reactors at Jaitapur, Maharashtra. The technical documents and drawings are supplied in English, and the AREVA scientists & engineers are all fluent English speakers. Under a globalized business environment, language is no longer a barrier and nuclear power has progressed."

Next time in Part 2...

In the March issue read Part 2 of Mr. Ghosh's Insider's View. Learn the main products that the Indian nuclear industry is looking to source from foreign suppliers, advice on the challenges suppliers face, and the long term energy strategy that will see India's nuclear program continue to flourish.