Journey I Enjoyed Amidst Challenges

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I was born on 10th January, 1949 in a middle class family. My mother, in particular had a great influence on my education, compassionate feeling towards the needy and fellow human beings, and inspired me to be dedicated to my job. I studied in a reputed government school in New Delhi, where the school teachers had shown extra affection and care for potential students who could get distinction in mathematics, physics and chemistry. I passed the school with distinction in these subjects.

The Central Board of Secondary Education at that time had a system unlike present time where the 11^{th} Board examination was based on the entire teaching from 9^{th} to 11^{th} class. There was no concept of coaching for IIT examination at that time. God has been extra kind to me in remembering with ease chemistry chemical equations and mathematical formulae and confidence in examinations.

I got selected in IIT thanks to my performance particularly in chemistry and mathematics and was offered mechanical engineering at IIT Kanpur / electrical engineering at IIT Delhi. Not able to imagine living away from my family, in particular from my mother, and being advised that mechanical engineering is the best branch, I joined Delhi College of Engineering in 1965 in mechanical engineering.

To take a job or opt for higher education after passing engineering in 1970 was a tough decision. I got selected for M.Tech at IIT Kanpur but did not join. An important lesson was learnt of engineering when one of my friend who appeared along with me for IIT Kanpur was advised that one cannot afford to forget fundamentals. I joined IIT, Delhi for M. Tech in thermal engineering. In the meantime, I was selected in Bhabha Atomic Research Centre (BARC) training school for a career in Department of Atomic Energy(DAE). After very prolonged discussions, I opted for the BARC training school, a decision I cherish as it has been very challenging and professionally rewarding.

The life in training school revolved around examinations on vastly different subjects on almost every Saturday Though at that time, I felt why a mechanical engineer should be taught so much physics and control systems, with time I realised the importance as my responsibilities increased in the organisation. It is important for all of us to do our best to learn other disciplines and respect the same. I did my best to perform in all subjects. I completed the post graduate training in nuclear engineering in 1971 with high ranking. Despite many other placement options, I was particularly lured by the challenges and importance of Fast Reactors, and joined the then Reactor Research Centre (RRC) at Kalpakkam, almost a village at that time and very far from my hometown Delhi. From August 1971 (beginning of my job) to January 2013 (superannuation), I was at Kalpakkam and held different positions at Indira Gandhi Centre for Atomic Research (earlier RRC).

After spending my first two years in engineering experiments in support of fast reactors, I joined the design team. I was engaged in the design of heat transport system of Fast Breeder Test Reactor (FBTR) in particular for sodium heated steam generators, the component known to decide plant availability. My senior engineers had enormous confidence in me and it made me work hard. I am extremely satisfied and feel proud that the steam generators and other equipment designed as well as system modifications carried by me for FBTR have been functioning to the desired level since beginning of FBTR operations.

For FBTR, when the bids were opened for the rupture discs, safety device to relieve pressure resulting from large sodium water reaction, the offers were far beyond the estimated value. The then Director and Principal Design Engineer decided to opt for indigenous development and entrusted the job to me. The rupture disc design primarily involves sheet metal forming to spherical shape without any die, theory of elastic buckling, and material hard enough to cut the stainless steel disc on reversal at set pressure. With the support of my draughtsman and unskilled labour, the development was successfully accomplished after a number of trials. In this journey of development, enormous moral support came from my seniors. All the rupture discs assemblies manufactured in-house were installed in FBTR. With time I realised and advised my young engineers that Indians could accomplish many challenging engineering tasks. The principal ingredients are confidence of seniors and technology denial by other developed nations.

During the course of my interactions with my Principal Design Engineer, I noticed him performing back of envelope calculations. I got inspired by this approach. With gift of memory of numbers and formulas in strength of materials, fluid mechanics and heat transfer, I started checking the design of my young engineers as I grew up in the organisation. I am of the strong opinion that every engineer should develop taste for approximate estimates through analytical approach through use of formulae even in present era of every activity solving by ‘software’.

It was realised at the early stage of my design activity that one needs to acquire expertise and accordingly I spent on regular basis considerable time at home to read design codes, background journal papers, and effect of imperfections on structural integrity of mechanical components. The expertise acquired has been of great help in taking decisions on non-conformances in manufacture of reactor components based on “fitness-for-purpose”. My interest in design codes increased with passage of time and I could spare time even when I was Director. It led to a number of modification proposals for both American and French pressure vessel codes.

Based on confidence in design and construction of FBTR, the Department of Atomic Energy took a tough decision to opt for indigenous design and construction 500 MWe Prototype Fast Breeder Reactor (PFBR). I was associated with this project since beginning and have enormous satisfaction to have contributed to this project in a number of ways. This includes conceptual design, detailed design, material selection from fuel cladding to condenser tubing, R&D, regulatory clearances from regulatory authorities, and dealing with deviations during manufacturing. There is feeling of pride that I had played a crucial role in encouraging and inspiring the Indian industries to successfully manufacture the reactor components, first of a kind, to very challenging specifications.

A great challenge and opportunity came in my career when I was asked to lead a composite team to select the materials and to define R&D for materials development for 500 MWe PFBR at young age of just 26 years. I enjoyed learning the subject of materials, in particular, mechanical metallurgy. I worked very hard to get grip over the subject of materials. The complimentary knowledge of design, materials, and relationship of materials with design has been of great help to me in carrying out a number of technical activities outside the Department. This includes the design and manufacturing of retorts for zirconium sponge plant and titanium sponge plant, and materials selection and its successful development for advanced ultra super critical thermal power plant.

Based on my interactions with engineers who have been exceptionally successful, I will like to sum up by stating that that every engineer should aim to follow ten E" commandments, as applicable, viz. I) Enjoy your professional and home life ii) be Effective in every activity you undertake iii) look for Excellence IV) do not be Emotional in both grand success and utter failures v) be Experimentalist vi) put Extra Effort to get success vii) upgrade your Education continuously viii) be Ethical ix) Express your views clearly x) design an Economical product.

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