Nuclear Energy
A Story of Unkept Promises

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BOOK REVIEW

The Power of Promise: Examining Nuclear Energy in India by M V Ramana, *Penguin Viking, 2012; pp 366, Rs 699.*

Nuclear energy invariably tends to bring up two extreme world views. The mainstream position is that of limitless, cheap and secure energy with a new found green (i e, climate-friendly) tag. The non-mainstream position is that nuclear power is a risky high cost option which has significant impacts on public health and the local environment and tends to distract from the process of building a safe and secure energy system-based largely on renewables and energy efficiency. As one can imagine, the reality is somewhere in between, though the evidence in this book suggests it is closer to the latter view, at least in the Indian context.

Public discourse on nuclear energy in India has always vacillated between such extremes and has been dominated by hyperbole. Hence this latest book, *The Power of Promise: Examining Nuclear Energy in India* by M V Ramana, is extremely timely and will hopefully bring in the much-needed objectivity and depth to the polarised public debate. Ramana is a physicist and has been a leading researcher and critic of the Indian nuclear scenario for over a decade. This book brings together the essence of his research and publications over the years. *The Power of Promise* is a solidly researched book (with over 50 pages just in references) that critically examines all aspects of the Indian nuclear energy sector right from the days of its inception to the present day. It systematically analyses all aspects of the sector: institutional, technological, economic and socio-environmental. The evidence presented in the book strongly suggests that the current plans of the nuclear energy sector in India are not economically sound, technologically feasible or environmentally benign. While this is alarming enough, even more worrisome is the institutional challenge that seems to make a mockery of democratic principles.

The aptness of the book's title is best illustrated by considering nuclear power generation capacity targets and achievements over time. The target for the year 2000 (set in 1984) was 10,000 MW, but what was achieved was a meagre 1,840 MW or 18% of the target. The Integrated Energy Policy (IEP) of 2006 from the Planning Commission had envisaged a cumulative nuclear capacity of 9,000-11,000 MW operation by 2010, while the reality in 2013 is only half of that at 4,780 MW.

As the book shows, all this did not prevent the power minister from claiming, as late as 2008, that we could add 40,000 MW by 2020. The IEP's long-term optimistic target for 2050 is 2,75,000 MW. While that seems impractical enough, Prime Minister Manmohan Singh announced in 2009 that India could have 4,70,000 MW of nuclear capacity in 2050, which implies an annual nuclear capacity addition of 11,500 MW from now until 2050. In other words, the prime minister claimed that, for the next 40 years, India could annually commission, on the average, 2.5 times the entire nuclear capacity added by the country over the last 40-odd years! In short, the nuclear establishment seems to possess the Markov property of being "memoryless" since their future projections and promises seem to have little to do with the reality thus far. However, unlike other industries and sectors, they continue to be able to get away with it by making ever more outlandish projections – hence the "Power of Promise".

Institutional Structure

As Ramana says, understanding the institutional structure of the Indian nuclear establishment is crucial to explain how they can get away with such chronic underperformance. The very first chapter on "History" does an excellent job of this and explains how the Department of Atomic Energy (DAE) came to possess such clout and political power and became so unaccountable. The Atomic Energy Commission (AEC) was set up to report directly to the prime minister, based on the argument that matters related to the nuclear sector required secrecy. This translated to a unique access to political authority and funding. Going ahead, the DAE, set up in 1954 subsumed the AEC and the secretary of the DAE became the ex officio chairman of the AEC. This arrangement further enhanced the influence of the nuclear establishment, reporting directly to the prime minister's office and thus not answerable even to the cabinet on policy matters, as is the case with other ministries. Even adverse reports from the Comptroller and Auditor General (CAG) which, as seen over the last few years, have forced some public discourse, legal interventions and reforms in some sectors had no impact on the nuclear establishment. There have been instances when even the Parliamentary Public Accounts Committee has expressed its frustration at the non-transparency and unaccountability of the DAE.

A recent example – after Ramana's book was published – of the power of DAE can be seen in the Twelfth Five-Year Plan document. Based on its deliberations, the report of the working group on power for the Twelfth Plan and the steering committee on energy had indicated that capacity addition from nuclear would be about 2,800 MW during the Twelfth Plan. However, the final Twelfth Five-Year Plan document has a significantly higher nuclear capacity and addition of 5,300 MW (which would, presumably, lead to higher budgetary allocations), showing that the number in the final

plan document ignored the deliberations at the Ministry of Power and the steering committee, and was inserted at a "higher level" in the hierarchy.

This lack of accountability and freedom from standard checks and balances is a serious issue given the various risks and the financial commitments to the nuclear energy sector, particularly when the country claims to be moving towards competitive energy markets.

To compound matters, the Atomic Energy Regulatory Board (AERB) formed in 1983 to overlook matters of safety in the sector is not an independent body but reports to the DAE thus undermining its own effectiveness. A recent CAG audit report highlights the ineffectiveness of the AERB when it notes that

> …AERB had no role in deciding the quantum of penalties and no powers with regard to imposition of the same…AERB failed to prepare a nuclear and radiation safety policy for the country in spite of a specific mandate in its Constitution Order of 1983…There was no legislative framework in India for decommissioning of nuclear power plants and AERB did not have any mandate except prescribing of codes, guides and safety manuals on decommissioning.

This does not bode well for the safety of nuclear installations in the country.

Economics

The nuclear establishment states that nuclear power is an abundantly available and cost-effective option for India and thus should be widely promoted. However, as stated by Ramana, publicly available information (methodologies, cost and operating data, assumptions, etc) to independently verify such claims is not easy to come by. Hence the chapter on "Economics" is an important contribution to the debate in India to separate the rhetoric from objective comparisons. This chapter addresses two questions: how does the Pressurised Heavy Water Reactors (PHWRs) technology, currently being used, compare with coal-based electricity, and what the likely economics of the proposed Fast Breeder Reactor (FBR) technology with respect to PHWRs will be?

For the first question, the author concludes that electricity from PHWRs is unlikely to be cost-competitive to coal-fired electricity. After a systematic consideration of all operating and cost parameters, he shows that, even under very conservative assumptions, nuclear power from PHWRs is slightly costlier than power from a comparable coal-fired power station. The biggest reason for the difference in Ramana's cost estimates and Nuclear Power Corporation of India Ltd's (NPCIL) estimates is the cost of heavy water, as the officially notified cost of heavy water is Rs 12,525/kg, while the author uses a value of Rs 24,880/kg, as estimated by the CAG. Other causes of difference come from how some costs are accounted for and by making some implicit subsidies explicit. For example, NPCIL assumes that heavy water is leased to them by DAE while in fact prudent accounting principles would dictate that it should be seen as an initial capital expenditure for which credit could be assumed at the end of the life when it is returned to DAE – a methodology used by the author. The presence of such accounting discrepancies has also been highlighted by the CAG which pointed out in an audit of the Madras Atomic Power Station (MAPS) reactor that provisions for decommissioning, repairs and waste management were inadequate.

Nuclear electricity tariffs are set by the DAE itself and it is not clear what is accounted for and what is not. Hence it is not surprising that the 32nd Report of the Standing Committee of the Lok Sabha on Energy in 2003 recommended that the central electricity regulator should be given the power to fix nuclear tariffs to ensure a level playing field and to promote competition, efficiency, economic use of resources, optimum investment, etc.

As the author points out, projections of reduced costs in future are unlikely to materialise as global experience, even in countries like the US and France with greater reliance on nuclear power, has shown little evidence of cost reduction as the industry matures. In fact, costs have gone up due to more safety requirements and complex designs.

The second question is important because the premise of India's three-stage nuclear programme is that India has limited uranium resources while having vast resources of thorium which could be potentially unlocked through the intermediate stage of FBRs using plutonium as a fuel. This is the basis for the 2050 targets of 2,75,000 – 4,70,000 GW. While true in theory, the author carefully examines these claims and demonstrates the many practical difficulties in getting such a large-scale programme off the ground. A major shortcoming revealed in the analysis is that the cost of plutonium (~Rs 7,800/gm) is not accounted for either at the fuel reprocessing end of PHWRs or as a fuel cost for the FBR, meaning that it is an implicit subsidy to the programme. Apart from this, the breeder programme is also based on a number of optimistic and unsubstantiated assumptions such as low capital costs, high plutonium breeding ratios, successful technological developments on the 500 MW Prototype Fast Breeder Reactor (PFBR) and low time for fuel processing. Ramana's conclusion is that electricity from the PFBR is likely to be about 80% dearer than electricity from PHWR (which, as shown earlier by the author, is more expensive than coal-based electricity). Hence there appears to be very little economic merit in pursuing breeders.

The tendency of the establishment to overstate benefits and underplay costs is also supported by a 1988 CAG report which noted that "unrealistic cost estimates and optimistic time schedules make financial allocations and controls less meaningful".

Safety and Environment

Ramana highlights the relative lack of importance given to safety by the nuclear establishment by giving numerous examples of "incidents" that have taken place at various nuclear reactors such as the collapse of the Kaiga dome during construction and AEC/DAE interference in the following investigation. He also raises the intriguing question of why there was (and still is) so much pressure to dilute the civil nuclear liability bill if nuclear energy were indeed so safe. The ineffectiveness of the AERB, which is expected to oversee safety issues, only adds to the concern. As stated by the author, an absence of catastrophic accidents thus far cannot be seen as evidence of no risk. As with other sectors, the environmental impact assessment (EIA) process for nuclear energy

projects is also fraught with problems, and thus has resulted in a situation where nuclear projects also face a lot of resistance from local population.

Gaps in the Book

While the book is an important contribution to the debate surrounding nuclear energy in India, it could have addressed some issues to further broaden and deepen the discourse.

The book exposes many problems with the DAE and its unending stream of promises. However, for a general reader, a discussion separating problems faced due to the structure and power of DAE from the fundamental problems with nuclear technology would have been useful. This could perhaps have been achieved through a detailed international comparison of experiences – technical, economic and institutional – particularly with countries like France, Japan and the US where nuclear energy plays a non-trivial role. This would have helped explain what part of that experience applies to India and what kind of role nuclear energy could have in India's energy future even with a more accountable establishment.

Given that nuclear energy is being pitched as a solution to the country's energy needs and energy security, a brief critique of the energy planning process would have been useful to place the role of nuclear energy in the larger energy context. In particular, a detailed analysis of imported light water reactors, which are likely to be an important part of the nuclear landscape after the signing of the Indo-US nuclear deal, and its comparison to imported coal/renewables would have been useful.

Two important pieces of legislation related to the nuclear sector are the Civil Nuclear Liability Act and the Safety Regulatory Authority Bill. A critical discussion of these pieces of legislation would have been useful, perhaps again with some examples of best practices (with all their limitations) from around the world. Examining people's movements and the question of social justice and the larger political economy of the sector in greater detail (partly covered under the India-US deal in Appendix 2) would have nicely balanced and complemented the more technical nature of the book.

Finally, the readability of the book would have improved with more figures and tables to conclude long textual discussions (e g, delays in construction, variations in plant load factor (PLF), cost comparison across countries, assumptions in cost comparisons, etc). May be one table (say, in Appendix 1) listing all the currently operating reactors, their technologies, design capacity, current capacity, original cost, actual/estimated cost, the PLF, gestation, etc, and one table giving similar information to the extent available about all the proposed reactors would have provided a bird's eye view of the sector.

Conclusions

The *Power of Promise* is a scholarly work and an excellent compilation of comprehensive information. Such books are very useful to cultivate informed debates, especially when a sector is as opaque to the public as the nuclear sector. The author deserves praise for putting together such a book in the overall vacuum of data. We are sure this seminal book will soon become an essential reference especially for those who are outside the nuclear scientific-industrial network.

One is hopeful that the book will facilitate a more objective scrutiny of what nuclear power has really delivered rather than being continually evaluated in the "future tense". Similarly, an understanding of the costs and risks that it represents could help moderate the Indian elite's fascination and pride in possessing nuclear technology. As Slavoj Zizek has very aptly said, "We do live in a society of risky choices, but one in which some do the choosing and others the risking".

Energy-efficient technologies and renewable sources of electricity generation (which India is rich in) have had falling cost trajectories, while the costs of nuclear energy have increased over time. Therefore, the arguments of energy security and climate-friendliness in favour of nuclear energy sound rather weak on purely economic grounds without even bringing in issues of radiation, waste disposal, decommissioning, etc. Therefore, while Indian scientists may deserve many plaudits for their research on atomic energy, it is hard to see an important role for nuclear energy in the energy basket of the country in the near future. If it is to have a future in a country that calls itself democratic, the nuclear establishment will have to become much more transparent and allow citizens to judge for themselves whether nuclear energy is economically competitive and socially and environmentally benign – and this requires overhauling the DAE's institutional structure to become radically more accountable and transparent. Until that happens, citizens will remain sceptical and there will be protests against nuclear projects; and nuclear energy will be "too costly to matter" rather than "too cheap to meter". Ramana's book holds the "power of promise" to be an important stepping stone towards such a transformation of India's nuclear establishment.

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