

Plutonium, Nuclear Energy, and India's Three-Stage Thorium Programme

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- On August 9, 2019, Brookings India hosted the sixth edition of its Foreign Policy & Security Tiffin Talk series, which features scholars presenting their evidence-based research to peers and practitioners. This series of closed-door seminars seeks to facilitate dialogue between researchers and policymakers on India's foreign and security affairs.
- **Alan J. Kuperman**, Associate Professor, LBJ School of Public Affairs, University of Texas at Austin, USA presented his recent book *Plutonium for Energy? Explaining the Global Decline of MOX* (2018) and discussed the reasons driving the global decline of MOX fuel and its important implications for the debate on nuclear energy sources in India.
- **Dr. Manpreet Sethi**, Distinguished Fellow, Centre for Air Power Studies (CAPS) served as the lead discussant and **Dr. Constantino Xavier**, Fellow, Foreign Policy at Brookings India moderated the seminar.
- In attendance were officials from the Ministry of External Affairs, and National Security Council Secretariat (NSCS), and scholars from India's leading think tanks.

The Global Decline of Plutonium for Energy

Professor Kuperman presented his recent book, *Plutonium for Energy?* which provides a comparative study of all seven countries that have commercially used or produced plutonium fuel for nuclear energy, namely Belgium, France, Germany, Japan, the Netherlands, Switzerland, and the United Kingdom. His findings, based on field research in each country, explain why five of the seven countries have already decided to phase out plutonium fuel – with the exception of France and Japan. This retreat is attributed to plutonium's three inherent downsides – safety, security, and cost – which make the fuel significantly more expensive, dangerous, and unpopular than traditional uranium fuel.

He provided several key takeaways for countries that are currently contemplating the initiation or expansion of plutonium fuel – including China, India, Japan, Russia, South Korea, the United Kingdom, and the United States. First, plutonium fuel costs up to 12 times as much as equivalent uranium fuel, even excluding the high cost of reprocessing spent fuel to obtain the plutonium, due to the expense of addressing

plutonium's radiotoxicity. Second, countries such as India that plan to use plutonium in fast-neutron breeder reactors (FBRs) will face additional hurdles, because such fast reactors are very expensive and prone to plutonium fires and leaks of sodium coolant – which is why they have been abandoned by most countries that pursued them, including France, Germany, Japan, and the United States. Since plutonium fuel and fast reactors make nuclear power more expensive and controversial, he explained, they tend to undermine nuclear energy. Kuperman said it was ironic that plutonium fuel, originally conceived as essential to sustain nuclear energy, due to perceived shortages of uranium, has proved more likely to kill it. The pro-nuclear position, he said, is anti-plutonium.

He highlighted that for India, the economic costs, technical challenges, health risks, and proliferation concerns were too grave for it to go ahead with recycling plutonium for energy, especially given that uranium is still abundantly available due to the limited growth of nuclear energy.

The Indian Case for Plutonium: Circumstances and Needs

Manpreet Sethi, the lead discussant, put forward India's different cost-benefit perceptions on the factors outlined by Kuperman. She noted that "the weightage countries accorded to the reasons outlined can be relative, such is the case for India as well." And while, India's three-stage programme was crafted decades ago, it remains relevant remains intact as circumstances have not changed for India. Sharply diverging from Kuperman's thesis, she said "India has a different perspective on plutonium, we believe it is a useful resource for the three-stage process... We do not think of it as a liability, but an asset for nuclear power plants." Presenting India's case, Sethi highlighted that India would not want to rule out any source of electricity, especially emission free

electricity, in a country where "one crore people die of air pollution every year." Sethi highlighted that while health concerns for people around factories might be a high priority for developed countries in the west, India is hungry to meet its demand-supply gap in a sustainable way, and views its nuclear energy programme and the closed fuel cycle as the right path to solve this problem."

Sethi and other discussants at the event acknowledged that the cost of generating power through plutonium is expensive but the cost of not having power "would manifest in handicapping economic growth and clean electricity is needed for development in a fast-growing economy such as India's."

The Indian Case for Plutonium: Fast Breeder Reactors

Sethi concluded by saying that the thermal MOX industry and nuclear power in general is in decline globally as a result of stagnant economic growth and the availability of alternative sources. However, neither of these options are available to India.

The discussion opened up to other participants – several relevant points were made pertaining to India’s need for nuclear energy, as it serves as a reliable and continuous energy source, acting as a much-needed base-load component. It was made clear that plutonium occupied a critical role in India’s plans to diversify its energy sources.

The discussion entailed debates on the comparative economics of plutonium as a fuel, and issues of recycling spent fuel, reprocessing rights, and safeguards. On the issue of FBRs, Kuperman noted that all other countries had abandoned the construction of FBRs with the exception of Russia and China. In response, one participant stated that “India has its eyes firmly on FBR, if it is a success and if it is commercially viable it will progress.” Discussants also noted that India is developing light-water reactors as it has been cost-effective to do so and “also does not put us outside the global mainstream... plutonium is just a byproduct of our programme, thorium reactors are the final destination.”

India’s Three-Stage Train

The debate highlighted that nations make choices on open or closed fuel cycle based on their set of individual circumstances. Although Kuperman presented evidence from countries that had pursued plutonium fuel and FBRs, as India is now doing, India also has faced unique constraints.

Many participants noted that historically, India had to get on to the “three-stage train” since it was not in a position to make choices, but was forced to go down this road as a result of traditional high-quality uranium being denied to it for decades - until the Indo-U.S. nuclear deal in 2008.

Summarising India’s stance on issues of national interest, one participant noted “India will hold on even if the rest of the world goes the other direction.” Kuperman suggested that India should reassess the decades-old three-stage plan in light of new considerations: abundant uranium, the high costs of plutonium and FBRs, and the dangers of setting a precedent for other regional countries to acquire plutonium that could be used for nuclear weapons.



(From L to R) Dr. Constantino Xavier, Fellow, Foreign Policy, Brookings India; Professor Alan J. Kuperman, Associate Professor, Lyndon B. Johnson School of Public Affairs, University of Texas at Austin; Dr. Manpreet Sethi, Distinguished Fellow, Centre for Air Power Studies (CAPS).

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