Does an Indian Uranium Scarcity Reinforce Critics of the US-India 123 Agreement?

Bruce D. Larkin

Advocates of the 2008 Nuclear Cooperation Agreement between India and the United States (‘123 Agreement’ or ‘nuclear deal’) promoted it as doing no harm to the Nuclear Nonproliferation Treaty, or even as strengthening the NPT regime. Some critics argued, to the contrary, that the Agreement undermined the NPT. Detailed commitments by India are spelled out in the complementary IAEA-India Safeguards Agreement.¹

One difference, among many, turns on assessing whether this Agreement ostensibly on civil nuclear cooperation also contributes to the Indian nuclear weapons program. [Note that this is not the argument that the Agreement ‘rewards’ a state that has refused to join the NPT. Note, too, that it is not the argument that India, by building nuclear weapons, has rejected one main purpose of the NPT. Nor is this the argument that the NPT is so widely accepted that it is part of the fabric of international law, binding on the

¹ The full title is “Agreement Between the Government of India and the International Atomic Energy Agency for the Application of Safeguards to Civilian Nuclear Facilities.” IAEA information circular INFCIRC/754, 29 May 2009. Three subsequent additions to the list of facilities subject to safeguards are in INFCIRC/754/Add.1 (12 November 2009), INFCIRC/754/Add.2 (7 April 2010), and INFCIRC/754/Add.3 (16 December 2010). IAEA links to INFCIRCs are at http://www.iaea.org/Publications/Documents/Infcircs/
Does Indian U Scarcity Reinforce Critics of the US-India 123 Agreement?

Cite: Bruce D. Larkin. NOTE ONE. 2011.02.07

Journal of Denuclearization Design

handful of states—four, or three—that are not, or say they are not, States Party.] Critics argued that the Agreement fudged the distinction between India’s civil and military nuclear sectors. Each depends on nuclear reactors. In turn, the reactors are fueled by fissile material, either ‘natural uranium’ (0.7% $^{235}$U) or ‘enriched uranium’ (typically with 3% or more $^{235}$U). Civil sector reactors produce heat, and then steam, to turn turbines, generating electricity. Military reactors produce in ‘spent fuel’ plutonium (Pu) that can be separated and shaped into the key ingredient of a nuclear weapon.2

Will the ‘wall’ between India’s civil and military sectors render India in effect two different make-believe states, one a de facto nuclear weapon state (NWS) though not recognized as such by the NPT, and the second a de facto ‘non-nuclear-weapon state’ (NNWS)? Or will activities in the Indian civil nuclear sector, such as import of reactor fuel made possible by the Agreement, leak into India’s nuclear weapons sector, enabling it in some significant respects?

This note examines the ‘Indian uranium scarcity hypothesis’. India has indigenous uranium mining, milling, and enrichment facilities. But is the Indian military sector in some respect hobbled by uranium ‘scarcity’? (As we will see, this is not the only way that the civil sector could affect the military sector, but it is the most obvious.)

India is not open about its military nuclear plant. Observers take what few figures are offered and exercise their knowledge of reactor engineering and operation to infer conditional estimates. I will cite those estimates, the best available to the public, and especially those published by the International Panel on Fissile

---

2 This discussion is abbreviated. Readers will know that uranium is not the only possible reactor fuel, and that civil-sector reactors also produce Pu in spent fuel. These facts are germane, but we can set them to one side.
Materials.  

The IPFM’s Research Report #1 puts the issue of U scarcity on the table.

First Bottleneck: ‘Natural Uranium’. India uses U as reactor fuel. Some is ‘enriched’. Some reactors are designed to be fueled by natural uranium. Others require that the natural uranium be enriched; then natural uranium is the feedstock to enrichment. What do we know about India’s uranium supply? Zia Mian et al. wrote in 2006 [highlighting added]:

In recent years, India’s nuclear complex has been constrained by access to uranium. We estimate that India’s current uranium production of less than 300 tons/year can meet at most, two-thirds of its needs for civil and military nuclear fuel. It has had to rely on stocks of previously mined and processed uranium to meet the shortfall and is now trying to increase production. Under the deal, India will be able to import uranium for safeguarded reactors and we estimate this may give it a ‘surplus’ of 70-120 tons a year of domestic uranium that it can use, if it so chose, in its weapons program. By expanding its practice of recycling depleted uranium (containing 0.61% uranium-235) from CIRUS and Dhruva in its unsafeguarded power reactors, India could increase this ‘surplus.’ We estimate that this could allow India to produce up to 200 kg a year of weapon grade plutonium in its ‘military’ power reactors, provided that it can overcome the associated practice problems of increased rates of spent fuel reprocessing and faster refueling of power reactors.

Subsequent comment by authors of the IPFM study, issued in November 2007 and March 2008, assess facets of India’s

---

3 The International Panel on Fissile Materials has issued an annual Global Fissile Material Report since 2006, cited below as GFRM 2006, 2007 … The reports and explanations of the Panel’s work are at http://www.fissilematerials.org

continuing uranium shortage. M. V. Ramana calls attention to the head of the Nuclear Power Corporation of India saying that [paraphrase] “uranium fuel shortages had led to five of India’s 17 nuclear power plants being shut down and the rest were now, on average, at half power.”


Zia Mian explores how terms of the Treaty of Pelindaba could bar India’s buying uranium from African states.

The potential African uranium suppliers that are mentioned include Gabon, Namibia, Niger, Nigeria, Uganda and Angola - some of which are major uranium exporters.

India is desperate to increase its access to uranium because domestic sources are increasingly insufficient to support its civil and military nuclear programs.

Pleading India’s case for imports, an Indian special envoy cited “availability of domestic uranium” as a constraint on prospective Indian growth of civil nuclear power.

Has Indian uranium supply improved since early 2008? Judging by a number of reports, India is actively seeking to procure U from abroad and to develop its domestic mines and mills, but is


Bruce D. Larkin. NOTE ONE. 2011.02.07

Does Indian U Scarcity Reinforce Critics of the US-India 123 Agreement?
dogged by difficulties. A 2010 US Congressional Research Service report observes that “India’s current fuel situation means that New Delhi cannot produce sufficient fuel for both its nuclear weapons program and its projected civil nuclear program.” Although one Indian nuclear official, speaking in 2009, envisioned Indian sufficiency in 2013, the balance of reportage stresses difficulties and delays.

The country’s largest nuclear reactors are running at half of their capacity due to uranium shortage resulting in cutting down electricity supply to western India.

The two 540 MWe units at Tarapur ran at 57 per cent of their capacity in January [2009] and on an average they were running at 55-70 per cent of their total capacity due to a shortfall in the availability [sic] domestic uranium, Union science and technology minister Prithviraj Chavan said in the Rajya Sabha on Thursday.

Chavan admitted a shortage of 324 MWe in nuclear power generation for the whole country, making it clear that the government is running behind schedule to operationalise new mills and mines in Jharkhand, Meghalaya, Andhra Pradesh and Karnataka. There are 18 operational nuclear plants across the country with a total installed capacity of 4340 MWe. The last one was a 220 MWe unit in Rajasthan that became critical in December.

India’s long-term interest in indigenous reactor fuels other than uranium is expressed in its breeder reactor program and long-standing fixation on a thorium cycle. The first would generate Pu in

8 See, for example, the array of reports listed by World Information Service on Energy: Uranium Project at http://www.wise-uranium.org/upin.html.
10 The Indian Express reported that “India is expected to achieve self-sufficiency in uranium production to feed its existing nuclear power projects and proposed plants by 2013, Atomic Energy Commission Chairman Anil Kakodkar said.” Indian Express, 2 August 2009. http://www.indianexpress.com/news/india-will-achieve-uranium-selfsufficiency/497107/.
11 “Nuke plants running at half their capacity.” New Delhi, DHNS, Deccan Herald, 4 March 2009.
greater amounts than required to fuel it. The second would exploit the fact that a thorium isotope can be transmuted into $^{233}$U that can, in turn, fuel a reactor. Breeder programs have been attempted elsewhere; despite their having been fraught with difficulty, breeders remain in Russian and Chinese plans. The thorium cycle will require solving a different set of formidable technical problems.

A more conventional approach would be to adopt a reactor fueled by MOX, mixed uranium oxide and plutonium oxide, reducing the $^{235}$U required. MOX-fueled reactors operate commercially.

Submitting to reuse partially depleted uranium from India’s Pu production reactors, which Zia Mian et al. termed an Indian “practice,” is an unusual device to squeeze more work from natural uranium.\(^\text{12}\)

**Second Bottleneck: Enriched Uranium.** If India were making, or planned to manufacture, atomic bombs using ‘highly enriched uranium’ (HEU) for their ‘bang!’, that program would lay claim to some enriched uranium. But IPFM has not seen any evidence to that effect:

The second potential use of HEU is in nuclear weapons, either in secondaries of thermonuclear weapons or in composite pits. However, there is no evidence that the DAE tested such designs in 1998.\(^\text{13}\)

IPFM interprets India’s developing a U enrichment program as a way to fuel submarine-borne reactors. A saving in volume and weight can be achieved by adopting HEU for naval propulsion. Other countries’ initial design of naval reactors to use 90% $^{235}$U (‘weapon grade’) has been followed by a view that more dilute

\(^\text{12}\) IPFM GFMR 2006, quoted above. In a power reactor the U fuel would be left longer, for fission of both the original $^{235}$U and resultant $^{239}$Pu make for heat. In a Pu production reactor the object is different: to stop the process and harvest $^{239}$Pu—best for weapons—before it has been further transformed into higher isotopes of Pu. Useful U remains in the spent fuel and, like Pu, can be separated.

\(^\text{13}\) GFMR 2010, p. 125. On India’s HEU efforts, GFMR 2010, pp. 122-125.
uranium could do the job without creating what lawyers call an ‘attractive nuisance’.

The estimate is that India can meet the needs of its submarine program—as long as there is sufficient natural U as feedstock—from present output of HEU, at least for a while.

Third Bottleneck: ‘Weapons Grade’ Plutonium. If India could not fuel the reactors from which it extracts Pu rich in $^{239}$Pu, then it would be obliged to delay making further nuclear weapons. All reports agree that India’s fission weapons, present and planned, are Pu-based, not U weapons. There is no public indication that India has near-term weapons plans that its inventory of weapons-grade Pu cannot support. Moreover, India maintains an active reprocessing program. On 7 January 2011 Indian Prime Minister Manmohan Singh dedicated a new reprocessing plant, to separate Pu from spent reactor fuel, and “which will use spent fuel from indigenous nuclear power plants for fast breeder reactors.” It remains to be seen how future reactors (and so the spent fuel, containing $^{239}$Pu, they produce) and reprocessing plants will be allocated between the ‘civil’ and ‘military’ sectors.

Conclusion

This brief survey of the ‘uranium scarcity’ hypothesis leads to two conclusions. Those who say that the US-India deal doesn’t arm India—and recall that Mohamed ElBaradei supported the arrangement with its special IAEA-India Safeguards Agreement—

---

15 IAEA. Press release, “IAEA Director General Welcomes U.S. and India Nuclear Deal,” 2 March 2006:

IAEA Director General Mohamed ElBaradei welcomes the announcement of the nuclear cooperation agreement reached today between India and the United States.
can make a case. They stress that India may manufacture all the nuclear weapons it ‘needs’ without violating the terms of separation between ‘civil’ and ‘military’ sectors. On the other hand, critics also appear to be well-anchored in evidence: they complain that India is given a largely free hand how it may grow its ‘military’ sector, that some activities (such as transfer of expertise) are unregulated, and that the existence of extensive nuclear facilities and fissile materials just across the ‘wall’ between sectors could prove too sweet to be left alone were India’s military and government to encounter circumstances of ‘necessity’.

So: for the short term, or medium term, while everyone’s on good behavior, while use of nuclear weapons remains ‘unthinkable’, advantages of safeguarding the ‘civil’ sector are attractive. Advocates of ZNW or Global Zero are presented a testbed for the proposition that a sophisticated civil sector can be overseen by rigorous safeguards. While foreign suppliers queue to sell uranium to India ‘uranium scarcity’ is not an immediate impetus to violation.

But: for the future, the US-India deal is rickety, and especially to the extent ‘uranium scarcity’ draws India further into possession and use of separated Pu there could be incentives to violation and all the dangers of a ‘plutonium economy’, actively canvassed in the mid-1970s. Every agreement has its grey areas, and as Wolfgang Panovsky argued in the Cold War context it is by testing the grey areas that parties come to establish and confirm just what is meant

“This agreement is an important step towards satisfying India’s growing need for energy, including nuclear technology and fuel, as an engine for development. It would also bring India closer as an important partner in the non-proliferation regime,” he said. “It would be a milestone, timely for ongoing efforts to consolidate the non-proliferation regime, combat nuclear terrorism and strengthen nuclear safety.”

“The agreement would assure India of reliable access to nuclear technology and nuclear fuel. It would also be a step forward towards universalisation of the international safeguards regime,” Dr. ElBaradei said. “This agreement would serve the interests of both India and the international community.”

http://www.iaea.org/newscenter/pressreleases/2006/prn200605.html

Bruce D. Larkin. NOTE ONE. 2011.02.07
Does Indian U Scarcity Reinforce Critics of the US-India 123 Agreement?
about the boundaries between permitted and forbidden actions. As recently as 2001-2002 a nuclear power turned its back on a landmark treaty that many considered a pillar of nuclear restraint.

Even if all terms of India’s commitments are honored, a back door through the ‘wall’ is left ajar, in the far corner of the civil nuclear garden. Had India remained unable to source from abroad hardware and fuel for civil nuclear energy, any plan to rely on nuclear for a greater share of Indian electricity would have required significant central government investment. By buying abroad India navigates past up-front costs and escapes performance issues which have plagued earlier Indian nuclear ventures. Because longer-term, more extensive, autonomous, and unsafeguarded military nuclear industry, Indian from mines and plutonium production reactors to the fabrication of warheads, can only be domestically sourced, there will be a premium on allocating central funds and scarce capacities—including uranium supply—to the military sector.

To the extent that India’s successful political maneuver instantiates the ‘nuclearist script’ it complicates all efforts to ban nuclear weapons, whether region by region (as concern for the Treaty of Pelindaba’s restrictions on transfers to countries not agreeing to full-scope safeguards illustrates) or as part of the global drive for zero. If only to diversify its sources and ensure price competition among prospective suppliers India has an interest in breaking the Pelindaba barrier. A single country’s ‘uranium scarcity’ can have far broader consequences.

In summary, this deal—as well as Indian and Pakistani restraint in general and the drive for nuclear weapons abolition more generally—rests on ongoing political understandings. Technical facts inform understandings, but do not assure them. Solving India’s energy needs without ecological misprision or nuclear foolhardiness is a laudable aim of global significance, an objective for Indians and others alike.
Abbreviations

FM       Fissile Material
FMCT     Fissile Material Control Treaty or Fissile Material Cutoff Treaty
GFMR     Global Fissile Material Report
HEU      Highly enriched uranium
IAEA     International Atomic Energy Agency
IPFM     International Panel on Fissile Materials
MOX      Mixed oxide fuel
NPT      Non-Proliferation Treaty [Treaty on the Non-Proliferation of Nuclear Weapons]
NSG      Nuclear Suppliers Group
Pu, $^{239}$Pu  Plutonium, Plutonium 239
U, $^{233}$U, $^{235}$U  Uranium, Uranium 233, Uranium 235

Revision History

2011.02.07  First published to web.

The *Journal of Denuclearization Design* is a cumulative digital-only journal edited and issued by the Global Collaborative on Denuclearization Design.

Access to the *Journal* is at the GC.DD website: www.gcdd.net. Please direct correspondence and submissions to editor@gcdd.net.

*Some rights reserved:* this work, its contents pages, or any complete article or set of articles, may be distributed freely subject to the attribution, non-commercial, and no derivative works conditions of the Creative Commons license 3.0. ‘Attribution’ is met by including this page as the last page of the article.
Bruce D. Larkin. NOTE ONE. 2011.02.07
Does Indian Uranium Scarcity Reinforce Critics of the US-India 123 Agreement?

Bruce D. Larkin is Professor Emeritus of Politics at the University of California at
Santa Cruz, and the Convenor and Director of Studies of the Global Collaborative
on Denuclearization Design. He is the author of Nuclear Designs: Great Britain,
France, & China in the Global Governance of Nuclear Arms (1996); War Stories (2001);
and Designing Denuclearization: An Interpretive Encyclopedia (2008).