The Future of Military Fissile Material Production Facilities in South Asia Under an FMCT

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Workshop on
Technical Issues related to a Fissile Material Cut-off Treaty (FMCT)
Geneva, 30 May 2012

About the IPFM

Mission: provide the technical basis for policy initiatives to reduce global stocks of military and civilian fissile materials

Fissile materials – the highly enriched uranium and plutonium that are the key ingredients in nuclear weapons.

- controlling fissile materials would foster reversible nuclear-warhead reductions; lay the basis for nuclear disarmament; strengthen the nonproliferation regime, and reduce risks of nuclear terrorism.

•Established in 2006, IPFM has 26 members from 16 states

•Publications: annual *Global Fissile Material Report*; research reports and country studies

•www.fissilematerials.org; www.fissilematerials.org/blog

Fissile material production for weapons

- Four NPT weapon states have declared an end to production of plutonium and HEU for weapons
- China is believed to have suspended production

	HEU production	Plutonium production for weapons
China	stopped 1987 (unofficial)	stopped 1991 (unofficial)
France	stopped 1996	stopped 1992
Russia	stopped 1987-1988	stopped 1994*
United Kingdom	stopped 1962 (but imports from US)	stopped 1995
United States	stopped 1992	stopped 1988

*Russia's last plutonium production reactor was shutdown in 2010

Pakistan: fissile material production facilities

Location	Facility Type	Operation
Kahuta	Enrichment plant (A.Q. Khan Laboratories)	1980s
Gadwal	Enrichment plant	1990s?
Chaklala	Enrichment (pilot plant)	1970s
Sihala	Enrichment (pilot plant)	1970s
Golra	Enrichment (pilot plant)	1980s
Khushab–I	Production reactor	1998
Khushab–II	Production reactor	2010
Khushab–III	Production reactor	2012?
Khushab–IV	Production reactor	2014?
Rawalpindi	Reprocessing facility–I (New Laboratories)	1998
Rawalpindi	Reprocessing facility–II (New Laboratories)	2006
Chashma	Reprocessing facility	incomplete

Highly enriched uranium stocks and plans

Estimated stockpile
~2700 kg HEU

Kahuta & Gadwal plants produce HEU for weapons estimated capacity too small for LEU for power reactors

Planned commercial-scale centrifuge enrichment plant for power reactor fuel

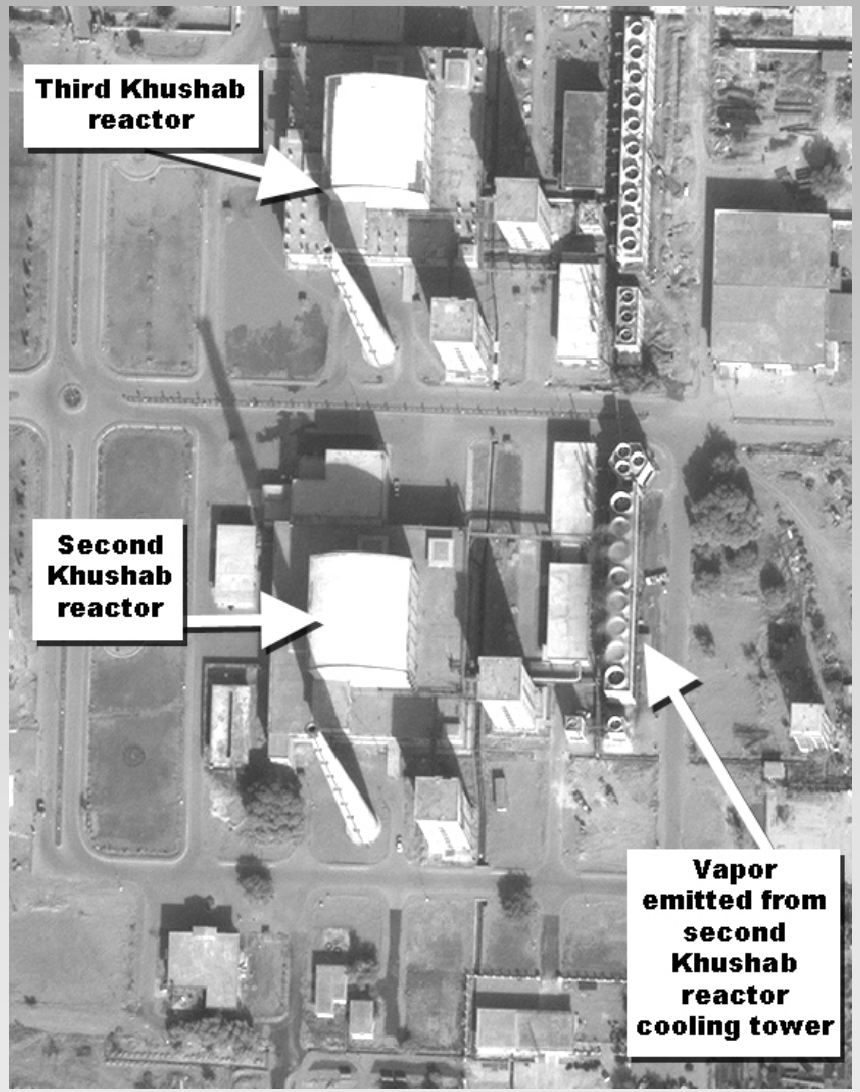
Nuclear submarine program to keep up with India?

- But need not be HEU fuel

Khushab-I reactor

Reactor (40-50 MWt) started 1998, can produce 5-10 kg per year
Weapon plutonium stock ~ 120 kg

Khushab-II, III and IV reactors



Khushab-II reactor
Start-up: 2010/2011

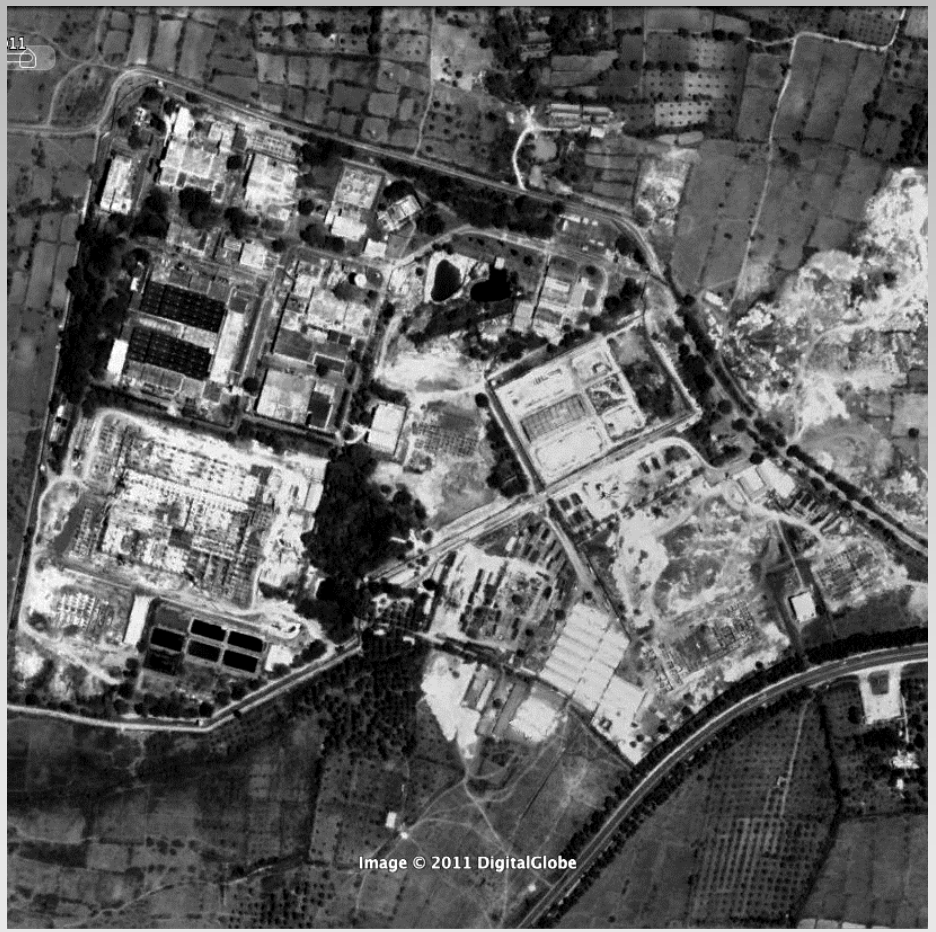
Khushab-III reactor
Construction: 2006-

Khushab-IV, under construction

India: fissile material production facilities

Location	Facility Type	Operation
BARC	Enrichment (pilot plant)	1980s
Ratehalli	Enrichment plant	1990
Chitradurga	Enrichment plant	planned
CIRUS	Production reactor	shutdown
Dhruva	Production reactor	1985
PFBR	Breeder reactor (500 MWe)	2013?
PHWRs	Nine power reactors (unsafeguarded)	operating
Trombay	Reprocessing facility	1964/1983
Tarapur	Reprocessing facility – I	1978
Tarapur	Reprocessing facility – II	2011
Kalpakkam	Reprocessing facility	1998
Kalpakkam	Reprocessing facility – II	2013?

Rare Materials Plant
(Rattehalli: Mysore, Karnataka)



Stockpile ~ 2 ± 0.8 tons

HEU is 30-45% enriched
to fuel nuclear submarines

Capacity is expanding with additional centrifuges and new generation machines

New centrifuge halls are under construction

Special Material Enrichment Facility

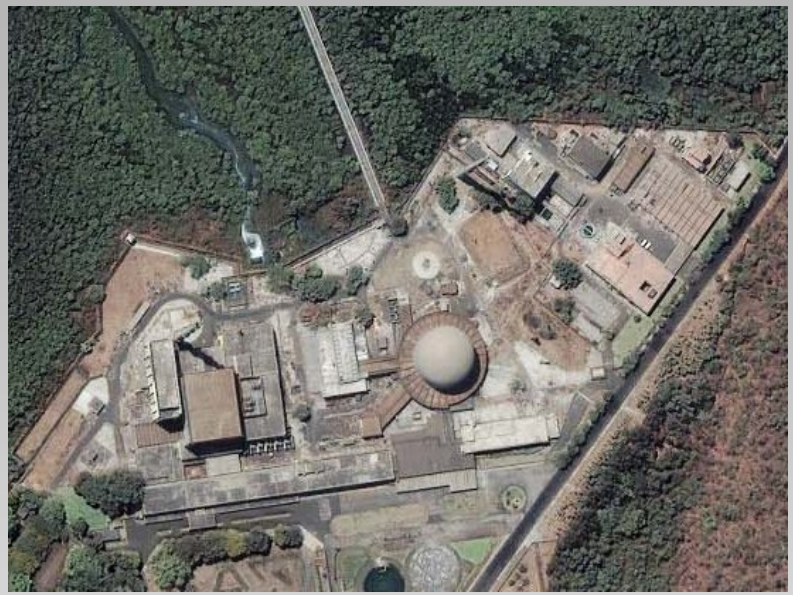
Plans for second enrichment complex – Chitradurga, Karnataka

India “keeping the option open of using it for multiple roles”:

- Enrichment of HEU for fueling nuclear submarine fleet
- Production of HEU for weapon purposes
- Production of enriched uranium to fuel civilian power reactors

India's plutonium stocks and plans

- Weapon plutonium stock ~ 500 kg
- Dhruva reactor (100 MWt)
- New "multipurpose" reactor planned
- 4.2 tons of power-reactor plutonium (~6 tons still in spent fuel)
- More reprocessing plants planned
- Breeder reactor under construction (500 MWe, expected 2012-2013)
- Could produce up to 140 kg/year of weapon-grade plutonium
- Plans for 4 more breeder reactors



Conversion options

Enrichment

- Convert to LEU for power reactor fuel
  - No experience with enrichment plant safeguards
  - Monitor using standard centrifuge enrichment plant safeguards
  - Age dating to detect fresh HEU particles may not work

- Produce HEU for naval reactor fuel
  - Follow the HEU to ensure no diversion

Reprocessing

- Convert to civilian use (MOX and breeder program under safeguards)
  - Military reprocessing plants probably treat uranium metal fuel
  - Limited/no experience with reprocessing safeguards

Conversion to non-weapon use

- Opening facilities to inspection may reveal:
  - Production capacity and history
  - Isotopics of fissile material
  - Genealogy of technologies
  - Problems of safety, security

- Conversion may not be viable:
  - Civilian production standards include cost, efficiency, reliability,…
  - Production reactors may be too small for electricity production
  - Enrichment plants may be too small to fuel large PWRs
  - India's indigenous power reactors use natural uranium fuel
  - Imported PWRs likely come with LEU fuel supply
  - Reprocessing, MOX and breeder reactors are costly and unreliable

Summary of conversion issues

- What does it mean to "convert" to non-weapons purpose?
  - Technical reversibility/irreversibility
  - Multilateral conversion study (with participation of IAEA)
- What needs to be kept secret?
- Timing and transparency of conversion?
- Naval fuel cycle?
  - Issue for India under FMCT, possibly Pakistan
  - Problem also under NPT (material withdrawn from safeguards)
  - Multilateral expert study on naval fuel cycles (with IAEA)