

China and FM(C)T

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Operating history of China's military fissile-material-production facilities

Facility	Start up	Shutdown
Enrichment plants		
Lanzhou Gaseous Diffusion Plant	1964	Stopped HEU production in 1979
Heping Gaseous Diffusion Plant	1970	Stopped HEU production in 1987
Plutonium production Reactors		
Jiuquan reactor	1966	Closed in 1987
Guangyuan reactor	1973	Closed in 1987
Reprocessing facilities		
Jiuquan military pilot plant	1968	Closed down in early 1970s
Jiuquan reprocessing plant	1970	closed around 1987
Guangyuan reprocessing plant	1976	closed around 1987

Jiuquan Plutonium Production Complex

- 1978 “military to civilian conversion” policy
- 1984 began work on reactor conversion to dual use
- Aug.1987 the government required “closed reactor and reprocessing”
- 1990 began decommissioning

Collocated site for:

- the processing of plutonium and HEU produced in the past into metal,
- the fabrication of weapons components; final assembly of weapons.
- civilian pilot plant

Concerned about on-site sampling?

Some sensitive information, e.g., chemical composition, etc.



The Guangyuan Plutonium Complex

- Under “military to civilian conversion” policy, mid-1980s worked on reactor conversion to dual use
- In 1987 the government required cessation of Pu production;
- since 1990, decommissioning.

Collocated site for:

- the processing of plutonium and HEU produced in the past into metal
- the fabrication of weapons components;
- the final assembly of weapons.

Concerned on-site sampling ?

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Credit: DigitalGlobe

Civilian reprocessing programs

In the mid-1980s, China selected a closed fuel cycle strategy to reprocess spent fuel and has recently sped up development of this strategy.

The reprocessing pilot plant

- Capacity: 50 tHM/year; Jiuquan nuclear complex, Gansu;
- Project approved July 1986; construction commenced July 1997;
- Successful hot test Dec 21, 2010, operating about 10 days, producing 13.8kg Pu. Later: 25.4 kg
- problem: MUF ; high waste volume;
- Capital cost : about 3.2 billion RMB in 2014; several times more than earlier estimates.
- Long delay: from projected approval to hot test =14 year, then operating only 10 days.
- Operation resumed around early 2016.



Source: CNNC

200 tHM/yr reprocessing plant

-- approved July 2015, site preparation at Jinta, Gansu province.

--operational 2020?

800 tHM/yr reprocessing plant

--Since 2007 negotiation with AREVA – disputes over price,
--Finished first stage (technical) and second stage (business) since 2015

-- CNNC plans to start construction 2020

Limiting SF reprocessing?

--Submits annual INFCIR/549 report of civilian plutonium
--concerned about large Japanese Pu stock, China may be interested.

--But the collocated pilot plant at plant 404 could affect China's willingness (if verification needed).

The pilot MOX fuel fabrication facility (0.5 tons/year) at plant 404

--built near the pilot reprocessing plant, its purpose is to supply fuel for China's Experimental Fast Reactor.

--loading of CEFR with MOX fuel is expected before 2020. Several research projects about pellets, cladding, rod and subassembly were approved. The testing rods would be put into CEFR for irradiation before 2017.



Source: CIAE

China's fast neutron reactor projects

China's experimental fast reactor

- Construction started May 2000
- Completed in July 2010
- Design capacity: 25 Mwe
- Located: CIAE, Beijing

--Operations:

- ✓ 1st criticality 7/2010, 40% power;
- ✓ 26 hours in 2011,
- ✓ no operation 2012 & 13;
- ✓ 72 hours Dec. 2014 (100% power)
- ✓ since then for R&D

CFR-600 demonstration fast reactor

- design power: 600 MWe
- location: Xiapu, Fujian province
- Dec. 2015, Concept design;
- by end 2016, preliminary design
- to start construction in 2017
- commission in 2023.

Commercial fast reactor

- a 1000 MWe CFR-1000 in 2030s.

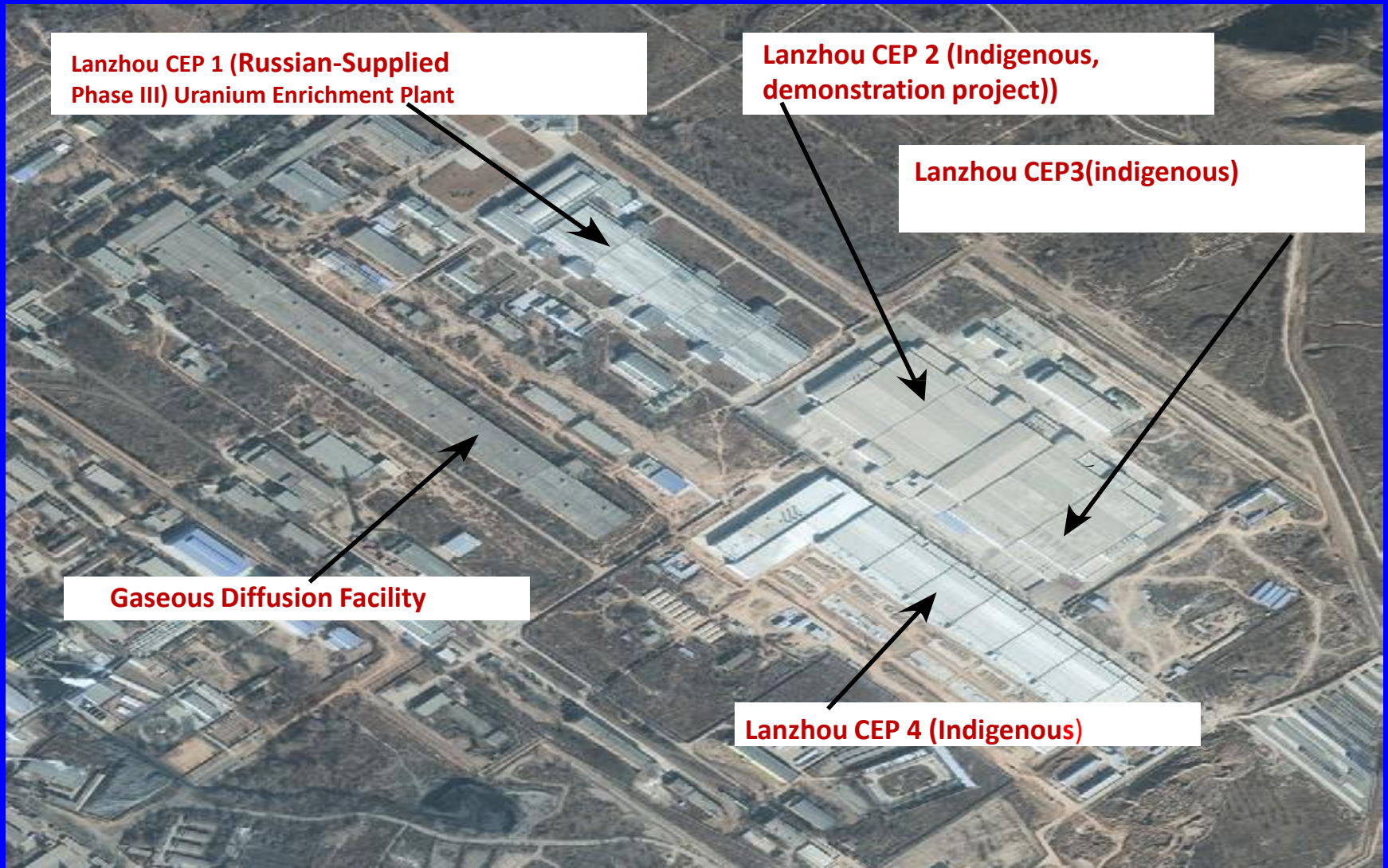
Others

- to buy Russian BN-800?

CEFR



Lanzhou Uranium Enrichment Plant



Satellite image from 18 January 2015
Coordinates: 36°08'53.30" N/103°31'24.49" E). Credit: DigitalGlobe

Lanzhou facilities

Project	Capacity (million SWU/year)	Comments
Lanzhou GDP	0.2 (pre-1979), 0.3 (post-1979)	Began operation in 1964; stopped HEU production in 1979; Closed in 2000.
Lanzhou CEP 1 (Russia-supplied phase III)	0.5	Began operation in 2001.
Lanzhou CEP2 (demonstration project, domestic)	0.5	On July 4,2008 started construction; began operation in 2010.
Lanzhou CEP3 (domestic)	0.5	Construction almost finished in 2010. Began operation in 2013.
Lanzhou CEP4 (domestic): Phase I , II	0.6+0.6	Phase I: Began construction in 2013. Trial tests in April 2016. Phase II: significantly delayed?

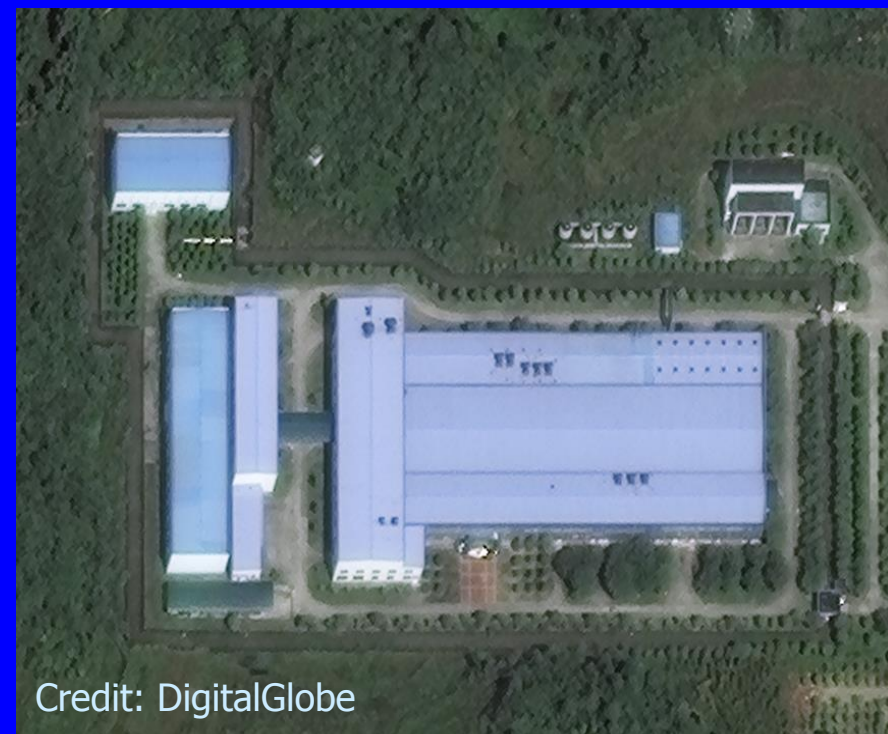
Plant 814: Dual/military use

Plant 814: Heping GDP at Jinkouhe

- 25 June 1970—1987 HEU for weapons.
- capacity: around 0.23 million SWY /year
- since 1987 continues operation for non-weapons purpose.

Plant 814 : Dual/military CEP near Emeishan ?

- In 2007 started operation
- capacity around 0.25 million SWU/year.
- dual/military CEP? Eg., isolated, secured location, etc.



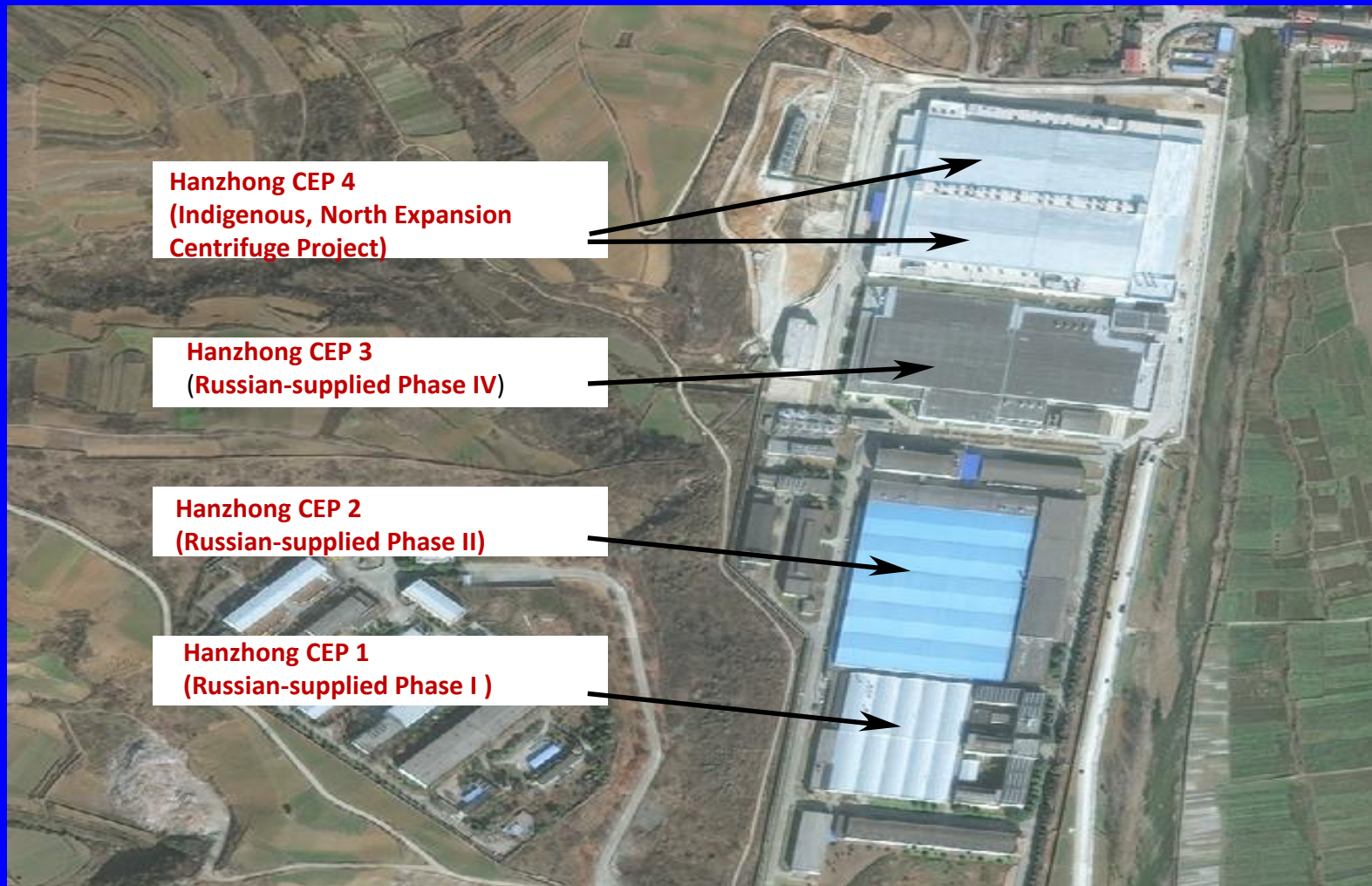
Plant 814 : Commercial CEPs near Emeishan city

- CEP1**: local government planned to start the project in 2008
- Construction around 2011, and operation around 2013
- around 0.8 million SWU/year
- CEP2**: recently completed construction, around 0.8 million SWU/year



Satellite image from October 5, 2014 (Coordinates: 29°40'38.33" N/103°32'04.65" E). The image shows CEP2 under construction. Source: DigitalGlobe

Hanzhong Uranium Enrichment Plant (Plant405)



Satellite image from January 27, 2013

Coordinates: 33°15'47.70" N/107°25'52.74" E. Source: DigitalGlobe.

Hanzhong centrifuge facilities

Project	Capacity (million SWU/year)	Comments
Hanzhong CEP1 (Russian-supplied phase I)	0.2	Began operation in February 1997, under IAEA Safeguards
Hanzhong CEP2 (Russian-supplied phase II)	0.3	Began operation in January 1999, under IAEA Safeguards
Hanzhong CEP 3 (Russian-supplied phase IV)	0.5	Construction started in 2009; conducted trials in 2011. Began normal operation in 2013.
Hanzhong CEP 4 (domestic) Phase I &II	1.2 (0.6+0.6)	Construction permit on January 4, 2012. Phase I: Began operation in 2014. Phase II: installment and adjustment

❖ **Chinese non-weapon uses of HEU are very limited**

- **Nuclear-power submarines fueled with LEU (from first generation to current)**
- **Only a few research reactors with HEU**
 - most converted to LEU fuels.
 - CEFR: HEU to be replaced by MOX before 2020.
 - Zero Power Fast Critical Reactor (NPIC, Chengdu)
- **Tritium production reactor**
 - Produced by Jiuquan and Guangyuan reactors in the past. Should use power reactors?

➤ **Support HEU phase-out proposals?**

--Xi Jinping addressed at 2016 NSS: “We support all countries in minimizing the use of HEU according to their needs as long as it is economically and technologically viable.”

Research Reactor	Operator	Characteristics	Status
China Experimental Fast Reactor (CEFR)	China Institute of Atomic Energy (CIAE), Beijing	FBR, 64.4% HEU, 65 MWt/25MWe	Operational Loading MoX before 2020
Zero Power Fast Critical Reactor	Nuclear Power Institute of China (NPIC) , Chengdu, Sichuan	Critical fast, 90%HEU, 0.05 kWt	Operational
PPR Pulsing Reactor	NPIC, Chengdu	Pool, 20% HEU, 1 MWt	Operational
MNSR-SZ	Shenzhen University, Guangdong	Tank in pool, LW, 90% HEU, 30 kWt	Operational (converting)
MNSR-IAE	CIAE, Beijing	Tank in pool, LW, 90% HEU, 27 kWt	Operational (converted, March2016)
HFETR	NPIC, Chengdu	Tank , LW, 90% HEU, 125 MWt	Converted in 2007, Operational
MJTR	NPIC, Chengdu	Pool, LW, 90% HEU, 5 MWt	Converted in 2007, Operational
MNSR-SD	Research Institute of Geological Science, Jinan, Shandong	Tank in pool, LW, 90% HEU, 33 kWt	Shut down
MNSR-SH	Shanghai Institute for Measurement and Testing Technology, Shanghai	Tank in pool, LW, 90% HEU, 30 kWt	Shut down in 2007
HFETR Critical Assembly	NPIC, Chengdu	Critical assembly, LW, 90% HEU, 0 KWt	Converted in 2007, reported shut down later
Fast Neutron Critical Assembly	CIAE, Beijing	0 kWt	Shutdown
HWRR	CIAE, Beijing	LEU, 15 MWt	Operational
SPR	CIAE, Beijing	Pool, LEU, 3.5 MW	Operational
China Advanced Research Reactor (CARR)	CIAE, Beijing	Tank in pool, LW, 19.75% LEU, 60 MWt	First Critical in May 2010
NHR-5	Tsinghua University, Beijing	Heating supply reactor, LEU, 5 MWt	Operational
HTR-10	Tsinghua University, Beijing	High Temperature Gas-Cooled Reactor, coated particle fuels, LEU, 10 MWt	Operational
ESR-901	Tsinghua University, Beijing	Pool, 2-cores, 19.75% LEU, 1 MWt	Critical in 1964, operational

China's policy

- ❑ On October 4, 1994, U.S. Secretary of State Christopher and Chinese Foreign Minister Qian issued a joint statement in which they promoted the “earliest possible achievement” of a treaty prohibiting the production of fissile material for use in nuclear weapons.
- ❑ Supported Shannon Mandate, 1995
- ❑ A linkage with PAROS, around 2000
 - “the Conference on Disarmament in Geneva should not emphasize the importance of only the FMCT negotiations to the neglect of the issues of nuclear disarmament and the prevention of an arms race in outer space, and should, at the minimum, give equal attention to all three issues by carrying out its substantive work in a balanced manner.” ---
In 2000 China's defense white paper
- ❑ China agreed to FMCT negotiation without linkage in 2003; however, US proposed an unverified FMCT in 2004, blocked a restart.

❖ **China's current position**

Such a treaty would be “conducive to preventing nuclear weapons proliferation and promoting nuclear disarmament.” China has advocated negotiations to “conclude at an early date a multilateral, non-discriminatory and internationally and effectively verifiable FMCT, based on a comprehensive and balanced program of work acceptable to all.”

China's position on an FM(C)T negotiation

- Ban “future production,” not including past stocks
- Wants an *verifiable* FMCT
- Prefers to a focus on verification approach
- Less intrusive approach at former military nuclear facilities
- Against abuse of on-site challenge inspection

China's major concerns

❑ China's serious concerns on US space weapons and missile defense programs

- Could neutralize China's strategic nuclear deterrent; More freedom to encroach on China's sovereignty (including Taiwan affair).
- Would damage nuclear arms control and disarmament regimes, damage strategic stability and international security.
- U.S. missile defense and space weapons plans will affect China's willingness to participate in an FMCT negotiation.

--Although China supports an FMCT negotiations, the reference to “a comprehensive and balanced program of work acceptable to all” could mean a consideration of space weapons issues.

- In practice, driven by US missile defense programs, recently China deploys MIRVs.

❑ The past shows China is sensitive to international security environment

- In 1950s, the Korean War and US nuclear threat motivated China to develop its nuclear weapon program, and began to build its first set of nuclear facilities (**Lanzhou GDP** and **Jiuquan Pu complex**).
- Since 1964, given worsening Chinese-Soviet relations, Vietnam war, and US threats, China started construction of “third line” nuclear materials production facilities as “back-up” (**Heping GDP**, **Fuling Pu complex** (project 816)—gave up construction in early 1980s).
- In late 1960s, given border conflicts with Soviet Union and a perception of coming war between two countries, China began a rush construction of the third set of nuclear facilities (**Guanyuan Pu complex**, **Hanzhong enrichment plant**—military facility never completed and civilian CEP since 1980s, and **Project 827** including a production reactor—once again gave up constructions in early 1980s).

❑ China's "military to civilian conversion" is a de facto moratorium on fissile material production

➤ Since late 1980s, given an improved external security situation (e.g. normalization of diplomatic relations between China and US), Deng Xiaoping judged "no large world wars within next twenty years" (instead of Mao Zedong's "war preparation" strategy). Thus China has pursued "military to civilian conversion" policy, ending construction of nuclear facilities (project 816 and 827); converting or closing all production facilities by 1987.

❖ The past may suggest international security situation (e.g. US-China strategic security) would affect China's attitude to an FMCT negotiation.



Fuling plutonium production complex--816 Underground Nuclear Project, started construction in 1967 and ended in 1984 (never finished) based on international security situation. Part of the site was opened as a domestic tourist attraction in 2010.