Verifying and building on the Iran Deal

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Evolution of IAEA safeguards

- **1972:** Basic NPT safeguards agreement.

  IAEA monitors declared nuclear materials.

- **1998: Additional Protocol (**informed by Iraq case).

  State informs IAEA of <u>all</u> its nuclear-related activities and plans, including enrichment R&D and centrifuge manufacture.

  IAEA can do ***spot checks*** of declared activities and for presence of undeclared activities.

  Iran has agreed to "provisional application" of AP and to seek parliamentary ratification eight years after the UN Security Council Resolution of 20 July 2015.

2015: Additional verification under the Iran-P5+1 (E3+3) Joint Comprehensive Plan of Action

Two objectives:

1) Quick detection of any breakout to produce HEU at Natanz

2) Make it as difficult as possible to do clandestine enrichment or reprocessing.

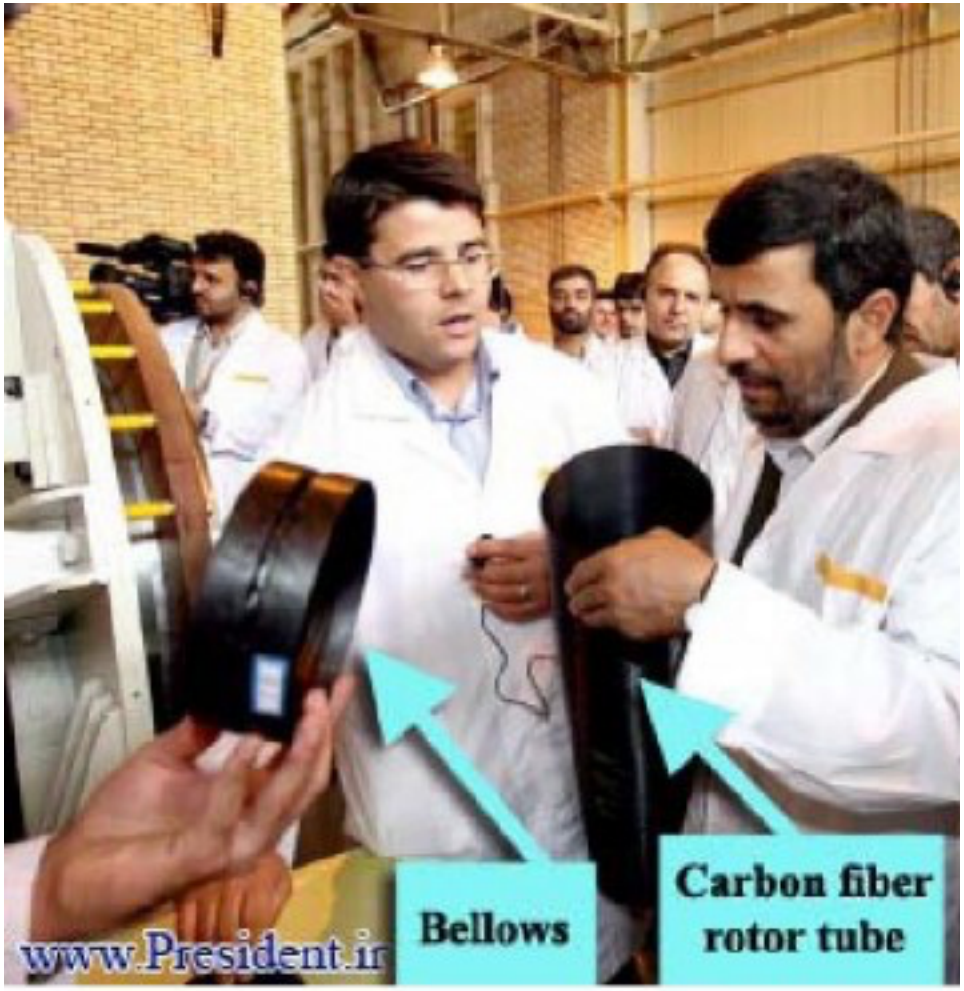
Additional monitoring in Iran beyond the AP

Continuous monitoring of enrichment

On-line enrichment measurements (185 keV) on cascade header pipes and electronic seals with remote on-site readout (15 years).

Containment and surveillance of centrifuge components and prod. equip. (20 years)

- Centrifuge rotors and bellows.
- Key equipment for centrifuge rotor and bellow manufacture: flow-forming machines, filament winding machines and mandrels.



Additional monitoring in Iran beyond the AP (cont.)

Transparent supply chains

- Monitor separation of natural uranium from ore to protect against diversion to clandestine ($U_3O_8 \rightarrow UF_6$) conversion facility (25 years).
- Monitor Iran's procurement of foreign nuclear technology or material (e.g. uranium or special steels or carbon fibers used in centrifuges) by a joint procurement working group (25 years).

No stalling

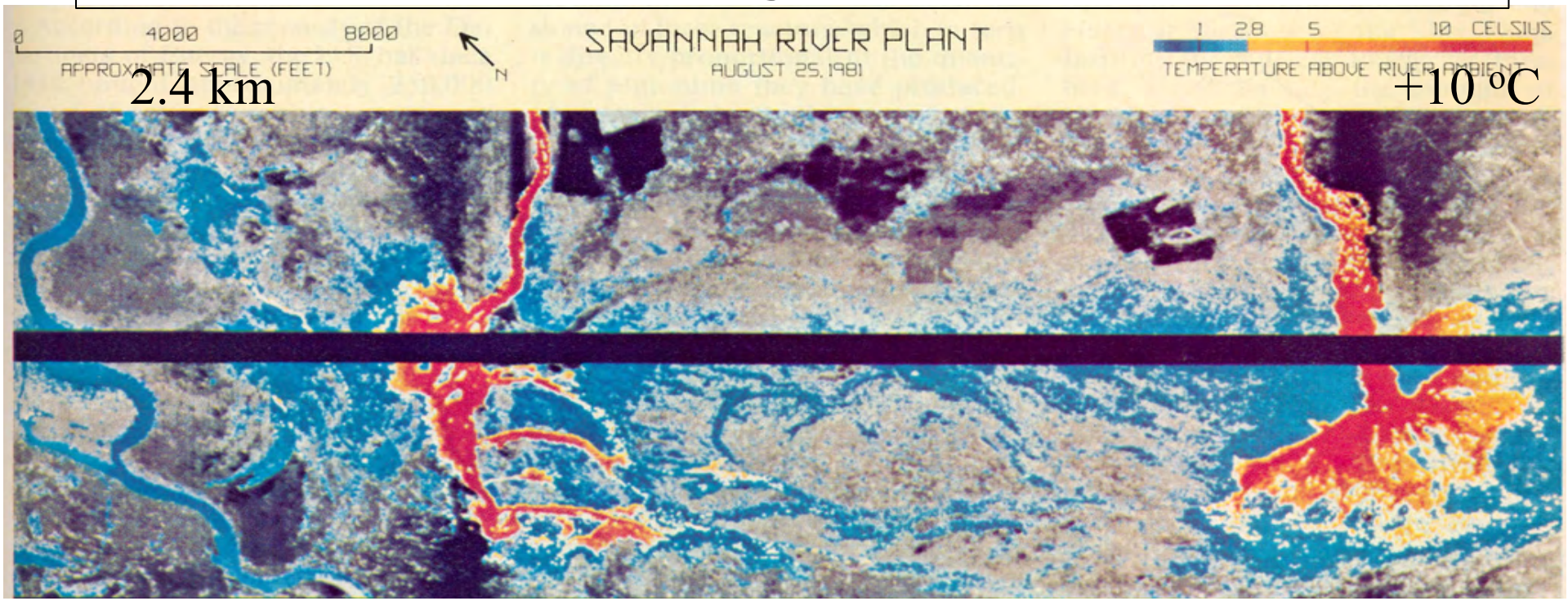
- Mechanism for forcing resolution of IAEA-Iran disputes over access within 24 days (25 years).

What about the plutonium route to a bomb?

- No reprocessing facilities or reprocessing R&D (≥15 years)
- No additional heavy-water reactors (≥15 years)
- Spent fuel from all Iranian reactors to be shipped out of the country (15 years) and from Arak within one year (reactor lifetime).

Very difficult to conceal a clandestine plutonium-production reactor

Aerial false color thermal image of Savannah River Site (1981)



“Possible Military Dimensions”

(Iran’s exploration of weapon-design, mostly before 2003)

14 July. IAEA and Iran agreed on on a "*Roadmap for Clarification of Past and Present Outstanding Issues*”

15 August. Iran provided IAEA with “its explanations in writing and related documents, on past and present outstanding issues.”

15 December. “the Director General will provide [the IAEA’s] final assessment on the resolution of all past and present outstanding issues”

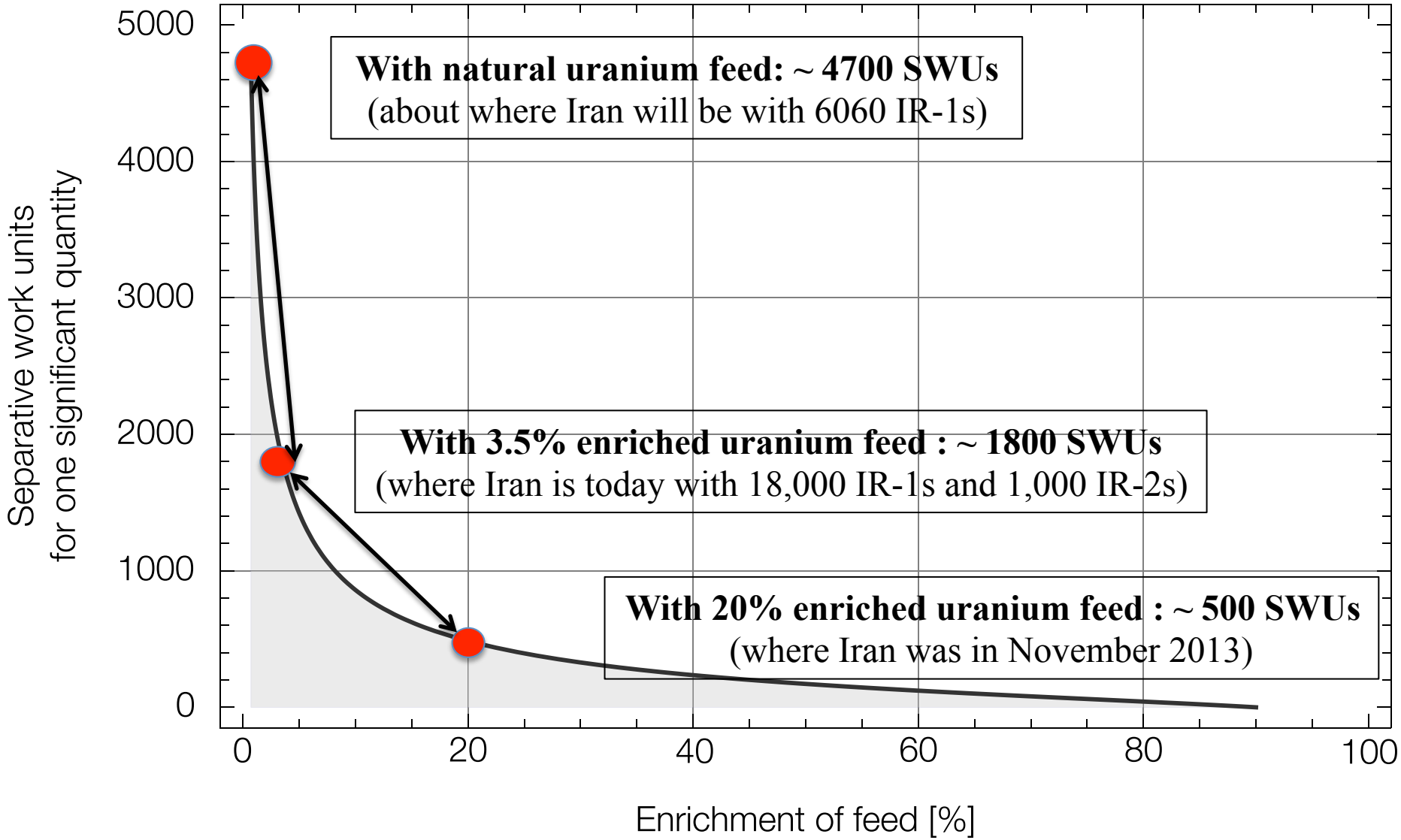
Unlikely that all questions can be satisfactorily answered in such a short time.

But

US estimate of Iran’s breakout time assumes conservatively zero time for Iran to make a nuclear bomb after it has sufficient HEU or Pu.

Understanding the 1-year breakout time

Approximate number of SWUs (or ~ IR-1 years) required to produce enough 90% enriched uranium to make a first bomb (25 kg U-235) as a function of enrichment of the feed.



What happens after 10 years?
Will Iran become another threshold nuclear-weapon state?

1946 Acheson-Lilienthal (Oppenheimer) ***Report on the International Control of Atomic Energy*** described uranium enrichment and plutonium separation (reprocessing) as "dangerous" technologies because owning them makes a country a threshold nuclear-weapon state.

UK, French, Indian, South African and North Korean nuclear programs were ambiguous initially but all involved reprocessing and/or enrichment.

Brazil's, Iran's and Japan's national enrichment programs provide each a nuclear weapon option, as does Japan's reprocessing program.

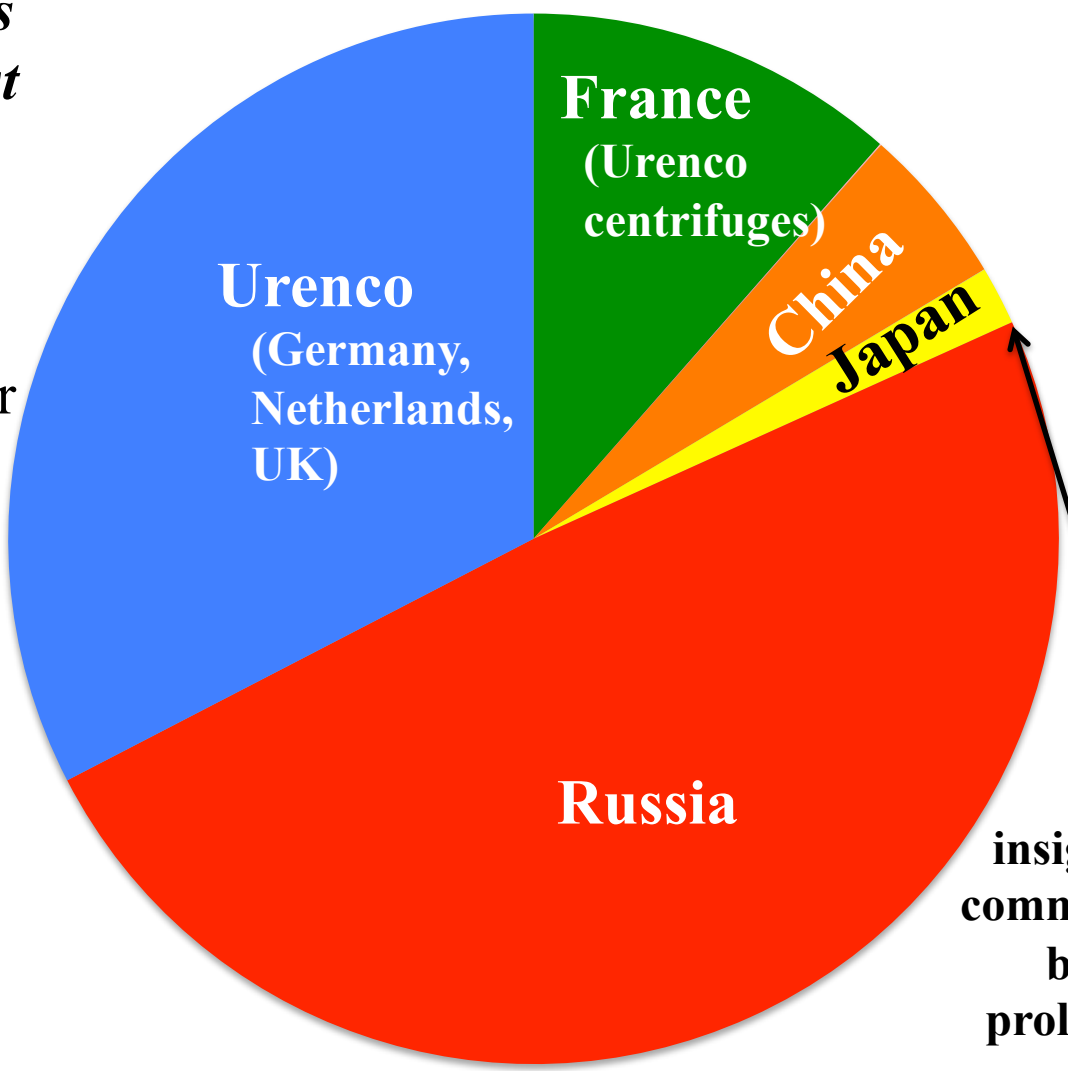
A better alternative to proliferation of national enrichment plants: A few enrichment plants under multinational control.

Urenco, a multinational, is already the second biggest supplier of enrichment services.

US, with ¼ of global nuclear capacity, no longer has a national commercial enrichment plant since it was privatized and then USEC went bankrupt.

Why doesn't the U.S. start saying, as with reprocessing, "We don't do it. You don't need to either."

Global Enrichment Capacity



Japan, Brazil, Iran: insignificant commercially, but not in proliferation potential

Conclusion and recommendation: Build on the Iran Deal to make enrichment less dangerous

With protections against clandestine plants:

1. Centralize import and manufacture of centrifuge rotors and the key materials used to make them.
2. Centralize production and stocks of UF_6.

With protections against misuse of overt plants:.

1. Multi-nationalize operating crews
2. Multi-nationalize control of operations including uranium and centrifuge supply chains

With protections against proliferation of national enrichment plants:

1. Require any proposed new national plants to be compared with reliance on existing plants or a multinational alternatives.
2. Multi-nationalize or shut down existing national plants.