Iran and Secure Nuclear Fuel Supply

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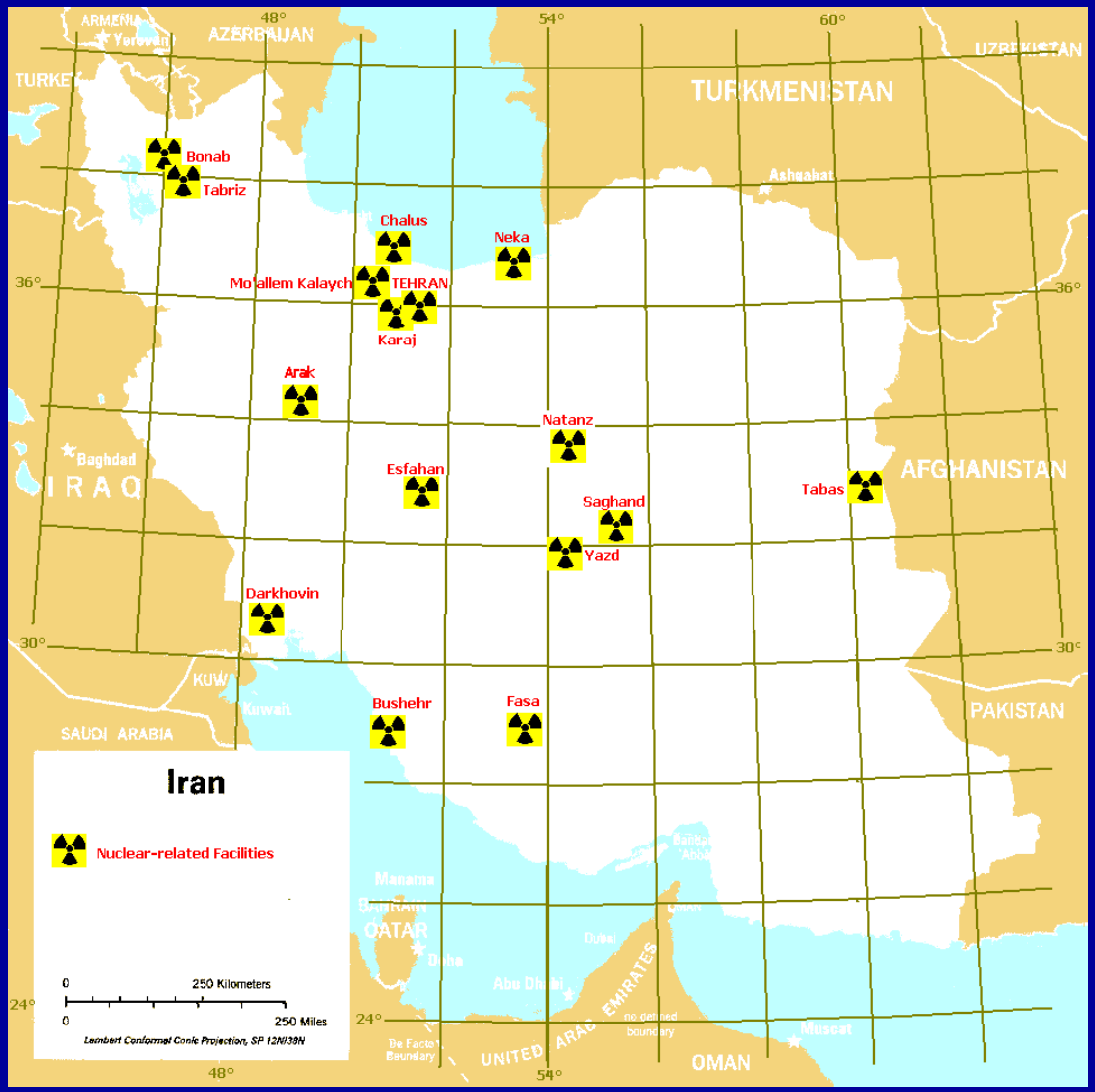
Presentation is based on work done by Chaim Braun and Michael May at CISAC Stanford University

Some Iran Nuclear Installations



Known Iran Nuclear Installations

- Bushehr reactor: 915 Mwe, online 2006
- Natanz enrichment plant frozen for now
- Esfahan: >30t UF_4 produced, kg UF_6?
- Arak: 40 MW heavy water reactor (2009?)
  - Heavy water production facility completed
- Others (partial list):
  - Laser enrichment experiments – milligrams
  - Esfahan Nuclear Fuel Research & Production Center: 3 research reactors, other facilities
  - Parchin military complex – HE and other work

Unknown Iran Nuclear Activities

- Besides the known nuclear facilities and activities, there may be others
- Iran has a history of not being straightforward with the IAEA
- Iran was one of the states supplied by A.Q. Khan; the full extent of these supplies is not known, nor whether they continue
- Iran recently told IAEA it had received instructions to make a nuclear weapon

Does Nuclear Energy Make Economic Sense for Iran?

- Iran has second largest gas reserves in the world, higher potential production, new pipeline plans
- High future prices for gas and oil are likely
- Trade-off involves higher present nuclear capital costs versus higher future gas fueling costs and probably higher export prices, as well as gains from competition, nuclear technical training
- The relative cost of gas versus nuclear power depends on the price of gas, distance from source

Does Uranium Enrichment Make Economic Sense for Iran?

- World price of enrichment services over past decades has ranged around $100/SWU
- Large enrichment facilities have many advantages: better centrifuges, cascade design, product quality
- Iran has said that Natanz is not justified on economic grounds alone
- Its key advantage is freedom from sanctions BUT Iran's domestic uranium resource is very limited

Natanz Facilities

- Now: pilot plant scale operations
- Iran eventual plan: 3,000 -> 54,000 centrifuges
- Natanz floor capacity: ~50,000 centrifuges
- ~ 5 SWU/year for P-2, <3 SWU/year for P-1
- ~ 150,000 SWU/Gw-year(e) (varies)
- ~ 6,000 SWU/weapon starting from natural U, ~3,000 SWU/weapon starting with 4% feed

Current Iran Position

- United on right to peaceful nuclear applications
- Divided on need for nuclear weapons
- Possible motivation for nuclear weapons:
  - Deterrence of US, Israel, possibly future Iraq or Taliban-led state
  - Prestige, perhaps leverage over OPEC
  - Anger with US
- Bargaining chip? Depends on leadership

Recent Statement from Iran President Ahmedinejad to UN

'What needs our particular attention is the fact that peaceful use of nuclear energy without possession of nuclear fuel cycle is an empty proposition. Nuclear power plants can indeed lead to total dependence of countries and peoples if they need to rely for their fuel on coercive powers, who do not refrain from any measure in furtherance of their interests. No popularly elected and responsible government can consider such a situation in the interest of its people.'

Current Negotiations Status

- Iran has:
  - largely frozen Natanz activities
  - re-started uranium conversion at Isfahan
  - offered cooperation on safeguarding its activities
- E-3 have offered economic incentives inadequate in Iran's eyes and guarantees of fuel supply
- US has:
  - Endorsed E-3 efforts but not joined them directly
  - Declined to offer security assurances
  - On occasion, called for regime change by Iranians

Outlook and a Question

- Successful outcome of negotiations seems unlikely soon
- Military action could unleash dangerous consequences, exceeding those in Iraq
- Sanctions are likely to be opposed by UNSC unless Iran breaks further agreements
- **Is there a way satisfactory to all sides to provide fuel for power reactors in Iran?**

An International Fuel Supply Regime Should …

- Support or enhance non-proliferation measures, present and proposed
- Credibly guarantee fresh fuel supply
- Provide credible obligations for spent fuel control and monitoring
- Be economically viable
- Be non-discriminatory in nature

Support or Enhance Non-proliferation Measures:

- Fuel exports permitted only from adequately controlled and monitored facilities
- Fuel exports conditional on entry into force of Additional Protocol (et al.) in recipient country
- Exporting and recipient countries must accept strengthened nuclear exports regulations
- Exporting and recipient country must have appropriately responded to UNSC 1540
- Spent fuel disposition monitored by IAEA

Provide Credible Guarantees of Fuel Supply

- For a guarantee to be credible, it must be more advantageous (or less damaging) to both sides to fulfill the guarantee than not
- That formula is relatively easy to reach in the case of most commercial transactions but it is not in the case of Iran
- If a way can be found for mutual trust to grow, a guarantee may become credible

Enhancing Credibility

- Credibility may be enhanced through:
  - Competing exporting entities in different states
  - Financial participation of recipient state
  - A UNSC umbrella agreement to complement Article IV of the NPT
  - A jointly funded escrow guaranteeing performance under the contract
  - Many terms (term, price, guarantee) need defining

Fuel Supply: Direct Sales

- Several international vendors sell fuel assemblies for each type of commercial nuclear power plant under license from their national government
- Direct fuel sales should also be subject to IAEA approval and monitoring of a plan for disposing of spent fuel

Fuel Supply: Lease-Take-Back

- Spent fuel take-back will necessitate policy changes in key countries (ongoing in Russia)
- L ease-take-back deals could be made financially attractive at minimal cost to suppliers, if any[1]
- Pending availability of permanent disposal sites, returned spent fuel could be placed into internationally monitored retrievable storage (at underutilized reprocessing facilities, e.g.)

Provide Credible Obligations for Spent Fuel Control and Monitoring

- An international fuel supply regime will have to be developed before storage and disposition sites become available[2]
- Such a regime must include a plan for securing spent fuel agreed to before export or lease and monitored by the IAEA
- Given the risk and difficulties of providing for spent fuel, lease-take-back should be preferred
- Regional safeguarded facilities could work best

Be Economically Viable

- The economics of fuel lease-take-back are different from the (now prevailing) economics of fuel sales, but both should be viable at a small fraction of electricity cost

The Bushehr Case

- Unique plant, German-Russian mix, uncertain cost
- The Russian-Iranian contract for spent fuel take-back reflects the tension between
  - Russian desire for compensation for expenses in storing and disposing of spent fuel
  - Iranian desire for compensation for energy value remaining in spent fuel
- Depending on outcome, contract could be of interest for future lease-take-back deals

Be Non-discriminatory

- Non-discrimination must cover availability over the lifetime of a plant and price
- This requirement can be partly met by the "guaranteed" supply but goes beyond it
- Non-discrimination requires the lifting of any supplier state sanction as pertains to NPT Article IV obligations
- This may be off the table for Iran for now

Iran versus Others

- Several countries besides the existing ones have plans to enrich and/or reprocess nuclear fuel
- US wants Natanz closed and dismantled but has given Japan and Brazil, e.g., little trouble
- It is not clear that the proposed Bush freeze can be enforced
- Nor would such measures as inspections or partnerships with e.g. EU allay US concerns

Can Any International Supply Scheme Solve the Problem?

- Internationally monitored nuclear fuel supply has not posed security problems in most cases
- But Iran and other states targeted by US have little reason to trust international assurances
- Improved international arrangements may do more to improve the accepted non-proliferation norms than to solve Iran-like problems
- Solving the tough cases will require solving other states' security problems