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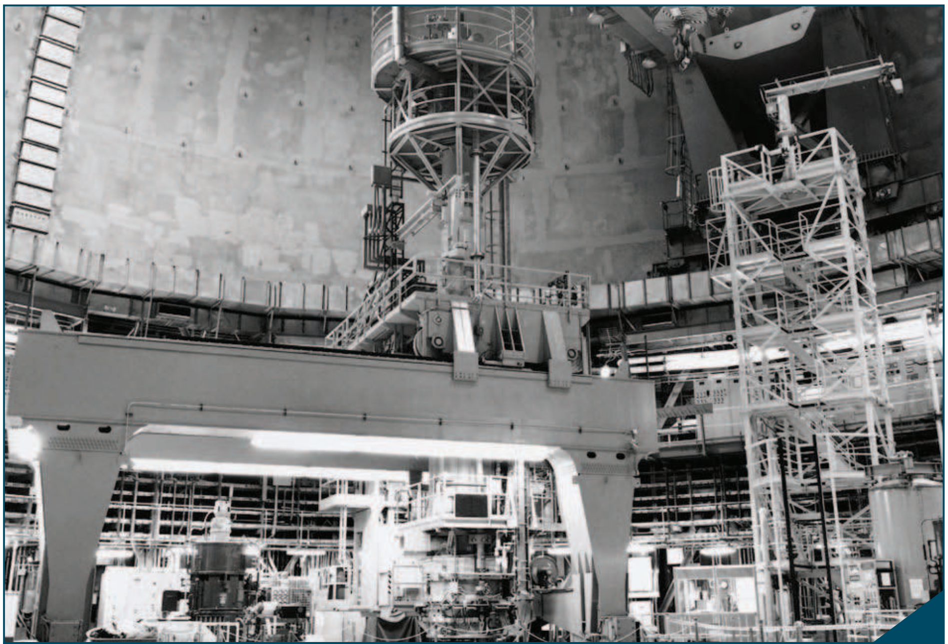

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Using military force against Iran's nuclear programme is likely to be very counter-productive

Iran's nuclear strategy – civil or military?

Iran is under scrutiny: Western governments claim its nascent nuclear power programme masks plans for nuclear weapons development. Frank Barnaby assesses the validity of the West's claims and argues that use of military force against Iran's nuclear programme will only make matters worse.

Iran has recently announced plans to seek bids for two new nuclear power reactors, each with a generating capacity of between 1,000 and 1,600 megawatts (MW) of electricity. Both will be partly fuelled with uranium dioxide produced indigenously in its uranium enrichment plant at Natanz. The rest of the nuclear fuel will be imported.

The new nuclear plants will be built at Bushehr, alongside Iran's first nuclear power reactor – which has just been constructed by the Russians. Iran says that it plans to build more nuclear power plants with a view to attaining a total generating capacity of 20,000 MW by 2020. Each 1,000 MW plant is expected to cost between US$1.4 billion and US$1.7 billion.

The West fears that Iran's civilian nuclear programme is a smokescreen for its ambitions to produce nuclear weapons. Iran insists that its nuclear programme is entirely for peaceful purposes. Many argue that because Iran has enormous reserves of oil and gas it does not need nuclear energy and therefore that its nuclear programme can only be driven by military ambitions. But Iran claims that it needs to export as much of its oil as possible to earn much needed foreign currency, that its oil reserves are finite and that nuclear power is a sensible investment for the future. Clearly, navigating through the political and economic arguments is not easy. But its importance is clear, given the looming threat of military action against Iran based on its assumed nuclear weapons intentions. What do the technical data suggest? This article, which draws extensively on an Oxford Research Group report[1], attempts to answer that question.

Iran has long experience in nuclear physics and engineering. Because it has been operating nuclear research reactors for some decades, it also has a

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Iran's nuclear strategy – civil or military?

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cadre of trained personnel that could be switched to a nuclear weapons programme. Once Iran can produce the fissile material – highly enriched uranium or plutonium or both – needed for nuclear weapons, it could fabricate those weapons in a relatively short time. The question is: how close it is to producing that fissile material in significant quantities?

Analysts greeted the announcement earlier this year by Iranian President Mahmoud Ahmadinejad that the country had begun enriching uranium on an "industrial scale" (for use as nuclear fuel) with scepticism. However the International Atomic Energy Agency (IAEA) has recently updated its assessment of Iran's enrichment work[2] and acknowledged that significant progress has been made in recent months. Mohamed El Baradei, Director General of the IAEA, stated: "The Iranians pretty much have the knowledge about how to enrich. From now on, it is simply a question of perfecting that knowledge." El Baradei estimates that Iran is likely to take between three and eight years to acquire enough fissile material for a nuclear weapon, in the absence of serious technical hitches. It is not clear whether or not Iran can maintain its recent rate of progress, but it is apparent that it is pursuing a programme of activities in this direction.

Iran's current nuclear activities

Iran operates four small research reactors – not for production purposes. Three of these, supplied by China, are at the Esfahan Nuclear Technology Centre; the other, supplied by the USA, is at the Nuclear Research Centre in Tehran.

The 1,000 megawatt electrical nuclear power reactor at Bushehr, built by the Russians, is now complete. It is a light-water reactor, of the Russian VVER type, and will be fuelled by low enriched uranium (to about 3.5% in uranium-235, appropriate for power generation but not weapons production).

In addition to this reactor and the uranium enrichment facilities at Natanz, Iran is constructing a heavy-water research reactor in Arak, about 250 kilometres from Tehran. A heavy-water reactor provides a particularly efficient way of producing plutonium for use in nuclear weapons. Called the IR-40, this will replace the 40-year old Tehran Research Reactor and will be a 40 MW (thermal) reactor cooled with heavy water and fuelled with natural uranium.

Iran is also developing uranium sources and has identified Saghand as the location of its first uranium ore mine. The deposit reportedly contains between 3,000 and 5,000 tonnes of uranium spread over an area of roughly 130 square kilometres. It is constructing a uranium conversion facility at the Esfahan Nuclear Technology Centre to convert uranium ore (yellow cake) into uranium hexafluoride gas, suitable for use in the gas centrifuges used for the enrichment of uranium. The IAEA says that the uranium dioxide fuel elements for the IR-40 will be manufactured in the Fuel Manufacturing Plant being built at the Esfahan establishment.

Its Natanz-based enrichment facility comprises two gas centrifuge plants; one is a Pilot Fuel Enrichment Plant and the other is a large commercial scale Fuel Enrichment Plant (FEP). Components for gas centrifuges are produced and tested in workshops at the Kalaye Electric Company in Tehran.

A recent IAEA inspection of Iran's Natanz facility found that engineers were already running about 1,300 gas centrifuges to produce fuel, enriched to about 4.5% in uranium-235, suitable for use in a nuclear power reactor (but not for weapons). Iran has shown that it can produce gas centrifuges, and balance and spin them for a number of months at the high speeds necessary to make nuclear fuel in a cascade of 164 centrifuges; two such cascades are now operating in the FEP. Thus it has the capability to run the equipment needed to produce highly enriched, weapons-grade uranium. According to Iranian officials, the Natanz facility has 1,600 active centrifuges, and will soon have 3,000 operating[3]. It has said it plans eventually to install more than 50,000 centrifuges.

All these activities inevitably raise suspicions.

How suspicious should we be?

Iran claims that the purpose of the IR-40 reactor is the production of radioactive isotopes for medical and industrial uses. In theory, the IR-40 could produce about 8 kg of plutonium a year, enough to produce two nuclear weapons a year. It is estimated that about 85 tonnes of heavy water will be initially required for the IR-40 and less than one tonne will be need annually. Iran is operating a plant to produce heavy water at Khondab near Arak.

If Iran does choose the plutonium route, it will be necessary to separate the plutonium chemically from the irradiated reactor fuel elements. The Iranian government has acknowledged to the IAEA that it has irradiated uranium dioxide targets with neutrons in the Tehran Research Reactor and subsequently chemically separated the plutonium produced in the targets. According to the Iranians, only a small amount of plutonium was separated, but this is nonetheless a significant admission. Considering the current state of development, however, plutonium from the Arak research reactor is unlikely to be available before about 2014.

Given that plutonium is not a short-term option for any Iranian nuclear weapon ambitions, what about its capacity for producing enriched uranium?

A facility comprising 3,000 centrifuges (of the P-1 type currently deployed) could, if they are operating smoothly and continuously (and this is a big if), produce about 40 kg of highly enriched uranium per year – enough for two nuclear weapons (for which the uranium should be enriched to at least 90% in uranium-235; compared with 3 – 5% for use as fuel in nuclear power reactors.) It is estimated that it would take the Natanz facility at least five years (including remaining development time) to produce enough highly enriched uranium for a nuclear force of six nuclear weapons, the amount required if Iran were to be strategically significant in the region. (Note though that Iran is experimenting with the P-2 type gas centrifuge, which may be about twice as efficient; the status of the P-2 development is not publicly known.)

Assuming about 60% of the centrifuges are rejected as sub-standard (a typical figure), Iran would need to produce about 5,000 centrifuges to get this facility of 3,000 centrifuges running. Moreover, gas centrifuges break down frequently because of the mechanical stresses they are under, so there must be a steady supply of replacement machines. Iran will therefore need to produce many thousands of gas centrifuges to produce a strategically significant number of nuclear weapons.

The prospects are further impeded by a difficult technical problem that must be solved before significant amounts of highly enriched uranium can be produced at all. Iranian uranium is reportedly contaminated with large amounts of molybdenum and other heavy metals. These impurities could condense, and block pipes and valves in the gas centrifuges. This problem will not hamper the process required for the low enrichment levels needed for civil nuclear power reactor fuel, but will prevent enrichment above about 20% in uranium-235. So, to produce weapons-grade uranium, the Iranians will have to remove most of the molybdenum. This would need foreign technical help – from, for example, China or Russia.

So, if Iran does succeed in setting up such a production line of highly enriched uranium, the technical requirements make it reasonable to estimate that it will be unlikely to have significant amounts – i.e. for an arsenal of six weapons – until around 2012, and possibly 2015 or later, even taking into account the observations from the latest inspections.

Given the challenges presented by uranium enrichment, if Iran does take the decision to have a nuclear weapon force, it may after all decide to wait until the IR-40 heavy water reactor at Arak is operating and use plutonium instead. They may find this preferable; about 5 kg of plutonium is needed to produce a nuclear weapon, compared with about four times as much highly enriched uranium.

Time still for diplomacy

The key questions are: how long could it take Iran to develop a nuclear weapons capability, were it to take the political decision to do so? And is it at all likely that a military strike might be an effective preventative measure (even before considering the ethics of such a course of action)?

In fact, there are many reasons why a military strike would be ineffective regardless of the real or alleged time scales of Iran's nuclear adventures – see Box right. But it is important to examine the time scales nonetheless.

As we have seen, the technical analysis suggests that plutonium from the Arak research reactor is unlikely to be available before about 2014, and enriched uranium is unlikely to be available in sufficient quantities until around 2012.

The US Director of National Intelligence, John D Negroponte, told the US Senate Committee on 2 February 2006 that Iran "will likely have the capability to produce a nuclear weapon within the next decade". David Albright, President of the Washington-based Institute for Science and International Security (ISIS) and an authoritative expert on Iran's nuclear programme, estimates that "Iran is not likely to have enough highly-enriched uranium until 2009".

And fuel is not the only requirement: the components for a nuclear weapon will have to be manufactured and tested, and nuclear warheads will have to be miniaturised for delivery by surface-to-surface missiles. These steps will take significant time, although Iran is reportedly developing three types of ballistic missiles that could deliver nuclear warheads, the Shahab-3, -4, and -5.

It must be emphasised that all estimates about the time scales are very uncertain. Many details about Iran's technical nuclear capabilities are not known. History shows, though, that it usually takes longer to produce nuclear weapons than estimates suggest. Since it looks likely that Iran will need at least five more years to build a nuclear weapon, and longer to put together a substantial capability, it appears that any claims of imminent nuclear threats from Iran are unfounded.

What is certain is that claims that military action against Iran is needed soon are not justified. A military attack on Iran's nuclear facilities, many of which are in urban areas, would inevitably kill a large number of civilians. It would be highly unlikely to destroy all Iran's nuclear facilities, instead stimulating a determined effort to use all available means to achieve a nuclear weapons capability as quickly as possible.

There is plenty of time – probably between five and ten years – for diplomacy to take its course.

Dr Frank Barnaby is Nuclear Issues Consultant to the Oxford Research Group.

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Why military strikes would not be effective

There are a number of factors that cast doubt on whether pre-emptive military air strikes could succeed.

Each nuclear site contains many targets. A large number, perhaps many hundreds, of aircraft sorties would be required if all the sites were to be targeted. There is an inherent contradiction in arguments that a military strike could both encompass all key nuclear facilities and be surgical and brief.

Many of these targets are in built-up, heavily populated areas, increasing significantly the risk of collateral damage and civilian casualties.

It is known that some of the Iranian nuclear facilities are underground. Over the past few years, Iran's Natanz uranium enrichment facility has been buried under more than 15 m of reinforced concrete and soil. There is a possibility that Iran has constructed secret facilities in anticipation of a military strike. It is also conceivable that Iran has built false targets as decoys.

Without adequate intelligence, it is unlikely to be possible to identify and destroy the number of targets needed to set back Iran's nuclear programme significantly.

Unless Iran's scientific and technological know-how is eliminated, it would only be a matter of time before technicians reconstructed its nuclear programme. It is anticipated that many key personnel could survive military strikes.

Furthermore, it is to be expected that the Iranian population, including the scientific community, would unite around the current government after a military strike from the West and support any subsequent moves to attain a nuclear weapon for deterrent purposes. If the Iranian regime did embark on a crash nuclear programme in the aftermath of an attack, i.e. withdrawing from the Non-Proliferation Treaty, committing itself fully to building a nuclear weapon using all available assets, including damaged nuclear equipment and materials, and purchasing additional supplies on the black market, it could probably achieve this in two or three years, possibly even less.

Therefore, it is possible that a military attack on the Iranian nuclear programme would not delay it by a significant time period, since the very anticipation of the attack and the increased resolve after it could speed up the programme by as much as the attack had set it back.