IRAN'S STRATEGIC WEAPONS PROGRAMMES
a net assessment

Press Launch
Arundel House, London
6 September, 2005

REMARKS BY
Dr John Chipman, Director, IISS

INTRODUCTION

Welcome to the press launch of the latest IISS 'Strategic Dossier' – *Iran's Strategic Weapons Programmes – A Net Assessment.* This dossier is the third in our series, which has included similar publications on Iraq (published in September 2002) and North Korea (published in January 2004).

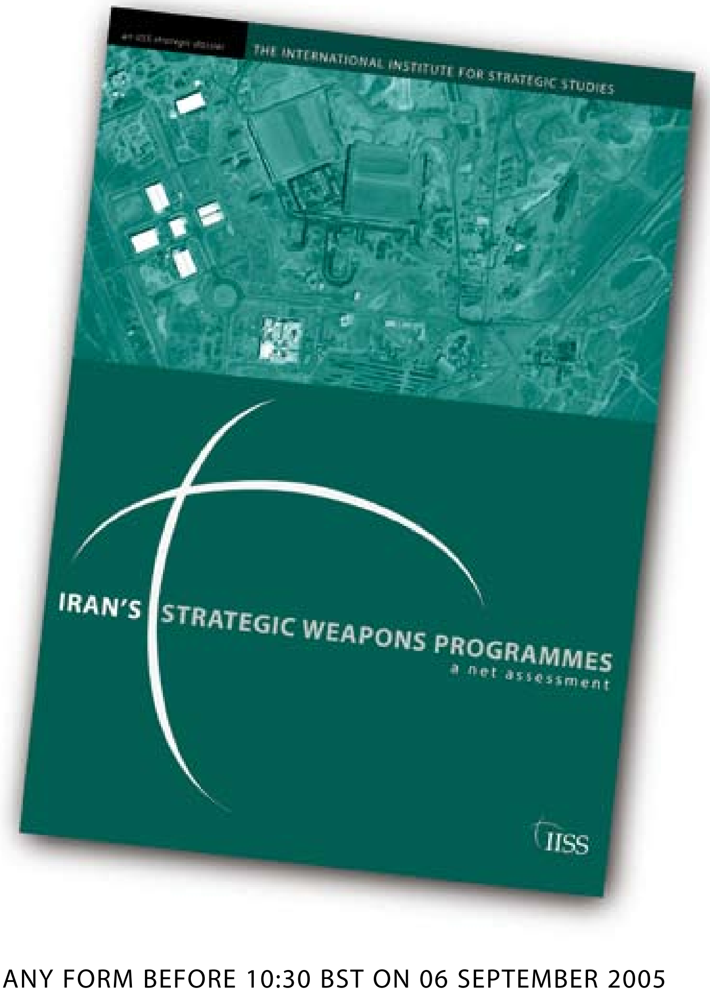
Each of our dossiers has presented a particular set of assessment challenges. Unlike North Korea under Kim Jong Il and Iraq under Saddam Hussein – police states at home and pariah states abroad – Iran has a more open society, with a more complex and diverse internal political system, a broader range of public opinion, and more interest in preserving its international respectability and avoiding world condemnation and isolation. This relative openness has meant that there is more in the public domain about Iran's capacities and there are greater opportunities to discuss information that has become public with relevant officials in Iran. Nevertheless, as in all areas of great military sensitivity, there remains a good deal that cannot be known for certain from the outside. Where information is too scarce to make a firm judgement, we make this clear.

SOURCES AND ASSESSMENT CHALLENGES

In the nuclear area, to avoid referral to the UN Security Council, Iran has submitted to extensive investigations by the International Atomic Energy Agency (IAEA) since 2003 to verify Iran's acknowledgement of undeclared nuclear activities extending back over nearly 20 years. The results of these IAEA investigations form the basis for our nuclear assessment. We also benefited from discussions with knowledgeable experts, as well as technical briefings and visits to nuclear facilities organised by the Iranian Atomic Energy Organization. Although a number of uncertainties remain about past and current activities, including the history of Iran's enrichment and reprocessing efforts, we judge it is unlikely that Iran is hiding significant stocks of fissile material or production facilities for such material.

Much less reliable technical information is available on Iran's suspected chemical and biological weapons (CBW) programmes, which have not been exposed to the same degree of international inspections. Given this limited information base, we evaluate a range of public sources, including official US government estimates, other reports of Iranian procurement efforts, and claims by opposition groups. In most cases, the accuracy and reliability of this information cannot be confirmed and so our judgements are more circumspect. In contrast, the existence of Iran's ballistic missile programme is not in question, but details of missile production facilities and capabilities and operational military details, such as inventories, deployment and doctrine are less clear from available public sources.

With all these pitfalls in mind, we have tried to present a balanced and cautious set of assessments in individual chapters on Iran's nuclear, chemical and biological capabilities and its ballistic missile programme. To help establish the



political context, we have also included an opening chapter that recounts a political history of Iran's nuclear programme, analysing how domestic and international political factors have shaped the course of Iran's nuclear development for nearly 40 years, including a detailed account of the more recent EU-3 negotiations with Iran. Finally, the conclusion seeks to summarise our judgements about technical capabilities and the political motivations that form the basis for our overall assessment of the risks posed by Iran's strategic weapons programmes.

NUCLEAR WEAPONS CAPABILITIES

Public estimates for how long it would take Iran to acquire nuclear weapons range from only a few years to at least a decade. In our dossier, we analyse several different possible scenarios, based on both technical and political factors. From a technical standpoint, the most critical factor is Iran's ability to produce sufficient quantities of nuclear weapons usable fissile material, requiring approximately 20–25kg of weapons-grade uranium or 6–8kg of separated plutonium for a simple implosion device. For over two decades, Iran has sought to develop fuel cycle capabilities in both areas. In the uranium area, Iran is constructing pilot- and industrial-scale gas centrifuge uranium enrichment facilities at Natanz. These facilities are designed to produce low enriched uranium (LEU) to provide fuel for the Bushehr nuclear power plant, but they could be converted to produce enough highly enriched uranium (HEU) for a dozen or so nuclear weapons annually. In the plutonium area, Iran is commissioning a heavy-water production plant and is constructing a 40 megawatt (MW) heavy-water research reactor that could produce enough weapons-grade plutonium for one or two nuclear weapons a year, assuming that Iran builds a reprocessing facility to separate this plutonium from spent fuel.

Of the two approaches, the centrifuge enrichment programme is closest to fruition. Nonetheless, we estimate that it will likely take Iran at least a few years to complete and operate the pilot scale enrichment plant at Natanz, currently planned to contain 1,000 centrifuge machines.

Firstly, Iran will need to resolve technical problems at the Esfahan Uranium Conversion Facility (UCF) in order to produce sufficient quantities of high quality uranium hexafluoride (UF_6) feed material for enrichment. The particular chemical process and the equipment used by Iran in the initial yellowcake purification step in the conversion process are inferior for producing clean UF_6. As a result, the UF_6 produced at the UCF thus far is too contaminated with traces of molybdenum and other elements to be used as feed material. With practice, Iran should be able to overcome this problem, although it may mean running the UCF at very low capacities.

Secondly, Iran will need to complete and operate the pilot-scale centrifuge facility at Natanz before it can produce weapons-grade uranium in sufficient quantities to support a nuclear weapons programme. Currently, a single cascade of 164 machines is installed at the pilot plant. The cascade only operated briefly with UF_6 gas before the October 2003 suspension agreement with the EU-3 took effect, and its ability to sustain prolonged operations is unknown. In any event, it would take more than a decade for a 164-machine cascade to produce enough weapons-grade uranium for a single nuclear weapon, assuming ideal conditions. Despite the suspension, Iran has already manufactured and assembled enough centrifuge machines (more than 1,200) to complete the additional five 164-machine cascades originally planned for the pilot centrifuge plant. But, based on Iran's demonstrated rate of installing and testing centrifuges at the pilot plant before the October 2003 suspension, and the likelihood that some of these machines will fail, we estimate it will probably take at least a year or two to install and test the remaining cascades and work out the usual start-up problems that typically plague first-time centrifuge operators before the facility could operate on a reliable sustained basis.

Once it is operational, the pilot-scale centrifuge facility will have a limited capability to produce the highly enriched uranium (HEU), of about 90% U-235, required for nuclear weapons use. Under ideal conditions, a pilot plant of 1,000 P-1 centrifuges can theoretically produce about 10kg of HEU a year starting from natural uranium feed, thus requiring about 2–3 years of operation to produce enough weapons grade uranium for a single weapon. However, the pilot plant (as currently planned) is configured to produce low enriched uranium (LEU) of about 5% U-235 for nuclear power reactor fuel rather than HEU, and continuous operation is unrealistic. As a result, actual production of HEU is likely to be considerably less than the theoretical maximum, perhaps as much as 50%. Iran could scrap its current plans and build the pilot plant in a configuration to maximise HEU production, but this would take at least a year or two. If the pilot plant is built and completed as currently planned, it would take a further six months to reconfigure it for improved HEU production.

As an alternative to producing HEU directly from natural uranium feed, Iran could produce a stockpile of LEU, ostensibly for nuclear power reactor fuel, and then break out by using this material as feed to produce HEU in a short period of time. In theory, with LEU feed, the 1,000-machine pilot plant could produce enough HEU for a single weapon within several months of operation, even taking into consideration likely inefficiencies and some requirements for re-configuration. However, unless Iran acquired an alternative source of LEU feed, the plant would need to operate for at least a few years to produce enough LEU for a running start to produce enough HEU for a single weapon.

Thus, in any break out scenario involving the 1,000-machine pilot centrifuge plant, at least a few years of high operation would be needed to produce enough HEU for a single nuclear weapon, whether this involves direct production of HEU from natural uranium or production of a stockpile of LEU that is then used to produce HEU. Iran could reduce this time by installing additional enrichment capacity, depending on the rate at which Iran can manufacture, assemble, install and test additional centrifuge machines and cascades. Based on partial data from IAEA reports, Iran has been able to manufacture and assemble additional centrifuge machines at a rate of between 50 and 100 new machines a month. Assuming Iran cannot easily increase this rate of production, it could double its enrichment capacity within a year or two of resuming the manufacture of centrifuge machines, with additional time required to install and test the machines in cascades.

In conclusion, if Iran threw caution to the wind, and sought a nuclear weapon capability as quickly as possible without regard for international reaction, it might be able to produce enough HEU for a single nuclear weapon by the end of this decade, assuming it can

1) produce sufficient quantities of clean UF_6;
2) complete the pilot centrifuge plant; and
3) operate the plant on a high capacity basis over a period of a couple years.

Unanticipated technical problems in any of these areas would lengthen the time frame.

As an alternative, if Tehran does not feel compelled to acquire nuclear weapons urgently or judges that the risk of breaking out with a marginal capacity is too great, it could wait until it completes the industrial-scale centrifuge plant at Natanz, planned to contain 50,000 machines. Although the industrial-scale plant is likely to take more than a decade to complete, such a facility could produce enough HEU for a nuclear weapon within a few weeks (with natural feed) or even a few days (with LEU feed) without reconfiguration, thus denying other countries adequate time to act before break out was achieved. In addition, this approach would enhance Iran's options to pursue covert enrichment options because the completion and operation of industrial-scale conversion and enrichment facilities would substantially facilitate efforts to conceal and construct smaller secret facilities.

In contrast to the production of weapons-grade uranium, Iran's ability to produce weapons-grade plutonium seems more distant. Iran's 40-megawatt heavy-water research reactor at Arak is in the early stages of construction, scheduled for completion in 2014. However, the project is likely to run over time. Moreover, although Iran has conducted laboratory-scale reprocessing experiments, it has very limited technical expertise to build an industrial-scale reprocessing facility. In theory, if Russia delivers fresh fuel, the Bushehr nuclear power reactor could accumulate substantial quantities of weapons-grade plutonium within only a few months of operating. In order to acquire that plutonium, however, Iran would need to build a reprocessing facility suited to Bushehr fuel. This poses some additional technical challenges beyond those that exist for building a reprocessing facility for fuel obtainable from the Arak reactor.

Assuming Iran produces sufficient quantities of fissile material, Iran's ability to design and fabricate nuclear weapons from this material is unknown. The IAEA has conducted some limited investigations of possible weaponisation research and development, but has found nothing conclusive. Some analysts speculate that Iran might have acquired a nuclear design from the A.Q. Khan network (as Libya did), but this has not been confirmed. According to press accounts, Western intelligence agencies have acquired a large set of computer files from an Iranian source, showing studies to develop a nuclear warhead for the *Shahab*-3 missile, but the details of this reported research are not public, and it is not clear whether this research has gone beyond theoretical studies. Thus, on the basis of public information, it is not possible to assess the status of Iran's suspected nuclear weaponisation efforts.

CHEMICAL AND BIOLOGICAL WEAPONS CAPABILITIES

Compared to its nuclear programme, it is much more difficult to assess Iran's suspected chemical and biological weapons capabilities. For many years, public US government estimates have accused Iran of stockpiling chemical and biological agent and weapons, but there is no conclusive evidence in the public domain to support this accusation. The most recent US government estimates have become more cautious about asserting that Iran actually possesses a CBW stockpile, while still claiming that Iran continues a CBW research and development programme and seeks dual-use materials, equipment and expertise to further its chemical weapons capabilities. From public information, we cannot determine whether Iran is conducting offensive CBW research. Nonetheless, it is certainly true that the development of Iran's civilian, chemical and biotechnical infrastructure has enhanced Iran's inherent ability to produce chemical and biological weapons agents if it decided to do so. Rather than risk exposure – especially in the area of maintaining stocks of agent or actual weapons – Iran may be content to conduct CBW research and development within its civilian activities (which would be very difficult to detect) and maintain a break out capability, in the event that the production and weaponisation of chemical and biological agents was deemed necessary.

BALLISTIC MISSILES

Iran's ballistic missile programme is based primarily on liquid fuel technology acquired from North Korea – the short range *Shahab*-1 (*Scud*-B) and *Shahab* -2 (*Scud*-C) missiles, with effective ranges of 300–500km, and the intermediate range *Shahad*-3 (*No dong*) missiles, with an effective range of 1,300–1,500km. We estimate that Iran has deployed a single *Shahab*-1/2 missile brigade, comprising three or four missile battalions for a total of 12–18 mobile missile launchers and 48–72 missiles in the field, and at least one *Shahab*-3 missile battery, which would normally consist of 3 launchers and 12 missiles in the field. Additional missiles are stored in reserve. As far as is known, Iran's missile forces are armed with conventional high explosive warheads, although Iran could probably build primitive CBW warheads if it chose to do so. Based on the most recent flight tests in 2004, Iran is seeking to develop a smaller warhead for the *Shahab*-3, which appears consistent with reports of research into the development of a nuclear warhead for the *Shahab*-3, but the details of this reported research are not available.

CONCLUSIONS

Unlike countries driven by a sense of national survival, Iran has not launched a dedicated effort to acquire nuclear weapons as quickly as possible at all costs. While most Iranians support the nuclear programme as a matter of national pride and accomplishment, and deeply resent efforts by outside powers to deny Iran the benefits of modern technology, few Iranians openly profess a desire for nuclear weapons. Officially, Iran claims that its nuclear programme is entirely peaceful and that the enrichment programme is only intended for fuel production. Privately, most Iranians make more sophisticated arguments, knowing that the 'purely peaceful' justification is not entirely plausible. Iran, they say, needs a latent nuclear weapons capability to stay afloat in a sea of nuclear states and to strengthen Iran's bargaining position against more powerful countries, such as the United States, but they assure that Iran would never actually build nuclear weapons. Except for some hardliners, they say, Iranians are sophisticated enough to recognise that nuclear weapons would make Iran a target of international hostility, spur further proliferation in the region, and help America enhance its security presence in the region. Finally, they say, Supreme Leader Khamene'i (like Ayatollah Khomeini before him) has ruled that nuclear weapons are contrary to Islam. Even if these arguments are genuine, however, the temptation for Iran's leaders eventually to translate nuclear potential into reality could be difficult to resist once the option is available.

Iran's nuclear option is not imminent. On purely technical grounds, Iran appears to be at least several years away from producing enough fissile material for a nuclear weapon, and whether Iran has the expertise to fabricate a nuclear weapon from this material is unknown. This 'worst case' scenario assumes that Tehran blatantly reaches for nuclear weapons without regard for international reaction. Up to now, however, Tehran has been more cautious. It has been prepared to accept delays and limits on its nuclear activities in the interests of dividing international opposition and avoiding confrontation. Rather than dash for a bomb, Iran may seek gradually to acquire a much more substantial nuclear production capability over a decade or more – for example by completing a large-scale centrifuge plant for producing nuclear fuel – before it decides whether to exercise a weapons option. The challenge for international diplomacy in these circumstances is a delicate one. It will be important on the one hand to apply pressure and create inducements to persuade Iran not to develop a fuel cycle capability that it could later turn into a weapons programme. On the other hand, it will be important to apply international diplomacy in a way that does not inspire Iran to abandon all restraint and seek a nuclear weapons capability without regard to the international repercussions. For its part, Iran must decide if mastery of the fuel cycle is worth the international isolation that in the current climate would no doubt result from its refusal to compromise on this point. It will also have to judge whether its power and status is reinforced or weakened if it defies the wishes of an international community aroused to the dangers of allowing a country to sneak towards a nuclear weapons capability. The IISS has provided with this dossier a technical analysis of present, putative and potential capabilities. The greater difficulty is conjuring a satisfactory diplomatic outcome to the present impasse.