Iranian Nuclear Weapons (Part II):

Operational Challenges

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ABOUT THE AUTHORS

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Brief Analysis

Counterproliferation strikes on nuclear sites are uncommon but by no means unprecedented. Germany's embryonic nuclear program was attacked during World War II, Iraq's Osiraq nuclear plant was bombed by Iran in 1980 and by Israel in 1981, and Iran's Bushehr reactor site was attacked by Iraq throughout 1984-1988. During the 1991 Gulf War, the United States set a precedent by attacking the al-Tuwaitha nuclear site while radioactive materials were present. In January 1993, the United States fired forty-four Tomahawk missiles at a suspected Iraqi uranium enrichment facility at Zafaraniyah. By the time Operation Desert Fox was launched in December 1998 with the aim of stunting Iraq's weapons of mass destruction (WMD) program, Baghdad had learned to disperse and conceal its WMD infrastructure within civilian dual-use industries. This forced the United States to strike indirectly at Iraqi WMD capabilities through military industries supporting the development of delivery systems. Iran appears to have learned the lessons of previous counterproliferation strikes; its nuclear program presents a difficult set of potential targets for U.S. forces to locate and attack.

Counterproliferation Targets

There are two fuels that can be used for nuclear weapons -- highly enriched uranium (HEU) and plutonium -- and Iran appears to be pursuing both routes. The HEU fuel cycle involves a chain of processes, each requiring facilities that may or may not serve as viable counterproliferation targets:

• Facilities for mining and milling uranium ore provide few targets; mine-heads cannot be permanently closed using conventional weapons, and milling facilities are relatively cheap to fabricate and easy to conceal.

• Uranium hexafluoride (UF6) conversion is undertaken at the Rudan Nuclear Research Center near Shiraz, which represents a primary target for counterproliferation strikes.

• Uranium enrichment facilities present another vital but problematic target set. The large site at Natanz may currently hold over 1,000 gas centrifuges, and it is scheduled to house 5,000 by 2005. Some of the buildings under construction there are partly buried and hardened with two-meter-thick walls.

• The industrial base of centrifuge production would need to be eliminated; otherwise, Iran could readily construct new enrichment facilities that are smaller and more nondescript. Specialized metallurgical design and manufacturing facilities (e.g., the National Iranian Steel Company; the Applied Research Center) are not required for centrifuge design, which involves relatively simple engineering techniques that have not changed since the 1940s. Finding and destroying all potential enrichment facilities would be a very daunting task.

• Fuel fabrication and bomb assembly facilities are required to weaponize HEU, but they do not have signatures that can be detected by satellites or aircraft; hence, it is unknown whether such sites exist in Iran.

As for the plutonium route, nuclear reactors remain the weakest link. Vulnerable, fixed, and highly visible on Iran's exposed southern coast, the Bushehr light-water reactor being constructed by Russia would be an easy target. Despite strong air defenses, the reactor halls and their vulnerable cores are essentially indefensible to stand-off precision-guided weapons. Preventing casualties among the 1,000 Russians working at the site could prove challenging. Because a pre-attack warning could spur Iran to deploy human shields, the best means of reducing the risk to foreigners would be careful timing of the strike outside their working hours.

A covertly assembled Iranian reactor would be difficult to detect during construction but relatively easy to locate once operational. The Arak heavy-water production plant -- a precursor to development of a heavy-water reactor -- is vulnerable, and future heavy-water production sites would be difficult to camouflage due to their distinct physical profile. If diplomacy or military action denied the Iranians the option of large reactors, they would be forced to either procure spent fuel rods from an outside source or scrape together spent fuel from their light-water research reactors -- a laborious process that would slow weapons development to a crawl.

Breaking the plutonium fuel cycle at the reprocessing stage would be very difficult. Iran is likely to favor parallel development of a number of smaller "disposable" reprocessing plants, as opposed to large sites with distinctive isotopic and heat signatures. Such plants could remain undetected for much of their short lives.

The Expanding Scope of Operations

The operational challenges of attacking Iran's nuclear program from the air are manifold. One approach would be to identify and target the most difficult element to replace, a strategy called "bottleneck" targeting. From what is known publicly, the key node in Iran's uranium-enrichment program is the Isafahan UF6 facility; in the plutonium program, it is the Bushehr reactor. To be sure, Iran could develop alternatives; for instance, smaller amounts of UF6 could be produced at the Physics Research Center at Sharif University of Technology in Tehran, and there may be covert sites as well. Nevertheless, attacks on the key nodes would delay Iranian nuclear weapons development by at least a few years.

Such bottleneck targeting would be a necessity if Israel chose to strike Iran's nuclear program. Israeli air forces would face a far longer and better defended route of attack than they did in the Osiraq strike, and regional states would be unlikely to support an attack on Iran (e.g., Turkey could refuse basing privileges; Arab states could deny overflight rights). Moreover, a manned aircraft strike would require massive refueling support, while the long-range strike capabilities of Israeli submarines remain uncertain, reducing the scope of an attack to a few targets in western Iran.

If the United States decided to preempt Iran's nuclear program, it could consider attacking a wider range of nuclear targets throughout the country, presumably including the Natanz centrifuge complex and, perhaps, the Arak heavy-water facility. Above-ground targets such as nuclear reactors could be attacked with cruise missiles, eliminating the challenge of securing basing rights and navigating air defenses. A wider strike would require the use of manned aircraft, however, which are much more capable of destroying buried and hardened targets. Although stealth aircraft could be used, their radar-defeating characteristics are typically supported with strikes on air defense systems.

Iran's air defense system would require a substantial suppression effort, involving strikes on command centers, radar networks, and a largely unmapped web of mobile and fixed surface-to-air missile batteries. Because forward bases in the Persian Gulf and the Indian Ocean would probably not be made available to the United States, this larger effort would require intensive use of aircraft based on carriers, which could be vulnerable to Iranian antishipping attacks.

A U.S. preemptive strike would also have to take into consideration Iran's potential reaction (the subject of Part III of this series). The United States has security commitments to preempt Iranian retaliation against its Gulf bases, its Gulf Cooperation Council allies, and commercial shipping. That might require strikes on Iran's Shahab-3 long-range ballistic missiles, numerous mobile theater ballistic missiles, antishipping missiles, and certain Iranian naval and air units. Such commitments would draw considerably on those assets needed for strikes on nuclear targets, prolonging the length of any counterproliferation air campaign.

The bottom line is that the United States would find it difficult to limit an air operation against Iran to a small set of targets, as was done in the 1998 Desert Fox counterproliferation strike against Iraq. As a result, a preemptive strike against Iran could become a substantial operation.

Michael Knights is the Mendelow defense fellow at The Washington Institute.

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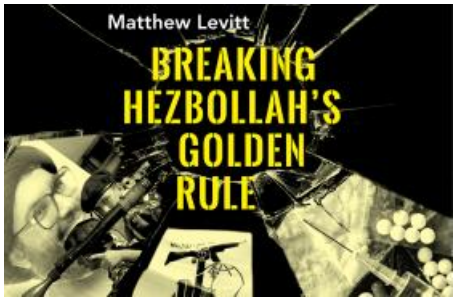

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