



# IRAN AS A NUCLEAR WEAPONS POWER

**Anthony H. Cordesman**  
**Arleigh A. Burke Chair in Strategy**  
**[acordesman@gmail.com](mailto:acordesman@gmail.com)**

December 15, 2009

# Iran as a Nuclear Weapons Power

## Anthony H. Cordesman

The latest discoveries regarding Iran's nuclear program are simply the next development in a process that has been going on since the Iran-Iraq War, and Khomeini's decision to resume nuclear research once Iran came under chemical weapons attack from Iraq. It is important to understand the "neutron initiator" document in this context, and to remember several key aspects of Iran's efforts:

- Iran did not begin its efforts with a focus on Israel, and its anti-Israeli rhetoric may still be more of a cloak for actions that give Iran power and influence over its immediate neighbors, and the potential ability to deter the US, than any real focus on Israel either ideologically or in a warfighting sense.
- Iran is a declared chemical weapons power, although it has never complied with the Chemical Weapons Convention (CWC), nor stated its holdings. It probably has the capability to manufacture persistent nerve gas. It could certainly put such gas in a unitary warhead and probably has some cluster weapon capability.
- Iran is a signatory to the Biological Weapons Convention (BWC), but there are no firm data to indicate whether it does or does not have a biological weapons effort. It is clear, however, that Iran has the capability to develop and produce advanced biological weapons – and could do so as either a supplement or substitute for nuclear weapons. Iran should acquire the ability to develop even more advanced genetically engineered biological weapons in the 2010-2015 time frame. Roughly the same timeframe as it could deploy a major nuclear force.
- There is no inspection regime for the BWC, and US studies raise serious questions as to whether such a regime is possible. Accordingly, even if Iran did fully comply with all IAEA requirements, it could still develop and produce weapons of mass destruction. Similarly, there is no enforceable way a true weapons of mass destruction free zone can be established and enforced in the Middle East or any other area with advanced biotechnology.
- Iran's missile programs represent a critical part of its military efforts and expenditures. They still, however, do not exhibit a test program that could give them the reliability and accuracy to be effective without using a weapon of mass destruction as a warhead. Even a chemical missile warhead, however, would be more a terror weapon than a true weapon of mass destruction. It would risk provoking a massive response that could be far more lethal to Iran even if it used precision conventional weapons.
- Iran's conventional forces remain obsolescent and limited in capability. This is why its emphasis on missiles, weapons of mass destruction, and asymmetric warfare both compensate for the limits of its conventional forces and act as a key substitute.

- Iran's steadily advancing capabilities for asymmetric and proxy warfare still leave it vulnerable to US conventional forces and devastating precision attacks on its military and economic assets. Acquiring weapons of mass destruction acts as a potential deterrent to US conventional attacks on Iran.
- Accordingly, no analysis of Iran's nuclear programs and intentions should be decoupled from an analysis of its overall military programs – although many discussions of Iran's nuclear programs have that defect.

That said, it is still possible that Iran may not develop a nuclear weapons capability or deploy other weapons of mass destruction (WMDs). Diplomacy may change Iranian actions, the regime may change, sanctions and economic problems might halt or delay Iran's efforts, and/or Iran may develop other security priorities. These options do, however, seem less probable with time.

Nearly two decades of sanctions, diplomacy, and dialog have had some impact in delaying Iran's programs, in making it keep its programs more covert, and in highlighting the risks Iran runs in moving forward. It has not, however, prevented Iran from acquiring steadily more capable long-range missiles and the technology and production facilities needed to make nuclear weapons. Iran also has retained the technology and production base to make chemical weapons, and even if it does not have covert active programs, its civil sector is steadily improving its dual capabilities and ability to develop and deploy advanced biological weapons.

It is also far from clear that any power can carry out preventive attacks at this point that would do more than delay a determined Iranian effort to acquire nuclear weapons for several years. Israel and Iran's neighbors do not have the capability to launch more than limited strikes. It might be militarily possible for the United States to carry out effective initial strikes, follow them up with immediate restrikes, and then maintain a restrike capability that it used to systematically deny Iran the ability to create new, dispersed facilities. This kind of U.S. posture, however, would pose major political challenges in terms of both the willingness of friendly powers such as the Gulf States and Turkey to support any phase of such operations, and it is clear that the United States would have major problems in obtaining broad international support.

These are not reasons to give up on diplomacy or dialog, or to abandon sanctions and efforts to develop military options to prevent or limit Iranian capabilities. They are, however, realities that indicate that the Gulf States, the region, and the world may have to learn how to live with Iranian proliferation, coupled with growing Iranian capabilities for asymmetric warfare.

If that happens, there are two major strategic alternatives: (1) accept a major increase in Iran's ability to influence and intimidate key oil exporters and other states throughout the region; (2) create the capability to contain Iran through defense and deterrence. In both cases, the result may still be a regional nuclear arms race and at least the possibility of a devastating nuclear exchange.

This report examines these options. The reader should also be aware that it draws on work the author did with Adam Seitz in a CSIS book entitled Iranian Weapons of Mass

Destruction issued in 2009. This book is available from Greenwood Publishing at:  
<http://www.praeger.com/catalog/A2233C.aspx>

## Table of Contents

<b>IRAN’S UNCERTAIN PATH TO PROLIFERATION</b> .....	<b>6</b>
IRAN’S PATHS TO NUCLEAR PROLIFERATION .....	6
ALREADY HALF PREGNANT .....	8
TO TEST OR NOT TO TEST .....	8
HOW SOPHISTICATED A NUCLEAR WEAPON DOES IRAN NEED?.....	9
GOING FROM POSSESSION TO FUNCTIONAL NUCLEAR FORCES .....	11
<b>PROVOKING A RESPONSE FROM IRAN’S NEIGHBORS</b> .....	<b>13</b>
<b>THE SEEDS OF AN UNSTABLE REGIONAL NUCLEAR ARMS RACE</b> .....	<b>13</b>
<b>BIOLOGICAL WEAPONS AS AN ALTERNATIVE OR SUPPLEMENT</b> .....	<b>14</b>
<b>MILITARY OPTIONS FOR DEALING WITH IRANIAN PROLIFERATION</b> .....	<b>17</b>
PREVENTIVE AND PREEMPTIVE STRIKES, AND .....	17
STRIKES BEFORE IRAN HAS A SIGNIFICANT FORCE .....	18
THE PROBLEM OF TARGETING .....	18
<b>ISRAELI OPTIONS</b> .....	<b>21</b>
POSSIBLE METHODS OF ISRAELI ATTACK .....	22
ISRAELI AIR STRIKES .....	23
ISRAELI PENETRATION CAPABILITIES .....	25
ISRAELI NUCLEAR OPTIONS .....	26
<b>U.S. OPTIONS AGAINST IRAN</b> .....	<b>27</b>
POSSIBLE U.S. STRIKE METHODS .....	27
THE EFFECTIVENESS OF US STRIKES .....	28
POSSIBLE U.S. WAR PLANS: ATTACKING, DELAYING, AND WAITING OUT .....	29
<b>IRANIAN DEFENSE AGAINST ISRAELI (AND U.S.) STRIKES</b> .....	<b>33</b>
IRANIAN RETALIATION AGAINST ISRAEL .....	35
IRANIAN RETALIATION AGAINST U.S. STRIKES .....	36
<b>CONTAINMENT: REACTING TO THE FACT IRAN BECOMES A SERIOUS NUCLEAR POWER</b> .....	<b>37</b>
<b>DETERRENCE AND NUCLEAR WARFIGHTING</b> .....	<b>38</b>
ISRAELI DETERRENCE.....	38
U.S. DETERRENCE .....	39
REGIONAL DETERRENCE .....	40
<b>MISSILE DEFENSE AND OTHER DEFENSIVE OPTIONS</b> .....	<b>40</b>
<b>THE ONLY WAY TO WIN IS NOT PLAY</b> .....	<b>42</b>

## **Iran's Uncertain Path to Proliferation**

Any examination of the options to change Iran's behavior must begin by looking at Iran's future options and how these evolve over time. The impact and risks of proliferation cannot be measured simply in terms of whether Iran does or does not have a nuclear weapon. Any realistic examination of Iran's options, and those of its neighbors and the United States, must consider what Iran may do over at least the next decade and the different ways in which it may deploy forces armed with weapons of mass destruction and other nations may respond.

Such an analysis is necessarily speculative. There is still no definitive evidence that Iran is planning to make or deploy nuclear and biological weapons. Iran does not have a public strategy for proliferating, much less any public force plan or goals for creating a nuclear posture.

It is also likely that even if Iran has secret plans, its actual behavior will be opportunistic and dictated at least as much by its future circumstances as by its current intentions. Reality intervenes in even the best-made plans of the most powerful states, and Iran is neither a regional superpower nor a state that has demonstrated any capability to formulate the "best-made plans." It has obvious major limitations in both areas.

It is equally dangerous to assume that Iran will follow some linear path in proliferating based on some form of game theory or rational events. Wild cards and unanticipated events dominate history over time. Behavior is often less than rational, at least in the sense of taking optimal actions or avoiding crises and sometimes catastrophes. This is particularly true once conditions reach the crisis or warfighting level, where perceptions can be drastically wrong and driven by time pressures that push decision makers down poorly chosen paths where they cannot reverse course. There is no reason to assume worst cases dominate, but there is every reason to assume that they are possible.

### **Iran's Paths to Nuclear Proliferation**

Iran has already advanced beyond the point where its choices consist of whether or not it should actually create some form of nuclear weapons capability. Its missile capabilities are giving it steadily better delivery options. Its technology and manufacturing base is approaching a "breakout" capability where it could choose to build a nuclear weapon within a year or so. Iran already has chemical weapons and has the technology base for a breakout capability in biological weapons.

There are many different ways, however, in which Iran could move forward, and it could halt its efforts to proliferate at many different levels of capability and risk. Iran has a wide range of nuclear options to create new military capabilities over the next decade, many of which could also be implemented in a similar form using advanced biological weapons:

- *Technology creep:* Iran has reached the point where even if it fully complied with the terms of the Nuclear Non-Proliferation Treaty (NNPT), United Nations (UN) resolutions, and International Atomic Energy Agency (IAEA) inspections, its technology and manufacturing base will steadily improve its future capabilities to design and manufacture nuclear weapons. There currently are no proposals to limit its development of ballistic or cruise missiles, or procurement of advanced strike aircraft—although UN resolutions do call for restraint in such arms transfers. Unless totally new inspection regimes are developed, and a firm halt can be made to Iran's research programs,

centrifuge programs, and heavy-water reactor programs, Iran's capabilities will improve under the best possible circumstances.

- *Modular progress*: Iran can speed progress beyond technology creep. There are many aspects of weapons and warhead design that can be broken out into modules of peaceful research and manufacturing capability—avoiding any formal nuclear weapons program. Improved centrifuge technology and the ability to link centrifuges into efficient production chains will overcome Iran's most serious problem: the rapid and efficient production of fissile material in ways that can be highly disperse, concealed, and made redundant.
- *Breakout capability*: At some point between 2009 and 2011, Iran's uranium enrichment capabilities will reach the point where Iran could build at least one fissile device within a 12–15-month period. This could quickly increase to several nuclear weapons a year. Iran can leverage this level of capability in many different ways. The threat to test and deploy will give it added negotiating leverage that can be increased by providing proof of capability or leaking a mix of real and exaggerated claims.
- *Undeclared possession: "Bomb in the Basement"*: There is no clear dividing line between a breakout capability and high confidence that a nation actually has nuclear weapons. The difference is largely one in terms of timelines and indicators. Much depends on whether possession is clearly credible, the country clearly had the technology and production capabilities, and delivery systems and exercises show potential nuclear capability.
- *Test/Suspect Event*: Any surface test of a nuclear weapon provides clear evidence of possession of a nuclear device, although not of a functioning bomb or missile warhead unless a country deliberately provides considerable supporting evidence. Underground tests can be more ambiguous, both in a positive or negative sense.
- *Initial Deployment*: Like the early steps in becoming a nuclear power, deployment can take a wide range of forms. Its impact will also be shaped by the nature of the steps a country has taken previously and the credibility and nature of its weapons programs. It is easy, for example, for a nation such as Iran to go from denial to claims of possession and having nuclear armed forces, but such claims are far more credible if Iran has tested a weapon, has overtly or covertly shown it has the technology base to build functional weapons, and intelligence sources can confirm that the operators of nuclear armed forces train for nuclear warfare and have high confidence they have real weapons.
- *Large-Scale Deployment*: Iran is probably a decade or more away from deploying a force of 60 or more weapons—a force large enough to offer tactical, air, and missile options; a range of strike options that did not stress counterpopulation targets; and deploy enough delivery systems to make preventive or preemptive strikes against Iran an unacceptable risk. It is impossible, however, to determine either Iran's capabilities or the interaction among Iran and Israel, the United States, and Iran's neighbors.
- *Proxy nuclear posture*: Most experts question whether any nation with only limited nuclear assets would ever transfer a nuclear weapon to a terrorist group or another state. This is not simply a matter of limited resources; it is a matter of trust. Nonstate actors presented very serious risks in terms of loyalty and restraint. Even state actors that are close allies still have different leaders and strategic priorities and may act independently—particularly in a crisis. Nevertheless, the risk exists. A nonstate actor might be a way of attacking while reducing the risk of attribution and retaliation. Arming nonstate actors is a way of dispersing weapons that makes them far harder to attack. The same is true of state actors, and Iran might find Syria or a Shi'ite-dominated Iraq to be ways of creating a nuclear bloc that reduces the risks an isolated nuclear Iran would face in the future.
- *Covert nuclear posture*: Iran might conclude that it could create a secure capability to deliver a nuclear weapon and create some degree of plausible deniability by smuggling a nuclear weapon

into an enemy state, detonating it in a port or coastal area, or launching a short-range missile from a ship or forward-deployed covert location in a neighbor state.

Iran can also avoid going beyond its present policy of denial and leave its capabilities ambiguous. At the same time, it can covertly or overtly increase its ability to rapidly make a number of weapons: test bomb and missile warheads which simulate arming its delivery systems with nuclear weapons. Iran can improve the yield of its fissile weapons designs without actual testing and move toward a breakout capability in “boosted,” higher yield fissile weapons, or even move toward thermonuclear weapons designs.

### **Already Half Pregnant**

No outside power will be certain how soon Iran could acquire given nuclear capabilities under such circumstances. Iran could also continue to negotiate, and partially cooperate with the IAEA. It might negotiate agreements that effectively limit overt testing and proliferation while tacitly signaling to other states that they must treat Iran as a “quasi-nuclear” power, giving it added influence and the ability to intimidate, and be cautious about challenging its use of asymmetric warfare.

In many ways, Iran has already advanced to this position. Moreover, barring a far more comprehensive set of limits and inspection options that has yet been imposed on any state to date, it is unclear that even the most successful negotiation by the “Six” [the United States,, EU3 (France, Germany, and Great Britain), Russia, China], the UN, and the IAEA can really change this.

If Iran moves ahead in improving its enrichment capabilities, technology base, and in acquiring nuclear power, every year will increase Iran’s potential capability to build better nuclear weapons more quickly and in greater numbers. There is no credible path to a truly secure negotiation or arms control agreement that would not require Iran to be totally open and forthcoming and to have a very different type of regime.

### **To Test or Not To Test**

In the past, some evidence of testing was generally required, although this did not apply to Israel—which was credited with nuclear capabilities more than a decade before a suspect “event” occurred. Today, however, the mathematics and engineering have been available to Iran at least since 1992, and it seems to have acquired many of the details of a Chinese weapons design.

Iran has the technology and equipment to do many critical tests using actual weapons designs that have nonfissile uranium or some other form of heavy metal. Pakistan and India made successful use of cruder approaches to such simulation tests before they tested actual weapons. Some experts also feel that subcritical or marginally critical—ultralow yield—tests would be enough and that simulation would work with large boosted weapons designs. These, however, are controversial areas that only an actual weapons designer could really comment upon.

There are questions as to whether Iran could create a reliable actual bomb or missile warhead with sufficient safety and reliability to build up a stockpile of weapons without testing. Once again, however, Iran could build actual weapons and warheads and test many aspects of their performance using nonfissile material. In fact, such simulations would be a key part of any realistic program, since testing of live weapons in flight would

present major political problems and is inherently “destructive” and does not reveal the details of engineering performance or many of the causes of potential failure.

This is also the threshold at which the “Nth weapon” becomes a critical problem. Once any weapons have actually been made, it becomes very difficult to create any kind of arms control or inspection regime that can be certain that all weapons have been turned over or destroyed. The possible existence of one or more dispersed weapons hidden somewhere in country becomes an possibility that no outside power can dismiss unless Iran turns over all its records and provides a level of unprecedented transparency and access to any suspect facility.

Some experts feel a nuclear underground test could be faked using massive amounts of conventional explosives. This has been an issue in terms of test ban verification, although other experts believe that this would not be possible even with an unvented underground test. Other experts feel that a subfractional or very low yield nuclear test could be concealed in an area with earth tremors or a seismic event or be so small that it would not be detected and characterized. Another approach would be remote testing in a sensitive seismic area in the Indian Ocean.

Iran could test and deny, knowing that many low yield tests would create some degree of uncertainty or that outside powers would not contest the issue. It could also create enough plausible or implausible deniability to both send a signal that it had weapons and still publicly deny this.

### **How Sophisticated a Nuclear Weapon Does Iran Need?**

There are also potential trade-offs in testing vs. not testing that affect weapons design. Some experts feel testing is needed to use a small or minimal amount of fissile material, reduce weapons size and weight, and to verify weapons safety. Others feel it could be critical if Iran is to move beyond basic fission weapons to highly sophisticated fission weapons, or to boosted or fusion weapons.

This could be a major consideration if Iran becomes involved in a nuclear arms race with Israel or another state. Pure fission guns or implosion weapons (Iran might need an implosion design for effective missile warheads) can produce high yields, but Iran might initially be limited to maximum yields of around 20–30 kilotons and weapons using relatively large amounts of fissile material—with much depending on the sophistication of the design and factors such as the number of explosive lenses, tamper, reflector, and pit. Such yields are highly destructive against any target, but are not large enough to achieve a decisive level of lethality over large-area targets such as a major city, or to compensate for real-world problems in missile accuracy—which can be considerably greater than the nominal circular error probable (CEP) may indicate.

Boosted weapons allow yields in the 100-kiloton range, but are more complex. They essentially use a pure fission device to generate enough heat and pressure to trigger a thermonuclear explosion from an integrated mix of tritium and deuterium gas (heavy isotopes of hydrogen). “The hydrogen fuses to form helium and free neutrons. The energy release from fusion reactions is relatively negligible, but each neutron starts a new fission chain reaction, greatly reducing the amount of fissile material that would otherwise be wasted.”<sup>1</sup> Boosting can double or even triple a fission weapon’s yield.

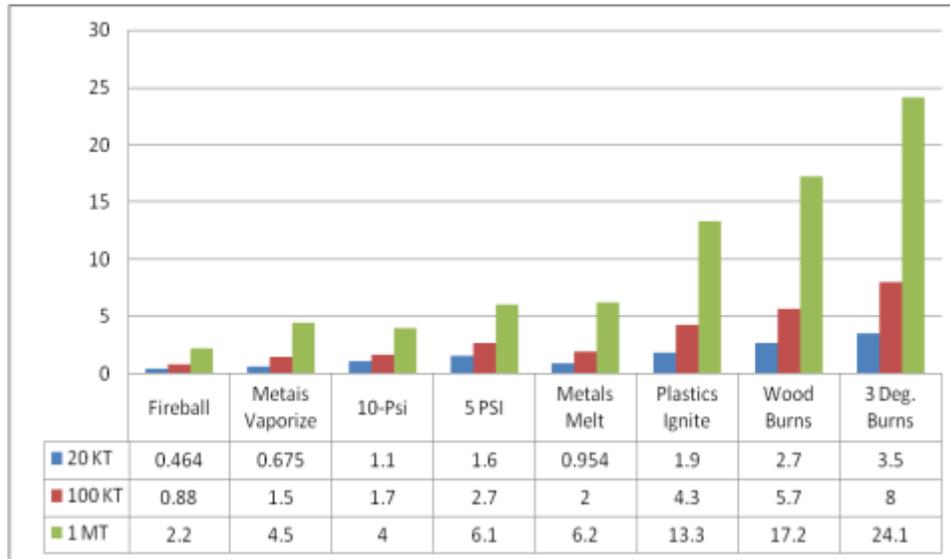
Thermonuclear weapons are even more complex, and there are indications that both India and Pakistan had failures to achieve their design goals even when they carried out actual tests. A rough idea of the complexity involved is apparent in the following explanation of how thermonuclear weapons work: “Two-stage thermonuclear weapons are essentially a daisy chain of fusion-boosted fission weapons, with only two daisies, or stages, in the chain. The second stage, called the "secondary," is imploded by x-ray energy from the first stage, called the "primary." This radiation implosion is much more effective than the high-explosive implosion of the primary. As a result, the secondary can be many times more powerful than the primary, without being bigger.”<sup>ii</sup>

The secondary can be designed to maximize fusion energy release, but in most designs fusion is employed only to drive or enhance fission, as it is in the primary. More stages can be added, but the result would be a heavy multimegaton weapon with yields much higher than the United States and the Soviet Union found useful during most of the Cold War. (Yields of 500 kilotons to 5 megatons have been deployed. The US briefly deployed 25-megaton weapons. The Soviet Union did build a 50-megaton weapon but did not deploy it.)

These considerations may seem arcane or pointless to an observer that does not have to design a functional force or ensure that a limited number of weapons can produce decisive killing effects, but as Figure One shows, they have a major impact on area coverage—and this shapes their impact in terms of intimidation and deterrence as well as lethality.

**Figure One: The Impact of Yield on Nuclear Weapons Effects**

(Radius from ground zero in kilometers)



Source: Data compiled from multiple including; <http://www.fas.org/nuke/intro/nuke/effects.htm>, [http://www.unitedstatesaction.com/nuclear\\_terrorism.htm](http://www.unitedstatesaction.com/nuclear_terrorism.htm), <http://www.globalsecurity.org/wmd/intro/nuke-blast.htm>, [http://www.princeton.edu/~aglasel/lecture2007\\_weaponeffects.pdf](http://www.princeton.edu/~aglasel/lecture2007_weaponeffects.pdf).

### Going From Possession to Functional Nuclear Forces

Much then depends on the number and type of weapons Iran possesses. Iran might, for example, begin its deployments with a few fission bombs. This would eliminate many of the technical and reliability risks in arming its missiles, and creating freefall bombs is a simpler design task and would present fewer weight and reliability problems. Iran would, however, have problems with the performance of its current fighter attack aircraft that are all aging U.S. and Russian designs, and any fighter attack would be much more vulnerable to defensive operations than a ballistic missile.

Small inventories of nuclear weapons also require trade-offs between safety (heavily guarded central facilities and devices that either require complex arming codes or assembly of the core from a separate location) and the kind of quick reaction capability that can ensure the survival of weapons and the ability to retaliate. The North Atlantic Treaty Organization (NATO), for example, stored its weapons in dispersed secure sites and maintained an air component of quick reaction alert aircraft that could be kept armed with nuclear weapons in a crisis and which could take off for strike missions before their bases could be struck by aircraft or medium- and intermediate-range ballistic missiles. Over time, the strike aircraft went from pilot-armed weapons to requiring arming codes.

Iran would have to contend with both the potential use of U.S. stealth aircraft and extremely precise conventional weapons, as well as the risk of nuclear preemption and preventive strikes by Israel or its neighbors. This, and the problem of arming aircraft and maintaining them on nuclear-armed alert, could either require the aircraft to be put into flight with very ambiguous levels of warning or risk losing them. Reliance on a small

number of weapons storage sites could lead to preventive/preemptive strikes. High levels of dispersed nuclear weapons storage sites risks unauthorized use.

Missile deployments offer a higher probability of penetrating today's defenses. They also offer the option of pretargeting key cities and high-value area targets such as key energy facilities and then authorizing or ordering a nuclear armed missile force to either launch on warning or at the first verified evidence that Iran and/or its nuclear forces are under attack. This is called launch under attack. Highly mobile missiles, or deeply sheltered missiles, can also offer the ability to ride out an attack on Iran and then decide whether and where to strike, but designing a small force on the basis of guaranteed survival and riding out attacks increases the risk Iran might lose much of its capability in a preventive/preemptive strike.

Small, early deployments of nuclear weapons on missiles have other potential drawbacks. Reliability can be very hard to predict both in terms of accuracy and how well a warhead will function. Small missile forces face steadily improving Israeli and U.S. missile defenses, and the probable acquisition of such defenses by other Gulf States, Turkey, and Europe. Older liquid-fueled missiles have slow reaction times and limited time spans in which they can be kept fueled and on alert. Security and control require the use of reliable coded systems to arm the warhead—ideally in flight and outside Iranian territory but in practice probably before launch.

Small forces present another problem. Regardless of the delivery system, how release is authorized, and choices about reaction times and ride out or launch, a small force has to be used to produce decisive results rather than carefully structured levels of escalation over time. This does not rule out one or two demonstrative strikes, but it probably does mean Iran would target enemy population centers and seek to do as much damage as possible to that population and an enemy's economy. It is also important to note that once a war begins, weapons numbers are not the number in inventory, but the number Iran can count on to actually penetrate to a target. In general, this means devoting at least two weapons to any given city or area target to ensure that it is hit.

Moreover, Iran would probably want to communicate its broad targeting plans in some way to maximize deterrence and minimize the risk of preventive or preemptive attack. Any such communication of a counterpopulation targeting plan does, however, lead to countertargeting by any potential nuclear power. It also compounds the level of confusion that is almost certain as to the intentions and actions of all the sides involved. It would be hard for Iran to predict the end result of aircraft and missile launches in terms of penetration, accuracy, and damage inflicted. An enemy such as Israel or the United States—with much larger nuclear forces—might seek to use its nuclear weapons to both retaliate in kind and limit damage by striking at any suspect Iranian installation or facility. Under these conditions, "battle management" could easily become a matter of unconstrained nuclear war.

Large forces offer a kind of increased safety and stability, particularly as they mature into forces with mobile or hardened basing modes, as warning and command-and-control systems become better, as weapons reliability and accuracy becomes more predictable and it becomes possible to use security codes and built-in safety devices. Such as

permissive actuation systems both to keep delivery systems armed and to prevent unauthorized use.

### **Provoking a Response from Iran's Neighbors**

Every act Iran takes, however, will produce a hostile or defensive response. Israel is probably already developing sea-basing options for its nuclear forces and may be increasing the range-payload of its weapons. It must have examined options for deterring any Iranian strike on Israel, and Iran is highly vulnerable. Its economy and structure of government is highly centralized in Tehran, and it is uncertain that a Persian society could recover from strikes on even 10 of its major cities. The fact that Israel is potentially vulnerable to “existential” strikes on its population means that it virtually has to develop existential strike options to destroy Iran’s ability to recover from an Israeli strike and secure basing modes to demonstrate that it can exercise such options regardless of the scale of an Iranian attack on Israel.

It is unclear whether Egypt, Turkey, or Saudi Arabia could or would seek to match Iran’s evolving nuclear capability, but a regional nuclear arms race is a real possibility. The U.S. response is harder to predict, but it could consist of some form of guarantees of extended deterrence, and the United States might well conclude that the Gulf is so critical to the U.S. and global economy that it could not allow Iran to create nuclear forces without targeting Iran in return.

In short, Iran cannot act in a vacuum. The more forces it deploys, the more it will be targeted in return. The kinds of safety it will gain from larger or less vulnerable forces may create a kind of mutual assured destruction, but this may not create a stable pattern of deterrence as Iran’s neighbors and the United States steadily increase their nuclear targeting of Iran. It is also important to note that it is likely that the United States will comprehensively target Iran with nuclear weapons if Iran deploys long-range, nuclear-armed missiles that can strike NATO and European targets, and the United States is virtually certain to do so if Iran develops any kind of nuclear strike option against it. It is equally likely that if Iran makes any overt—or serious covert—nuclear threats, it will be met with threats in kind.

### **The Seeds of an Unstable Regional Nuclear Arms Race**

The complex mix of players involved, and their very different levels of situational awareness, will also create a risk that if any one nation escalates to the use of nuclear weapons, or moves a crisis toward potential nuclear release, it will become progressively harder to control the situation and limit the ultimate pattern of escalation that results.

It is important to note in this regard that the nuclear arms race during the Cold War, and the level of deterrence created by mutual assured destruction, did not produce stability. The United States and the Union of Soviet Socialist Republics (USSR), and the NATO-Warsaw Pact, steadily increased the number of warheads and weapons on each side for several decades. They kept competing in deploying new delivery systems and creating new nuclear strike options. Their relative willingness to rely on conventional options was never clear, and they targeted both military forces and population centers—to the point where the USSR seems to have deployed biological weapons as a follow-up option to nuclear strikes on U.S. cities. Missile defenses added a further destabilizing element to

this process as did arms control agreements that sometimes did as much to stimulate new forms of nuclear competition as to limit the forces on each side. If Iran moves to deployment, it will almost certainly trigger a similar kind of regional arms race; it may not end as well.

Experts differ over the extent to which an Iranian nuclear weapon would have a unique radiological and material “fingerprint,” intelligence could warn or confirm that it was Iran that was responsible for a given attack, and any state could launch retaliatory strikes on Iran without 100-percent confirmation of Iranian responsibility.

These are valid concerns, although it is one thing to debate legal, political, and moral-ethical considerations before an attack and another to assume that they will lead to restraint after the devastation caused by being the victim of a nuclear explosion. This is particularly true in the case of an existential attack on a small state such as Israel or a nuclear-armed Gulf or neighboring state. Israel, for example, might well feel it necessary to launch an all-out nuclear retaliatory strike on Iran’s population unless there was decisive evidence that Iran was not responsible.

Other scenarios have considered Iranian covert attacks on the United States using ship-based missiles in cargo ships off the U.S. coast. There are reports that Iran did test a SCUD launch from a ship, and this is certainly technically feasible. Other scenarios assume Iran would use a high-altitude nuclear explosion to create an electromagnetic pulse to destroy an enemy’s electronic infrastructure, satellite, and communications capabilities over a wide area. The lethality of such an explosion is sometimes exaggerated, but it offers both a way of attacking without provoking the same kind of counterstrike on Iranian cities and a potential covert means of attack that would also reduce the risk of retaliation.

These scenarios involve a wide range of risks for Iran and present the problem that they could provoke truly massive retaliation for limited damage on an enemy. They are, however, technically feasible, and it is actually dangerous to assume that there are no future conditions under which Iran might take such action.

It should be stressed that all but the first of these postures represent *possibilities and not probabilities or predictions*. Iran could stop at virtually any point in this escalation ladder of rising nuclear capabilities and could potentially roll back any production and deployment of nuclear devices and weapons. At the same time, there is a grim natural progression in the creation of nuclear forces, driven in part by the fact that proliferation never occurs on a unilateral level. One way or another, it drives other states to respond.

The end result could be a nuclear arms race, heavily oriented toward destroying the population of potential enemies. It could also be to create a nuclear Gulf or Middle East. This is not a minor consideration when the U.S. Department of Energy estimates the Gulf will produce 23.7 million barrels a day of crude oil in 2010 (27 percent of the world supply of 89.2 million barrels a day, and 31.8 million barrels a day of crude oil in 2030 (28 percent of the world supply of 112.5 million barrels a day; plus a major part of its exports is natural gas.<sup>iii</sup>

## **Biological Weapons as an Alternative or Supplement**

One of the problems in analyzing Iran's options and that of any other real or potential proliferators is the tendency to divide the analysis of proliferation into separate studies of chemical, radiological, biological, and nuclear activities and options. This compartmentation is made worse by dividing the analysis of weapons and delivery systems and the analysis of arms control issues from warfighting impacts. One key aspect of Iran's potential future behavior, however, is that it does not have to develop and deploy nuclear weapons to be a major proliferator.

Iran has considerable potential as a chemical weapons power and may have a stockpile of nerve and other chemical weapons. These weapons can be effective as deterrents, in greatly complicating enemy operations because of the need for protection and decontamination, as an actual killing mechanism, and as ways of disrupting military operations and area denial. They are, however, far less lethal than nuclear weapons and biological weapons. Iran also has to know that the deterrent or shock effect of threatening to use—or actually using—chemical weapons can also be provocative and be used to justify massive conventional escalation. As a result, their value may be greatest as a defensive weapon, and they do not have the lethality to greatly intimidate or deter a potential opponent.

Radiological weapons have not been separately analyzed because most forms are essentially terror weapons that can contaminate a given building or small area, but which have more limited lethality than any similar investment of effort in conventional explosives and chemical weapons. There are designs for advanced forms of such weapons that may have wide area coverage, but their effectiveness is controversial and there are no indications that Iran is pursuing this path.<sup>iv</sup>

Biological weapons, however, can be a very different story. They can have equal or greater lethality than nuclear weapons, programs require fewer resources and are far easier to conceal, they can be tailored to have a wide range of different effects, and they lend themselves to covert delivery as well as use in missile warheads and bombs.

The report of the Commission on the Prevention of WMD Proliferation and Terrorism has warned,<sup>v</sup>

Iran has been rapidly developing capabilities that will enable it to build nuclear weapons; Dr. A. Q. Khan, of Pakistan, led a nuclear proliferation network that was a one-stop shop for aspiring nuclear weapons countries; and nuclear arms rivalries have intensified in the Middle East and Asia. If not constrained, this proliferation could prompt nuclear crises and even nuclear use at the very time that the United States and Russia are trying to reduce their nuclear weapons deployments and stockpiles.

...Meanwhile, biotechnology has spread globally. At the same time that it has benefited humanity by enabling advances in medicine and in agriculture, it has also increased the availability of pathogens and technologies that can be used for sinister purposes. Many biological pathogens and nuclear materials around the globe are poorly secured—and thus vulnerable to theft by those who would put these materials to harmful use, or would sell them on the black market to potential terrorists.

...In addition to the current threat of bioweapons proliferation and terrorism, a set of over-the-horizon risks is emerging, associated with recent advances in the life sciences and biotechnology and the world-wide diffusion of these capabilities. Over the past few decades, scientists have gained a deep understanding of the structure of genetic material (DNA) and its role in directing the operation of living cells. This knowledge has led to remarkable gains in the treatment of disease

and holds the promise of future medical breakthroughs. The industrial applications of this knowledge are also breathtaking: it is now possible to engineer microorganisms to give them new and beneficial characteristics.

Activity has been particularly intense in the area of biotechnology known as synthetic genomics. Since the early 1980s, scientists have developed automated machines that can synthesize long strands of DNA coding for genes and even entire microbial genomes. By piecing together large fragments of genetic material synthesized in the laboratory, scientists have been able to assemble infectious viruses, including the polio virus and the formerly extinct 1918 strain of the influenza virus, which was responsible for the global pandemic that killed between 20 million and 40 million people. As DNA synthesis technology continues to advance at a rapid pace, it will soon become feasible to synthesize nearly any virus whose DNA sequence has been decoded—such as the smallpox virus, which was eradicated from nature in 1977—as well as artificial microbes that do not exist in nature. This growing ability to engineer life at the molecular level carries with it the risk of facilitating the development of new and more deadly biological weapons. The only way to rule out the harmful use of advances in biotechnology would be to stifle their beneficial applications as well—and that is not a realistic option. Instead, the dual-use dilemma associated with the revolution in biology must be managed on an ongoing basis. As long as rapid innovations in biological science and the malevolent intentions of terrorists and proliferators continue on trajectories that are likely to intersect sooner or later, the risk that biological weapons pose to humanity must not be minimized or ignored.

...The Commission further believes that terrorists are more likely to be able to obtain and use a biological weapon than a nuclear weapon. The Commission believes that the U.S. government needs to move more aggressively to limit the proliferation of biological weapons and reduce the prospect of a bioterror attack.

Iran could develop biological weapons as a substitute for nuclear weapons or to supplement them. It would be possible to do so under the guise of developing biological defenses, medical research, or in small, dispersed cells that would be far harder to detect than nuclear or chemical weapons facilities. The fact that there is a Biological Weapons Convention places virtually no limits on a determined proliferator. There are no enforcement or inspection provisions.

Moreover, the costs of such an effort to a country already moving toward modern biological research and production capabilities in its civil sector is likely to be no higher than a single battalion of modern main battle tanks and is virtually certain to be lower than the cost of a single squadron of fighter aircraft. It is doubtful that Iran faces a massive financial burden in producing nuclear weapons—given the investments it has already made in nuclear power, delivery systems, and dual-use technology. The financial burden of a biological weapons effort in military terms is negligible.

Some experts do argue that biological weapons have far less deterrent impact because it is impossible to show their lethality until they are used, and there is no serious precedent that has demonstrated that they can produce massive casualties. There are also questions about Iran's ability to build advanced bombs and warheads, or a survivable penetrator that could distribute such weapons as a line source delivery system.

At the same time, unknowns produce fear as well as uncertainty. It is also possible to demonstrate some of the effectiveness of such weapons by leaking data about human testing against prisoners and conducting more open tests against livestock or crops. Much would depend on whether Iran chose to use a mix of different agents to ensure the effectiveness of an attack as well as complicate detection and treatment. Iran could also

effectively experiment in covert attacks to see which agents actually worked—carrying out tests on an enemy country.

Alternatively covert tests and proof of effectiveness allow the potential use of covert delivery with less risk of being identified as an attacker. Covert delivery can take advantage of attacks that mix a variety of different agents, appear to be natural outbreaks of human disease, or have an impact on agriculture similar to the constant spread of diseases and pests across national boundaries.

There also is the possibility that Iran would escalate to highly lethal infectious agents in response to any nuclear exchange or replace or supplement one. The restraints that exist before this kind of war could cease to have much practical meaning in a “broken back” conflict.

Once again, these are possibilities, not predictions. A nation committed to asymmetric warfare must, however, at least have studied all of these options and the decades of unclassified literature that describe them in far more detail. It is also a grim reality that no purely nuclear arms control regime can ever limit Iran’s—or any other nation’s—ability to deploy truly lethal weapons of mass destruction.

## **Military Options for Dealing with Iranian Proliferation**

This does not mean that other regional states and outside powers cannot contain and deter Iran, or that diplomatic and arms control options do not have value. There are a wide range of ways that outside states can react to Iran’s options, many of which are already in play:

- *Diplomacy and Dialog*: Efforts to persuade Iran not to proliferate by convincing Iran that it does not face a sufficient threat to proliferate and cannot make major gains in power or security by doing so.
- *Sanctions*: Controls and measures designed to put economic pressure on Iran, limit its access to technology, and/or limit its access to arms.
- *Incentives*: Options that give Iran security guarantees, economic and trade advantages.
- *Regime Change*: Efforts to change the regime and create one that will not proliferate.
- *Preventive or Preemptive Strikes before Iran Has a Significant Force*: Military options that would destroy Iran’s ability to proliferate and/or deploy significant nuclear forces.
- *Containment*: Creation of a mix of defensive and offensive measures that would both deny Iran the ability to exploit its WMD capabilities and show that any effort to use such weapons to intimidate or gain military advantage would be offset by the response.
- *Deterrence*: Creation of military threats to Iran so great that no rational Iranian leader could see an advantage from using weapons of mass destruction.
- *Defense*: A mix of measures such as missile defense, air defense, counterterrorism, countersmuggling/covert operations capability, civil defense, and passive defense that would both deter Iran and protect against any use it made of its WMD capabilities.

Military options are only one such approach, but they become steadily more critical as Iran moves to the point where it clearly can either produce nuclear weapons or has begun to produce them.

### **Preventive and Preemptive Strikes, and**

## **Strikes before Iran Has a Significant Force**

It is clear that the United States and Israel have examined preventive and/or preventive attack options. Israel and the United States do differ over the timing and level of risk posed by Iran's nuclear efforts. The United States sees a mature or serious Iranian nuclear threat as coming well after 2010. Israel claims to see it as coming as early as 2009—although much of this may be Israeli hype designed to push the United States into diplomatic action, and military action if that fails.

Reports began to surface in late 2008 and early 2009 that in the summer of 2008 Israeli officials had approached President Bush for support for operations against Iran's nuclear facilities, including specialized bunker busters for an attack on Iran's main nuclear complex and covert actions intended to sabotage other suspected facilities. A report by the *New York Times* suggests that President Bush was convinced by top administration officials—led by Secretary of Defense Robert M. Gates—that any overt attack on Iran would probably prove ineffective, lead to the expulsion of international inspectors, and drive Iran's nuclear effort further out of view. Mr. Bush and his aides also discussed the possibility that an air strike could ignite a broad Middle East war in which America's 140,000 troops in Iraq would inevitably become involved.<sup>vi</sup>

Official U.S. policy is to leave all options on the table and to emphasize diplomatic activity through the EU3 (France, Germany, and Great Britain) and the UN. The U.S. estimates of timelines for Iran's nuclear and missile efforts also leave at least several years in which to build an international consensus behind sanctions and diplomatic pressure, and a consensus behind military options if diplomacy fails. The United States would also have the potential advantage of finding any Iranian “smoking gun,” improving its targeting and strike options, and being able to strike targets in which Iran had invested much larger assets. The fact that Iran can exploit time as a weapon in which to proliferate does not mean that the United States cannot exploit time as a weapon with which to strike Iran.

Israel, on the other hand, sees Iran as an existential threat. A single strike on Tel Aviv and/or Haifa would raise major questions about Israel's future existence.

## **The Problem of Targeting**

There are no risk-free military options for Israel, the United States, or neighboring states. Tehran's known nuclear research facilities are dispersed around the country, generally large, and have constant new construction. There are at least six major complexes in Iran's public program, at least 18 major suspect facilities, and more facilities are under construction.

Iran has numerous facilities associated with its various nuclear programs and activities. Some of these sites are still suspected sites, and the details of the true activities taking place at these sites are still speculative and cannot be confirmed due to Iran's lack of transparency and full cooperation with IAEA inspectors.

The lack of knowledge about site locations is further exacerbated by the lack of knowledge about the types of activities that take place at known facilities. In creating target decks it is important to know how destruction of a particular target would affect or

cripple Tehran's nuclear programs and future efforts. Without this information the overall effectiveness of targeting Iran's known and suspect facilities is largely unknown.

Unclassified satellite photos show over 100 buildings in the major complexes, and many more in lesser areas.<sup>vii</sup> Key facilities, including facilities for centrifuge manufacture, are at relatively distant points from the Gulf and particularly from Israel in locations like Mashad. There is no way to know the level of knowledge the Israeli or U.S. intelligence community has, or the quality of their targeting data. Work by Frank Barnaby, reporting by the IAEA, ISIS, FAS, GlobalSecurity.org, NTI, the University of Wisconsin's Iran Watch program, and multiple media outlets have identified the following, declared, confirmed, suspected, and potential nuclear centers, many of which are also potential major target complexes:<sup>viii</sup> Jabr Ibn Hayan Multipurpose Laboratory (JHL)

- Suspected Rudan Conversion Facility at Fasa
- Isfahan (Esfahan) Nuclear Technology Center (INTC); Isfahan Uranium Conversion Facility (UCF); Isfahan **Fuel Manufacturing Plant (FMP)**; Isfahan **Fuel Element Cladding Plant**; Isfahan Nuclear Fuel Research and Production Center (NFRPC); Isfahan Nuclear Waste Storage Facility
- Natanz Enrichment Facility (FEP and PFEP)
- **Suspected Additional Enrichment Sites at** Lashkar-Abad and Ramandeh
- Khondab **Water Production Plant**; **Arak Heavy-Water Reactor (IR-40)**
- Bushehr Nuclear Power Generators
- **Tehran Nuclear Research Center (TNRC)**; **TRR (IR-0001)**; **Laboratory Scale Milling Facility**; **Kalaye Electric, Sharif University of Technology (SUT)**; **Atomic Energy of Iran**; Molybdenum, Iodine, and Xenon Radioisotope Production Facility (MIX Facility)
- Gorgan al-Kabir Center
- Weapons Development Facility at Chalus
- Moallem Kaleyah
- Saghand Uranium Mine
- **Talmesi and Meskani Uranium Mines**
- Bonab Atomic Research Center
- Ardakan **Pilot Yellowcake Production Facility and Uranium Ore Processing Plant**
- Yazd Radiation Processing Center (YRPC); **Beneficiation and Hydrometallurgical Center (BHRC)**
- Karaj Agricultural and Medical Research Center (30-MeV Cyclotron) (1-Millamp Calutron)
- Azad University Plasma Physics Research Center at Damarand
- Engineering Research Center for the Constructions Crusade (Jihad-e Sazandegi) at Tabriz
- Gchine
- Karazj
- Koloduz
- Darkhovin, also variously referred to as Ahvaz, Darkhouin, Esteghlal, and Karun
- Tabas

- Anarak

This list is partial and uncertain. There are no reliable unclassified data on the number and function of sites related to Iran's nuclear program, and estimates vary from organization to organization in their assessments. Some key sites are underground or spread out in complexes with many buildings and in areas with peaceful or non-nuclear functions. Others are unknown or cannot be characterized reliably and in detail. IAEA inspections have identified at least 18 sites, but others argue that there might be more than 70. A great deal of the equipment other than major centrifuge facilities is also easy to move or relocate. Iran may already be playing a shell game with key research facilities and equipment, constantly changing the targeting pattern.

Tehran has had a quarter of a century to learn from the experience of Israel's attack on Iraq in 1981. Iran may have built redundant sites, underground facilities, and constructed a high level of protection around its known nuclear research centers. Others have argued that Iranian nuclear sites may have been deliberately built near populated areas or in facilities with many other "legitimate" purposes so Israel and the United States would be confronted with the problem of collateral damage or being charged with having hit an "innocent target." Many of Iran's research, development, and production activities are almost certainly modular and can be rapidly moved to new sites, including tunnels, caves, and other hardened facilities.

U.S. and Israeli officials have publicly identified key nuclear research sites that may have been placed underground to shield them against airborne assaults. For example, the United States identified the Parchin military complex, located south of Tehran, as a "probable" location for nuclear weaponization research. This site alone has many sections, hundreds of bunkers, and several tunnels. It is also a site that is being used to manufacture conventional armaments and Iranian missiles. This is one possible site that could be attacked, but even the evidence linking this to military nuclear weapons manufacturing was ambiguous. The site has civilian and conventional military use. The IAEA's initial assessment was that the site was not linked to nuclear weapons manufacturing, but most agree that there was not definitive proof.

It is equally important to note that Iran had increased its protection of sites against possible U.S. or Israel air strikes. It has been reported that the IRGC launched a program to protect major nuclear facilities. The program was recommended by the Nuclear Control Center of Iran and endorsed by Iran's Supreme Leader, Ali Khamenei. The program's mission was to build a defense infrastructure for Iran's nuclear research facilities.

This program, reportedly coordinated with North Korea, is to build underground halls and tunnels at the cost of "hundreds of millions of dollars."<sup>ix</sup> Some key sites such as Isfahan and Natanz are high on the list of the program to protect. The Isfahan facility, which reached fully operational status in February 2006, is most likely the primary source for converting yellowcake into UF<sub>6</sub>. The logistic defense infrastructure would include natural barriers (tunnels into mountains and cliffs), manufactured barricades (concrete ceilings and multiple floors), and camouflage activities around key sites. The construction, a joint venture between Iranian and North Korean companies, was estimated to finish by June 1, 2006.

In January of 2006 *Jane's Defense Weekly* reported that "the 'Shahid Rajaei' company, which belongs to the IRGC, is involved in the project. It specialises in the excavation of underground tunnels and ducts and has accumulated extensive experience in such construction work, for instance at the underground nuclear site at Natanz. Company experts have divided the shielding project into two major stages, relating to topographic conditions in the area of the nuclear facility and branching tunnels."<sup>x</sup>

The report went on to say that, "JDW has learned that the Islamic Revolutionary Guards Corps (IRGC) is accelerating a programme to protect Iran's major nuclear facilities," and added that, "the office of Iran's Supreme Leader Ayatollah Ali Khomeini endorsed a decision by the Nuclear Control Centre to complete construction of a logistic defence infrastructure for the Iranian military nuclear programme by no later than 1 July."<sup>xi</sup>

The lack of reporting following this Jane's article, along with the information provided in the January 2006 JDW, suggests that phases of the initial contract with North Korea have been completed, but the overall status of the program is largely unknown, and shrouded in secrecy, much like the rest of Iran's nuclear program.

## **Israeli Options**

A number of Israeli officers, officials, and experts have said that Israel must not permit the Iranians to acquire nuclear capabilities, regardless of Tehran's motivations. Some have called for preemptive strikes by Israel. Ephraim Inbar, the President of the Jaffee Center for Strategic Studies, said, "For self-defense, we must act in a pre-emptive mode."<sup>xii</sup>

Senior U.S. officials in both the Bush and Obama Administrations have warned that this is a real possibility. Vice President Dick Cheney suggested on January 20, 2005, "Given the fact that Iran has a stated policy that their objective is the destruction of Israel, the Israelis might well decide to act first, and let the rest of the world worry about cleaning up the diplomatic mess afterwards."<sup>xiii</sup>

General Moshe Ya'alon, the Israeli Chief of Staff, was quoted as saying in August 2004 that Iran must not be permitted to acquire nuclear weapons. He added that Israel must not rely on the rest of the world to stop Iran from going nuclear because he said a nuclear Iran would change the Middle East where "Moderate States would become more extreme."<sup>xiv</sup>

Israeli military officials were quoted in press reports in January 2006 as saying that the Israel Defense Forces (IDF) got the order to get ready for a military strike against Iranian nuclear sites by March 2006.<sup>xv</sup> Reports also surfaced in late 2008 stating that the IDF was readying to carry out unilateral strikes against Iranian nuclear facilities.<sup>xvi</sup>

Israeli officials reportedly asked U.S. President George W. Bush about support in acquiring bunker busters for use against Iran's main facility, as well as support for covert operations against Iran's other suspect facilities in the summer of 2008.<sup>xvii</sup> The US does not seem to have transferred advanced hard target killers, but Israel has the technology and capability to develop its own.

Israeli politics are uncertain. Prime Minister Benjamin Netanyahu has been hawkish in his statements about Iran's WMD program and Iranian intentions for a global conflict.

Since his appointment to prime minister, not much has changed. Netanyahu continues to make it clear that he is strongly against Iran's pursuit of uranium enrichment and other potential WMD programs. On numerous occasions, Netanyahu has publicly stated that Israel will not stand by while Iran continues to progress its nuclear and missile programs.

Prime Minister Netanyahu has made numerous threats of military strikes against Iran if it does not halt its uranium enrichment, among other activities that Netanyahu perceives as threats to Israeli security. Since his appointment, the talk of unilateral strikes by Israel against Iran's suspected WMDs, and other military facilities, has been more prominent in official Israeli statements.

### **Possible Methods of Israeli Attack**

It is unclear what type of military strikes Israel may choose, if it decides to respond preemptively. Some have argued that Israel may declare its nuclear weapons and establish deterrence through "mutually assured destruction." While the impact of an Israeli declaration remains uncertain, it might have limited impact on Israel's strategic posture in the region, since most states factor Israel's nuclear weapons into their strategic thinking.

Some experts argue that Israel does not have viable military options to deal with Iran's capabilities to make nuclear weapons, much less deal with a deployed force once Iran is able to disperse its warheads and missiles. They argue it does not have U.S. targeting capability and simply cannot generate and sustain the necessary number of attack sorties. Some argue that Israel might do little more than drive Iranian activity further underground, provoke even more Iranian activity, make it impossible for diplomatic and UN pressure to work, and make Israel into a real, rather than a proxy or secondary, target.

In April 2005, it was reported that a senior Israeli Air Force (IAF) officer dismissed plans to strike Iran's nuclear facilities because it was too risky and too complex both in terms of executing the mission as well as in long-term consequences, although he did not rule out the feasibility of military action against Iran. The officer further said that the most critical targets were concentrated near Tehran and 150 kilometers to the south of the city. He also noted that Iran possesses only 20 ballistic missile launchers, which should not present insurmountable difficulties when planning attacks.<sup>xviii</sup>

There is no doubt that such a strike would face problems. Israel does not have conventional ballistic missiles or land-/sea-based cruise missiles suited for such a mission. The shortest flight routes would be around 1,500–1,700 kilometers through Jordan and Iraq, 1,900–2,100 kilometers through Saudi Arabia, and 2,600–2,800 kilometers in a loop through Turkey.

There have been reports that Israel approached the United States in order to obtain permission for overflying Iraq in case of a contingency.<sup>xix</sup> Another report has stated that Israeli forces have obtained U.S. permission to establish a military base in Iraq near the Iranian border. None of these reports seem accurate or founded on more than speculation.

There are many other problems in launching such a strike. Even if Israel had the attack capabilities needed for the destruction of the all elements of the Iranian nuclear program, it is uncertain whether Israel has the kind of intelligence needed to be certain that all the necessary elements of the program were traced and destroyed fully. Israel has good

photographic coverage of Iran with the Ofeq series of reconnaissance satellites, but being so distant from Iran, one can assume that other kinds of intelligence coverage are rather partial and weak.

Retired Brigadier General Shlomo Brom has argued that Israel's capabilities may not be enough to inflict enough damage on Iran's nuclear program.<sup>xx</sup>

[A]ny Israeli attack on an Iranian nuclear target would be a very complex operation in which a relatively large number of attack aircraft and support aircraft (interceptors, ECM [electronic countermeasures] aircraft, refuelers, and rescue aircraft) would participate. The conclusion is that Israel could attack only a few Iranian targets and not as part of a sustainable operation over time, but as a onetime surprise operation.

All that said, this does not mean that Israel and the United States cannot target and strike much or most of Iran's capabilities. One great danger in open-sourced analysis is that it is not targeting intelligence and cannot provide a meaningful picture of what the United States or other potential attackers know at the classified level. It is also dangerous, if not irresponsible, for analysts with no empirical training and experience in targeting and modern weapons effects to make sweeping judgments about strike options. They simply lack basic professional competence and even minimal credibility.

### **Israeli Air Strikes**

Israel could launch and refuel two to three full squadrons of 36–54 combat aircraft for a single set of strikes with refueling. It could use either its best F-15s (28 F-15C/D, 25 F-15I Ra'am) or part of its 126 F-16CDs and 23 F-16I Sufas. It has at least three specially configured squadrons with conformal fuel tanks specially designed for extended range use. It could add fighter escorts, but refueling and increased warning and detection would be major problems.

For the purposes of guessing how Israel might attack, its primary aircraft would probably be the F-15I, although again this is guesswork. GlobalSecurity.org has excellent reporting on the F-15I.<sup>xxi</sup>

The key aspects are that Boeing's (formerly McDonnell Douglas) F-15E Strike Eagle entered service with the IDF/Heyl Ha'Avir (Israeli Air Force) in January of 1998 and was designated the F-15I Ra'am (Thunder). The F-15E Strike Eagle is the ground attack variant of the F-15 air superiority fighter, capable of attacking targets day or night, and in all weather conditions.

The two seat F-15I, known as the Thunder in Israel, incorporates new and unique weapons, avionics, electronic warfare, and communications capabilities that make it one of the most advanced F-15s. Israel finalized its decision to purchase 25 F-15Is in November 1995. The F-15I, like the U.S. Air Force's F-15E Strike Eagle, is a dual-role fighter that combines long-range interdiction with the Eagle's air superiority capabilities. All aircraft are to be configured with either the F100-PW-229 or F110-GE-129 engines by direct commercial sale; Night Vision Goggle compatible cockpits; an Elbit display and sight helmet (DASH) system; conformal fuel tanks; and the capability to employ the AIM-120, AIM-7, AIM-9, and a wide variety of air-to-surface munitions.

Though externally the Ra'am looks similar to its USAF [United States Air Force] counterpart, there are some differences, mainly in the electronic countermeasures gear

and the exhaust nozzles. The Ra'am has a counterbalance on the port vertical stabilizer instead of the AN/ALQ-128 EWWS (Electronic Warfare Warning System) antenna found on USAF Strike Eagles. The Ra'am uses two AN/ALQ-135B band 3 antennas, one mounted vertically (starboard side) and one horizontally (port side). These are located on the end of the tail booms. They are distinguished by their chiseled ends, unlike the original AN/ALQ-135 antenna, which is round and located on the port tail boom of USAF Eagles.

The Ra'am utilizes extra chaff/flare dispensers mounted in the bottom side of the tail booms. Unlike USAF Eagles, the Ra'am still use engine actuator covers (turkey feathers) on their afterburner cans. The U.S. Air Force removed them because of cost and nozzle maintenance, though curiously, USAF F-16s still have their actuator covers installed. Israeli Strike Eagles and some USAF Eagles based in Europe use CFT air scoops. These scoops provide extra cooling to the engines.

The 25 F-15Is operational since 1999 [and the 100 F-16Is] were procured first and foremost to deal with the Iranian threat. In August 2003 the Israeli Air Force demonstrated the strategic capability to strike far-off targets such as Iran [which is 1,300 kilometers away], by flying three F-15 jets to Poland 1,600 nautical miles away. After they celebrated that country's air force's 85th birthday, on their return trip, the IAF warplanes staged a fly-past over the Auschwitz death camp.<sup>xxii</sup>

Israeli aircraft would probably need to carry close to their maximum payloads to achieve the necessary level of damage against most targets suspected of WMD activity, although any given structure could be destroyed with one to three weapons. (This would include the main Bushehr reactor enclosure, but its real-world potential value to an Iranian nuclear program is limited compared to more dispersed and/or hardened targets.) At least limited refueling would be required, and backup refueling and recovery would be an issue.

The key weapon to be used against hard targets and underground sites such as Natanz might be the GBU-28, although the United States may have quietly given Israel much more sophisticated systems or Israel may have developed its own, including a nuclear armed variant.

The GBU-28 is carried by the F-15I. It is a "5,000-pound" laser-guided bomb with a 4,400-pound (lb) earth-penetrating warhead that can be upgraded by the IAF to use electro-optical or global positioning system (GPS) targeting. It is a vintage weapon dating back to the early 1990s, and the IAF is reported to have bought at least 100. It has been steadily upgraded since 1991, and the USAF ordered an improved version in 1996. It looks like a long steel tube with rear fins and a forward guidance module. It can glide some three to seven miles depending on the height of delivery. It is 153 inches long x 14.5 inches in diameter.<sup>xxiii</sup>

Multiple strikes on the dispersed buildings and entries in a number of facilities would be necessary to ensure adequate damage without restrikes—which may not be feasible for Israel given the limits to its sortie generation capability over even Iranian soft targets. As for hardened and underground targets, the IAF's mix of standoff precision-guided missiles—such as Harpoon or Popeye—would not have the required lethality with

conventional warheads, and Israel's use of even small nuclear warheads would cause obvious problems.

Israel may have specially designed or adapted weapons for such strikes. Some reports state that it had bought 500 GBU-28, 5,000-lb laser-guided bombs from the United States in February 2005. These weapons are armed with BLU-113 penetrators and are sometimes called “bunker busters.” They were first rushed into service during the Gulf War in 1991 and use a penetrating warhead. The bombs are modified U.S. Army artillery tubes, weigh 4,637 pounds, and contain 630 pounds of high explosives. The Federation of American Scientists reports that they are fitted with GBU-27 laser-guided bomb guidance kits, are 14.5 inches in diameter, and are almost 19 feet long. The operator illuminates a target with a laser designator and then the munitions guides to a spot of laser energy reflected from the target.<sup>xxiv</sup>

Experts speculated whether the purchase was a power projection move or whether Israel was, in fact, planning to use these conventional bombs against Iranian nuclear sites. These speculations were further exacerbated when Israeli Chief of Staff Lieutenant General Dan Halutz was asked how far Israel would go to stop Iran's nuclear program; he said, “2,000 kilometers.”<sup>xxv</sup> According to some reports, The IAF took early delivery on some of these weapons during its war with the Hezbollah in 2006.<sup>xxvi</sup>

The hard-target bombs it has acquired from the United States are, however, not systems designed to kill underground facilities. They could damage entrances, but not the facilities. What is not known is whether Israel has its own ordnance or has secretly acquired the more sophisticated systems described later.

Israel also has considerable precision-strike capability and is reported to have bought 1,000 GBU-39 small diameter, precision-guided bombs from the United States in September 2008.<sup>xxvii</sup> These weapons have pop-out wings and a maximum range of up to 110 kilometers from very high altitudes and an accuracy of less than two meters. They can be launched from outside the range of most Iranian surface-to-air missiles, have considerable hard target kill capability, can be used against surface targets in densely populated areas with minimal risk of collateral damage, and can be used to extend range by reducing payload or to increase the load a given aircraft can carry—allowing multiple strikes to ensure target damage or strikes at larger numbers of aim points per aircraft.<sup>xxviii</sup>

### **Israeli Penetration Capabilities**

The IAF would have problems in penetrating through Arab airspace, unless it could stage through Turkey, and would also have problems in refueling—its 5 KC-130H and 5 B-707 tankers are slow and vulnerable and would need escorts—and its ordinary B-707 airborne early warning (AEW), electronic intelligence (ELINT), and electronic warfare aircraft are also slow fliers, although the new G-550 Shaved ELINT aircraft is a fast flier and the IAF has some long-range unmanned aerial vehicles (UAVs) that could support its aircraft before, during, and after such missions.

These big-manned “slow fliers” would have serious problems penetrating and surviving in Arab and Iranian airspace. Israel has, however, specially configured some of its F-15s and F-16s with targeting, EW, surface-to-air missile (SAM)-suppression aids, and ELINT for this kind of mission. The full details of such capabilities are unknown.

Repeated strikes would be a problem because Israel could probably get away with going through Jordan and then through Saudi Arabia/Gulf or Iraq once, but any repeated effort would be too politically dangerous for Arab governments to easily tolerate. Israel has also had problems with its intelligence satellites, and its battle damage assessment and time-urgent retargeting capabilities for precision strikes with a target mix as complex as Iran's could be a major problem.

Much would depend on just how advanced Israel's long-range UAV capabilities really are and whether Israel could get access to U.S. intelligence and intelligence, surveillance, and reconnaissance (IS&R) capabilities for both its initial targeting and restrikes, but confirming the actual nature of damage, carrying out restrikes, and sending a clear signal that Israel can repeat its strikes if Iran rebuilds or creates new facilities would be a problem. Israel has kept the details of such programs classified, along with those of its long-range cruise missile and ballistic missile booster developments. Enough has leaked into the press, however, to indicate that the Israel Defense Forces (IDF) has made very substantial progress in developing the long-range UAVs it would need for such missions.

The radars in the countries involved would probably detect IAF and U.S. missions relatively quickly, and very low-altitude penetration profiles would lead to serious range-payload problems. The countries overflown would be confronted with the need to either react or have limited credibility in claiming surprise. There are gaps in Syrian air defenses in the north and along the Syrian-Jordanian border. An overflight would still present political problems, however, and an overflight of Iraq would be a major violation of Iraqi sovereignty and seen in the region as having to have had a U.S. "green light." Iran would almost certainly see Jordanian, Turkish, and/or Saudi tolerance of such an IAF strike as a hostile act. It might well claim a U.S. green light in any case in an effort to mobilize hostile Arab and Muslim (and possibly world) reactions.

Many have compared current Israeli military options with Iran to that of the 1981 attack against Iraq's Osiraq reactor and have noted the conditions are very different. For example, Peter Brookes, a military expert and senior fellow at the Heritage Foundation, has argued that Israel has several options including satellite-guided Joint Direct Attack Munition (JDAM) bombs, cruise missiles on submarines, and Special Operation Forces. He, however, argued that attacking Iranian nuclear facilities are "much tougher" to target given the nature of the Iranian nuclear facilities and the strategic balance in the region.<sup>xxix</sup>

As for covert action, this demands significant operational capabilities and intelligence. It seems doubtful that Israel has the capability to conduct large-scale covert operations in Iran. The Iranian program is also hard to assess and covertly attack because it has reached the point where it is independent of external assistance. Moreover, much of the foreign assistance Iran has obtained came from nations such as Pakistan, which are not traditional areas of operations for the Israeli Secret Services, such as Europe or South America.

### **Israeli Nuclear Options**

Reports have surfaced, however, about more drastic Israeli strike options. One report, dating from early 2007, states that Israel has created plans to strike Iran with nuclear bunker-buster bombs. This would apparently be used if the United States fails to neutralize Iran's nuclear facilities. The three prime targets in this plan include the enrichment facility in Natanz, the uranium conversion in Isfahan, and the heavy-water

reactor in Arak.<sup>xxx</sup> Other, possibly longer-term, options include deploying Israeli submarines in the Gulf or Gulf of Oman, which could respond to lower-level Iranian attacks on Israel by attacking Iran's oil exports and eventually being armed with nuclear cruise missiles to preempt or retaliate to an Iranian nuclear strike on Israel.

## **U.S. Options against Iran**

A power as large as the United States would have far greater capabilities than Israel. It could strike on a scale that could destroy all highly suspect possible targets as well as confirmed targets. For Iran, this would present the problem that playing a shell game is dangerous when the opponent can strike at all the shells.

The United States also could strike at a wide range of critical Iranian military facilities, including its missile production facilities. Most are soft targets and would be extremely costly to Iran. Even if many of Iran's nuclear facilities did survive U.S. strikes, Iran would be faced with either complying with the EU3 (France, Germany, and United Kingdom) and UN terms or taking much broader military losses—losses its aging and limited forces can ill afford.

### **Possible U.S. Strike Methods**

The United States has a wide range of attack assets it could use, including cruise missiles, standoff precision-guided weapons, and stealth aircraft. Military operations against Iran's nuclear, missile, and other WMD facilities and forces would still be challenging, however, even for the United States. Iran would find it difficult to defend against U.S. forces using cruise missiles, stealth aircraft, standoff precision weapons, and equipped with a mix of vastly superior air combat assets and the IS&R assets necessary to strike and restrike Iranian targets in near real time.

For example, each U.S. B-2A Spirit stealth bomber could carry eight 4,500-pound enhanced BLU-28 satellite-guided bunker busting bombs—potentially enough to take out one hardened Iranian site per sortie. Such bombers could operate flying from Al Udeid air base in Qatar, Diego Garcia in the Indian Ocean, RAF Fairford in Gloucestershire, United Kingdom, and Whiteman USAF Base in Missouri.

The United States also has a number of other new systems that are known to be in the developmental stage and can probably deploy systems capable of roughly twice the depth of penetration with twice the effectiveness of the systems known from its attacks on Iraq in 1991. There seems to be a follow-on version of the 2,000-pound BLU-109, with an advanced unitary penetrator that can go twice as deep as the original BLU-109.<sup>xxxii</sup> The nature and characteristics of such systems are classified, but the newest development in the BLU series that has been openly reported is the 5,000-pound BLU-122, which was fielded in late 2007. Further, there is the Massive Ordnance Penetrator (MOP), weighing almost 30,000 pounds, carrying 5,300 pounds of explosives. According to some estimates, optimum penetrating distance is up to 200 feet. Possible future alternatives to these weapons include directed-energy and high-power microwave weapons, none of which are currently beyond the testing phase.

The JDAM GBU-31 version has a nominal range of 15 kilometers with a CEP of 13 meters in the GPS-aided Inertial Navigation System (INS) modes of operation and 30 meters in the INS-only modes of operation.<sup>xxxii</sup>

More advanced systems that have been publicly discussed in the unclassified literature include the BLU-116 Advanced Unitary Penetrator, the GBU-24 C/B (USAF), or the GBU-24 D/B (U.S. Navy), which has about three times the penetration capability of the BLU-109.<sup>xxxiii</sup> The United States is investing in weapons that are supposed to destroy targets that are buried under more than 20 meters of dirt and concrete.

It is not clear whether the United States has deployed the AGM-130C with an advanced earth penetrating/hard-target kill system. The AGM-130 Surface Attack Guided Munitions was developed to be integrated into the F-15E, so that the F-15E could carry two such missiles, one on each inboard store station. The AGM-130 is a retargetable, precision-guided standoff weapon using inertial navigation aided by GPS satellites and has a 15–40-nautical mile range.<sup>xxxiv</sup>

Northrop-Grumman announced in July 2007 that it had begun integrating a new 30,000-pound-class "penetrator bomb" for use by the B-2. In 2008, it was reported that USAF ordnance handlers at Whiteman Air Force Base, Missouri, had loaded a dummy version of the 20.5-foot long MOP into a mocked-up duplicate of the stealth bombers weapons bay on December 18, 2007. The USAF was reported to be checking in the test whether the B-2's existing mounting hardware was adequate, and if the bomb would fit in the bomb bay. The combined weight of the two MOPs was said to be 20,000 pounds—more than the published 40,000-pound maximum payload the B-2 is listed as carrying. However, the B-2 was believed to be able to carry the 60,000-pound payload of two conventional MOP weapons. Reports indicate that the USAF had asked the Congress for nearly \$88 million in development funds for the MOP in FY2008.<sup>xxxv</sup>

### **The Effectiveness of US Strikes**

It is not clear whether any combination of such weapons could destroy all of Iran's most hardened underground sites, although it seems likely that the BLU-28 could do serious damage at a minimum and might well collapse enough of them to make them unusable. Much depends on the accuracy of reports that Iran has undertaken a massive tunneling project with some 10,000 square meters of underground halls and tunnels branching off for hundreds of meters from each hall.

Iran is reported to be drawing on North Korean expertise and to have created a separate corporation (Shahid Rajaei Company) for such tunneling and hardening efforts under the IRGC, with extensive activity already under way in Natanz and Isfahan. The facilities are said to make extensive use of blast-proof doors, extensive divider walls, hardened ceilings, 20-centimeter-thick concrete walls, and double concrete ceilings with earth filled between layers to defeat earth penetrates.<sup>xxxvi</sup> Such passive defenses could have a major impact, but reports of such activity are often premature, exaggerated, or report far higher construction standards than are actually executed.

At the same time, the B-2A, other bombers, and U.S. land and carrier-based attack aircraft—some with stealth-like features—could be used to deliver large numbers of precision-guided 250- and 500-pound bombs against dispersed surface targets or a mix of light and heavy precision-guided weapons. Submarines and surface ships could deliver cruise missiles for such strikes, and conventional strike aircraft and bombers could deliver standoff weapons against most suspect Iranian facilities without suffering a high

risk of serious attrition. The challenge would be to properly determine what targets and aim points were actually valuable, not to inflict high levels of damage.

One analyst projects that strikes against some 400 targets would be necessary to dismantle the program. According to other reports, the U.S. Department of Defense is considering both conventional and nuclear weapons to use against reinforced underground targets and would strike at Iran's other WMD facilities, missiles and missile production facilities, and create an entry corridor by destroying part of Iran's air-defense system. This could easily require 800–1,200 sorties and cruise missile strikes.

One expert (Lieutenant General Thomas McNerny, the former retired Assistant Vice Chief of the USAF) speculates that this could require an initial strike force of 75 stealth aircraft, including B-2s, F-117s, and F-22s; and 250 non-stealth aircraft, including F-15s, F-16s, B-52s, and B-1s, It might include three carrier task forces with 120 F-18s, and large numbers of cruise missiles, supported by a large array of intelligence platforms, support aircraft, and UAVs.<sup>xxxvii</sup>

More generally, the United States could cripple Iran's economy by striking at major domestic gas production and distribution facilities, refineries, and electric power generations. There are no rules that would preclude the United States from immediate restrikes or restrikes over time. If the United States chose to strike at the necessary level of intensity, it could use conventional weapons to cripple Iran's ability to function as a nation in a matter of days with attacks limited to several hundred aim points.

### **Possible U.S. War Plans: Attacking, Delaying, and Waiting Out**

If the United States does choose to respond militarily, it has several major types of military and strategic options. These options are summarized below. Each of these options might have many of the following broad characteristics, although it should be stressed that these are only rough outlines of U.S. options and are purely speculative and illustrative points.

They are more warnings than recommendations, and they are not based on any inside knowledge of actual U.S. war plans and calculations. Those who argue strongly for and against such options should note, however, that there are many different ways in which the United States could act. There are no rules or certainties that say such attacks either could not succeed or that they would.

It is also important to point out that the United States cannot clearly separate its actions from those of Israel. Alliance never means identity of interest, and this is particularly true given the currently weak nature of Israel's political situation, its tendency to exaggerate and overreact, and the danger the United States could suddenly be pressured to finish what Israeli forces start. Either a U.S. attack is necessary in the U.S. national interest, or the United States should clearly oppose Israeli action. Israel is simply too weak a power, and too divisive in terms of regional politics, to be either a useful alternative or a proxy.

- **Demonstrative, Coercive, or Deterrent Strikes**

- Conduct a few cruise missile or stealth strikes simply as a demonstration or warning of the seriousness of U.S. intentions if Iran does not comply with the terms of the EU3 or UN.

- Hit at least one high-value target recognized by the IAEA and the EU3 to show credibility to Iran, minimize international criticism.
- Might strike at new sites and activities to show Iran cannot secretly proceed with, or expand, its efforts by ignoring the UN or EU3.
- Could carrier base; would not need territory of Gulf ally.
- International reaction would be a problem regardless of the level of U.S. action.
- Might trigger Iranian counteraction in Iraq, Afghanistan, and dealing with Hezbollah.
- **Limited U.S. Attacks:**
  - A limited strike would probably take 16–20 cruise missile and strike sorties. (Total sorties in the Gulf and the area would probably have to total 100 or more including escorts, enablers, and refuelers.)
  - Might be able to combine B-2s and carrier-based aircraft and sea-launched cruise missiles. Might well need land base(s) in the Gulf for staging, refueling, and recovery.
  - Goal would be at least two to three of the most costly and major facilities critically damaged or destroyed.
  - Hit at high-value targets recognized by the IAEA and the EU3 to show credibility to Iran, minimize international criticism.
  - Might strike at new sites and activities to show Iran cannot secretly proceed with, or expand, its efforts by ignoring the UN or EU3.
  - Might slow down Iran if used stealth aircraft to strike at hard and underground targets, but impact over time would probably still be more demonstrative than crippling.
  - Hitting hard and underground targets could easily require multiple strikes during mission and follow-on restrikes to be effective.
  - Battle damage would be a significant problem, particularly for large buildings and underground facilities.
  - Size and effectiveness would depend very heavily on the quality of U.S. intelligence, and suitability of given ordnance, as well as the time the United States sought to inflict a given effect.
  - Iran's technology base would survive; the same would be true of much of the equipment even in facilities hit with strikes. Little impact, if any, on pool of scientists and experts.
  - Iranian response in terms of proliferation could vary sharply and unpredictably: deter and delay vs. mobilize and provoke.
  - Likely to produce cosmetic Iranian change in behavior at best. Would probably make Iran disperse program even more and drive it to deep underground facilities. Might provoke to implement (more) active biological warfare program.
  - Any oil embargo likely to be demonstrative.
  - Would probably trigger Iranian counteraction in Iraq, Afghanistan, and dealing with Hezbollah.
  - International reaction could be a serious problem; United States might well face same level of political problems as if it had launched a comprehensive strike on Iranian facilities.
- **Major U.S. Attacks on Iranian CBRN and Major Missile Targets:**
  - Period of attacks could extend from 3–10 days with 200–600 cruise missiles and strike sorties; would have to be at least a matching number of escorts, enablers, and refuelers.

- Hit all suspect facilities for nuclear, missile, biological warfare (BW), and related C4I/BM.
  - Knock out key surface-to-air missile sites and radars for future freedom of action.
  - Would need to combine B-2s, carrier-based aircraft, and sea-launched cruise missiles and use land base(s) in Gulf for staging, refueling, and recovery.
  - Threaten to strike extensively at Iranian capabilities for asymmetric warfare and to threaten tanker traffic, facilities in the Gulf, and neighboring states.
  - Would take at least 7–10 days to fully execute and validate.
  - Goal would be at least 70–80 percent of the most costly and major facilities critically damaged or destroyed.
  - Hit at all high-value targets recognized by the IAEA and the EU3 to show credibility to Iran, minimize international criticism, but also possible sites as well.
  - Strike at all known new sites and activities to show Iran cannot secretly proceed with, or expand, its efforts unless hold back some targets as hostages to the future.
  - Impact over time would probably be crippling, but Iran might still covertly assemble some nuclear devices and could not halt Iranian biological weapons effort.
  - Hitting hard and underground targets could easily require multiple strikes during mission and follow-on restrikes to be effective.
  - Battle damage would be a significant problem, particularly for large buildings and underground facilities.
  - Size and effectiveness would depend very heavily on the quality of U.S. intelligence and suitability of given ordnance, as well as the time the United States sought to inflict a given effect.
  - Much of Iran's technology base would still survive; the same would be true of many equipment items, even in facilities hit with strikes. Some impact, if any, on pool of scientists and experts.
  - Iranian response in terms of proliferation could vary sharply and unpredictably: deter and delay vs. mobilize and provoke.
  - A truly serious strike may be enough of a deterrent to change Iranian behavior, particularly if coupled to the threat of follow-on strikes in the future. It still, however, could as easily produce only a cosmetic Iranian change in behavior at best. Iran might still disperse its program even more and shift to multiple, small, deep underground facilities.
  - Might well provoke Iran to implement (more) active BW program.
  - An oil embargo might be serious.
  - Iranian government could probably not prevent some elements in Iranian forces and intelligence from seeking to use Iraq, Afghanistan, support of terrorism, and Hezbollah to hit back at the United States and its allies if it tried; it probably would not try.
  - International reaction would be a serious problem, but the United States might well face the same level of political problems as if it had launched a small strike on Iranian facilities.
- **Major U.S. Attacks on Military and Related Civilian Targets:**
    - Would take 1,000–2,500 cruise missiles and strike sorties
    - Hit all suspect facilities for nuclear, missile, BW, and C4I/BM, and potentially “technology base” targets including universities and dual-use facilities.

- Either strike extensively at Iranian capabilities for asymmetric warfare and to threaten tanker traffic, facilities in the Gulf, and neighboring states or threaten to do so if Iran should deploy for such action.
  - Would require a major portion of total U.S. global assets. Need to combine B-2s, other bombers, and carrier-based aircraft and sea-launched cruise missiles. Would need land base(s) in the Gulf for staging, refueling, and recovery. Staging out of Diego Garcia would be highly desirable.
  - Would probably take several weeks to two months to fully execute and validate.
  - Goal would be 70–80-percent-plus of the most costly and major CBRN, missile, and other delivery systems, key conventional air and naval strike assets, and major military production facilities critically damaged or destroyed.
  - Hit at all high-value targets recognized by the IAEA and the EU3 to show credibility to Iran, minimize international criticism, but also possible sites as well.
  - Strike at all known new sites and activities to show Iran cannot secretly proceed with, or expand, its efforts unless hold back some targets as hostages to the future.
  - Hitting hard and underground targets could easily require multiple strikes during mission and follow-on restrikes to be effective.
  - Impact over time would probably be crippling, but Iran might still covertly assemble some nuclear device and could not halt Iranian biological weapons effort.
  - Battle damage would be a significant problem, particularly for large buildings and underground facilities.
  - Size and effectiveness would depend very heavily on the quality of U.S. intelligence and suitability of given ordnance, as well as the time the United States sought to inflict a given effect.
  - Much of Iran's technology base would still survive; the same would be true of many equipment items, even in facilities hit with strikes. Some impact, if any, on pool of scientists and experts.
  - Iranian response in terms of proliferation could vary sharply and unpredictably: deter and delay vs. mobilize and provoke.
  - Such a series of strikes might be enough of a deterrent to change Iranian behavior, particularly if coupled to the threat of follow-on strikes in the future. It still, however, could as easily produce only a cosmetic Iranian change in behavior at best. Iran might still disperse its program even more, and shift to multiple, small, deep underground facilities.
  - Might well provoke Iran to implement (more) active biological warfare program.
  - An oil embargo might be serious.
  - Iranian government could probably not prevent some elements in Iranian forces and intelligence from seeking to use Iraq, Afghanistan, support of terrorism, and Hezbollah to hit back at the United States and its allies if it tried; it probably would not try.
  - International reaction would be a serious problem, and far greater than strikes that could be clearly associated with Iran's efforts to proliferate.
- **Delay and Then Strike:**
    - The United States could execute any of the above options and wait until after Iran provided proof it was proliferating. Such a smoking gun would create a much higher chance of allied support, and international tolerance or consensus
    - Iran will have committed major resources and created much higher-value targets

- The counter-risk is an unanticipated Iranian breakout: some form of Iranian launch on warning, launch under attack, or survivable “ride out” capability.
  - Iranian dispersal and sheltering may be much better.
  - Iran might have biological weapons as a counter.
  - Allied and regional reactions would be uncertain. Time tends to breed tolerance of proliferation.
- **Ride Out Iranian Proliferation:**
    - Announce or quietly demonstrate U.S. nuclear targeting of Iran's military and CBRN facilities and cities.
    - Tacitly signal U.S. green light for Israeli nuclear retaliation or preemption.
    - Deploy antiballistic and cruise missile defenses, and sell to Gulf and neighboring states.
    - Signal U.S. conventional option to cripple Iran by destroying its power generation, gas, and refinery facilities.
    - Provide U.S. guarantees of extended deterrence to Gulf States.
    - Tacitly accept Saudi acquisition of nuclear weapons.
    - Maintain preventive/preemptive option at constant combat readiness. Act without warning.
    - Encourage Israel to openly declare its strike options as a deterrent.
    - Announce doctrine that any Iranian use of biological weapons will lead to nuclear retaliation against Iran.

Iran's ride-out option is one that many commentators need to consider in more depth, particularly as long as Iran's capital investment is limited, its programs are not fully mature, the United States cannot be sure of destroying a target mix Iran cannot replace, and the United States does not have broad international support for its attacks. Unless the United States does find evidence of an imminent Iranian threat—which at this point might well require Iran to find some outside source of nuclear weapons or weapons-grade material—the United States may well simply choose to wait. Patience is not always a virtue, but it has never been labeled a mortal sin.

Furthermore, these options do deteriorate with time. The more Iran disperses its facilities and forces, and makes them redundant, the larger the attack the United States must launch and the greater the risk of at least partial failure. Iran's air defenses will improve if it gets modern fighters and a system such as the S-300. The risk Iran has some form of covert weapons storage or an early form of launch of warning or launch under attack also grows with time, as does the fact that once it has fissile material, the key component in a nuclear weapon might well survive any U.S. strike.

### **Iranian Defense against Israeli (and U.S.) Strikes**

Iran would find it difficult to defend against U.S. forces using cruise missiles, stealth aircraft, standoff precision weapons, and equipped with a mix of vastly superior air combat assets and the IS&R assets necessary to strike and restrike Iranian targets in near real time. Iran might be able to intercept Israeli fighters; Iran has "quantity," but its air defenses have limited "quality." It has assigned some 12,000–15,000 men in its air force to land-based air-defense functions, including at least 8,000 regulars and 4,000 IRGC

personnel. It is not possible to distinguish clearly between the major air-defense weapons holdings of the regular air force and of the IRGC, but the air force appeared to operate most major SAM systems.

Although Iran has made some progress in improving and updating its land-based air-defense missiles, sensors, and electronic warfare capability—and has learned much from Iraq's efforts to defeat U.S. enforcement of the "no-fly zones" from 1992–2003—its defenses are outdated and poorly integrated. All of its major systems are based on technology that is now more than 35 years old, and all are vulnerable to U.S. use of active and passive countermeasures.

Iran's land-based air-defense forces are too widely spaced to provide more than limited air defense for key bases and facilities, and many lack the missile launcher strength to be fully effective. This is particularly true of Iran's SA-5 sites, which provide long-range, medium-to-high altitude coverage of key coastal installations. Too few launchers are scattered over too wide an area to prevent relatively rapid suppression. Iran also lacks the low-altitude radar coverage, overall radar net, command-and-control assets, sensors, resistance to sophisticated jamming and electronic countermeasures, and systems integration capability necessary to create an effective air-defense net.

Iran has, however, bought the advanced TOR-M short-range missile from Russia and can use this for point defense of key facilities—although Israel and the United States have standoff weapons that can launch from outside its range. Iran also claimed on December 22, 2008, that it had bought the far more advanced long-range Russian S-300 surface-to-air missile system from Russia.<sup>xxxviii</sup>

Statements and reporting by Iranian and Israeli officials suggest that such a sale has taken place and that Iran has received the S-300 system from Russia. Deputy Head of the National Security and Foreign Policy Commission in Iran's parliament, Esma'il Kowsari, on December 21, 2008, announced that Tehran had reached an agreement with Moscow on the delivery of the advanced S-300 surface-to-air missile system after years of negotiations. RIA (Russian Information Agency) Novosti quoted an unnamed Russian source as saying, "Moscow has earlier met its obligations on supplying Tor-M1 systems to Iran and is currently implementing a contract to deliver S-300 systems."<sup>xxxix</sup>

Russia has repeatedly denied such a sale, but if Russia did sell the S-300—which some reporting indicates is likely—it would offer a fully modern surface-to-air missile, limited ballistic and cruise missile defense capability, much better electronic warfare capability, and a much better sensor and battle management (BM) system. Much would depend on delivery numbers and schedules, the exact variant of the S-300, and whether Russia also sold a modern command, control, communications, computers, and intelligence (C4I)/BM radar system to go with it. It would also take some time for proper training of personnel to operate these systems, as well as to fully integrate them into the overall Iranian defense network. At a minimum, however, the S-300 would make a major difference. Long-time Pentagon advisor Dan Gouré stated, "If Tehran obtained the S-300, it would be a game-changer in military thinking for tackling Iran."<sup>xl</sup>

Most Iranian squadrons can perform both air-defense and attack missions, regardless of their principal mission—although this does not apply to Iran's F-14 (air defense) and Su-24 (strike/attack) units. Iran's F-14s were, however, designed as dual-capable aircraft,

and the Iranian Air Force has not been able to use its Phoenix air-to-air missiles since the early 1980s. Iran has claimed that it is modernizing its F-14s by equipping them with Improved Hawk missiles adapted to the air-to-air role, but it is far from clear that this is the case or that such adaptations can have more than limited effectiveness. In practice, this means that Iran might well use the F-14s in nuclear strike missions. They are capable of long-range, high-payload missions and would require minimal adaptation to carry and release a nuclear weapon.<sup>xli</sup>

Iran's air forces are only marginally better able to survive in air-to-air combat than Iraq's were before 2003. Its land-based air defenses must operate largely in the point defense mode, and Iran lacks the battle management systems, and data links are not fast and effective enough to allow it to take maximum advantage of the overlapping coverage of some of its missile systems—a problem further complicated by the problems in trying to net different systems supplied by Britain, China, Russia, and the United States. Iran's missiles and sensors are most effective at high-to-medium altitudes against aircraft with limited penetrating and jamming capability.

### **Iranian Retaliation against Israel**

For all the reasons outlined earlier, however, Iran has other capabilities to strike back against Israel. In fact, it has threatened retaliation if attacked by Israel. Iranian Foreign Minister Manouchehr Mottaki was quoted as saying that an attack by Israel or the United States would have “severe consequence,” and threatened that Iran would retaliate “by all means” at its disposal. Mottaki added, “Iran does not think that the Zionist regime is in a condition to engage in such a dangerous venture and they know how severe the possible Iranian response will be to its possible audacity [...] Suffice to say that the Zionist regime, if they attack, will regret it.”<sup>xlii</sup>

On May 17, 2009, the head of the UN's nuclear watchdog, Mohamed ElBaradei, called any possible Israeli strike on Iran's nuclear facilities an “insane” move. “Attacking Iran would be insane,” ElBaradei, the director general of the International Atomic Energy Agency, told Der Spiegel, and added that “this would trigger an explosion across the whole region and the Iranians would immediately start to construct a (nuclear) bomb and would be assured the support of the entire Muslim world.”<sup>xliii</sup>

Iran has several options in responding to an Israeli attack:

- Multiple launches of Shahab-3 including the possibility of CBR warheads against Tel Aviv, Israeli military and civilian centers, and Israeli suspected nuclear weapons sites.
- Using proxy groups such Hezbollah or Hamas to attack Israel proper with suicide bombings, covert CBR attacks, and missile attacks from southern Lebanon and Syria.
- Covert attacks against Israeli interests by its intelligence and IRGC assets. This could include low-level bombings against Israeli embassies, Jewish centers, and other Israeli assets outside and inside Israel.
- Use of “suicide drone” UAVs possibly armed with CBR munitions against Israel overtly or through proxy groups such as Hezbollah.

In addition, most Israeli military options would have to include an air strike that involved overflights of Arab territory that might seriously complicate Israel's fragile relations with Jordan and may provoke Saudi Arabia to respond. An Israeli strike against Iranian

nuclear facilities may also strengthen the Iranian regime's stance to move toward nuclear capabilities and drive many neighboring states to support Iran's bid for nuclear weapons. In addition, it could lead to further escalation of the Iraqi insurgency and increase the threat of asymmetric attacks against American interests and allies in the region.

On the other hand, Israeli officials have expressed the concern that if Iran acquires nuclear weapons and the means to deliver them, this could spark further proliferation in the region. This would spread WMD capabilities around the Middle East and greatly increase the threat of CBRN attacks against Israel and the entire region. Waiting also has its penalties.

### **Iranian Retaliation against U.S. Strikes**

The United States would have political problems in exercising its military options, particularly if they require extended restrikes and coverage of Iran over time. Turkey and the southern Gulf States would be reluctant to provide bases and facilities. The United Kingdom, France, Germany, Russia, and China are not prepared to support such strikes at this point, although they might if Iran tests or provides more evidence that it is moving forward. The UN would probably oppose such actions, as would most U.S. allies.

U.S. military options also are not risk-free. As is the case with Israeli attacks on Iran, Tehran has several retaliatory options:

- Retaliate against U.S. forces in Iraq and Afghanistan overtly using Shahab-3 missiles armed with CBR warheads.
- Use of suicide drone UAVs possibly armed with CBR munitions against U.S. military installations or naval units, diplomatic missions, or countries of interest in the Middle East.
- Use proxy groups including Abu Musab al-Zarqawi and Muqtada al-Sadr in Iraq to intensify the insurgency and escalate the attacks against U.S. forces and Iraqi Security Forces.
- Turn the Shi'ite majority in Iraq against the U.S. presence.
- Attack the U.S. homeland with suicide bombs by proxy groups or deliver CBR weapons to Al Qaeda to use against the United States.
- Use its asymmetric capabilities to attack U.S. interests in the region, including soft targets, e.g., embassies, commercial centers, and American citizens.
- Use of suicide drone UAVs possibly armed with CBR munitions against Israel overtly or through proxy groups such as Hezbollah.
- Attack U.S. naval forces stationed in the Gulf with antiship missiles, asymmetric warfare, and mines.
- Attack Israel with missile attacks possibly with CBR warheads.
- Retaliate against energy targets in the Gulf and temporarily shut off the flow of oil from the Strait of Hormuz.
- Stop all of its oil and gas shipments to increase the price of oil and inflict damage on the global and U.S. economies.

Iran has close relations with many Iraqi Shi'ites, particularly Shi'ite political parties and militias. While the consequences of U.S. military attacks against Iran remain unclear, the Shi'ite majority in Iraq can (1) ask the United States forces to leave Iraq, (2) instigate

Shi'ite militia groups to directly attack U.S. forces, and/or (3) turn the new Iraqi security and military forces against U.S. forces in Iraq.

Iran has extensive forces suited to asymmetric warfare. It could not close the Strait of Hormuz, or halt tanker traffic, but it could threaten and disrupt it and create a high-risk premium and potential panic in oil markets. Iran could potentially destabilize part of Afghanistan and use Hezbollah and Syria to threaten Israel.

Iran can also use its IRGC asymmetric warfare assets to attack U.S. interests in the region. Iranian officials do not hide the fact that they would use asymmetric attacks against U.S. interests. For example, a Brigadier General in the IRGC and the commander of the "Lovers of Martyrdom Garrison," Mohammad-Reza Jaafari, threatened U.S. interests with suicide operations if the United States were to attack Iran.<sup>xliv</sup>

Now that America is after gaining allies against the righteous Islamic Republic and wants to attack our sanctities, members of the martyrdom-seeking garrisons across the world have been put on alert so that if the Islamic Republic of Iran receives the smallest threat, the American and Israeli strategic interests will be burnt down everywhere.

The only tool against the enemy that we have with which we can become victorious are martyrdom-seeking operations and, God willing, our possession of faithful, brave, trained and zealous persons will give us the upper hand in the battlefield...

Upon receiving their orders, our martyrdom-seeking forces will be uncontrollable and a guerrilla war may go on in various places for years to come...

America and any other power cannot win in the unbalanced war against us.

Iran could seek to create an alliance with extremist movements such as Al Qa'ida in spite of their hostility to Shi'ites. It can seek to exploit Arab and Muslim anger against U.S. ties to Israel and the invasion of Iraq on a global level, and European and other concerns that the United States might be repeating its miscalculation of the threat posed by Iraq and striking without adequate cause. Unless Iran is far more egregious in its noncompliance, or the United States can find a definitive smoking gun to prove Iran is proliferating, Iran would be certain to have some success in such efforts.

Iran's energy resources are another potential weapon. Shutting off exports would deeply hurt Iran but would also have an impact on global markets.<sup>xlv</sup> As Iraq found, energy deals can also sharply weaken support for even diplomatic options, and Russia and China might well oppose any kind of U.S. military strike, regardless of the level of justification the United States could advance at the time.

## **Containment: Reacting to the Fact Iran Becomes a Serious Nuclear Power**

Iran already faces a kind of containment. The United States and Israel have a nuclear monopoly. A combination of U.S., British, French, and Gulf forces can decisively defeat Iran's forces in either conventional or asymmetric warfare, although scarcely without cost. The Gulf States, Israel, and the United States have limited missile defenses, and Iran does not even have effective fighter and surface-to-air missile capability. War with Iran is scarcely desirable, but Iran cannot escalate to the point where it wins any conflict unless its opponents fail to organize and fail to fight back. It also would lose any attempt to outescalate its opponents decisively and at vastly greater cost.

The situation will change strikingly if Iran goes from developing nuclear weapons and long-range missiles to deploying an effective nuclear strike capability. At this point in time, there is no way to be certain what such a force would look like or how capable it would be, but certainly the political-psychological impact would be enormous.

As has been discussed earlier, there are many different ways in which Iran can proliferate, deploy nuclear-armed or other CBRN weapons, and use them to deter, intimidate, and strike against other nations. All have only one thing in common: they are all provocative and dangerous to any nation Iran may choose to try to intimidate and target.

At the same time, Iranian nuclear weapons and missiles are provocative and will almost certainly be dangerous to Iran. Iran has no monopoly on escalation. It almost certainly will provoke nuclear deterrence in kind, and this means creating a nuclear warfighting capability to strike at Iran at least as devastating as the damage Iran could do to any neighboring state, including Israel. Deterrence will be accompanied by defense, and this means a broader arms race in the region.

Iran's actions already are leading Iran's southern Gulf neighbors to consider buying missile defenses and modern combat aircraft and pushing them into closer relations with the United States. They are probably leading Israel to develop nuclear forces that can ride out any Iranian attack and destroy Iran's cities and population. They may lead other neighboring states to seek their own nuclear missile forces, and they may well lead the United States to deploy nuclear-armed submarines or other nuclear forces targeted on Iran.

## **Deterrence and Nuclear Warfighting**

Deterrence almost certainly means nuclear targeting of Iran by Israel, the United States, and possibly neighboring countries. Even Iranian ambiguity will probably lead Israel and the United States—and possibly India, Pakistan, and Russia—to develop nuclear options to deter or retaliate against Iran. Israeli and/or U.S. restraint in striking Iran does not have to stop at the first convincing Iranian threat to use nuclear or highly lethal biological weapons, but it could do so.

Such targeting is almost certain to begin with countervalue options directed at Iran's cities and population, rather than countervalue targets directed against Iran's military forces. Iran already has mobile missile forces, and these will become steadily easier to disperse once their numbers and range increase, Iran acquires quick reaction liquid fuel or solid fuel missiles, Iran acquires more nuclear warheads, and/or Iran's warning and command-and-control systems improve. Iran also has the options of launch on warning, launch under attack, and covert sea basing on surface ships. Some form of counterforce strike may still be possible, but it seems likely that Iran will face retaliatory threats and deterrents that are largely "city busting" in character.

### **Israeli Deterrence**

There already are reports that Israel is developing a sea-based launch capability and that its submarines will be able to launch nuclear-armed cruise missiles. It already has intelligence satellites with the capability to support nuclear targeting of Iran, and it may have much longer-range missiles than much of the literature indicates. Israel seems to

have developed large boosters in the late 1980s, it has experience with satellite launches, and it may have developed or deployed missiles that can reach any target in Iran.<sup>xlvi</sup>

If Israel has not already done so, it certainly has the capability to develop and deploy such weapons in a few years, and the nuclear stockpile to target every major city in Iran with multiple ground bursts. Iran faces a future where any existential attack on Israel would almost certainly lead to an existential attack on Iran, and Israel might well have the advantage, at least for the first decade of any nuclear-armed missile arms race. Israel probably has thermonuclear weapons while Iran may be limited to much lower-yield fission or early boosted weapons.

Ground bursts on Israeli cities would almost certainly affect the Palestinians and Jerusalem. Ground bursts on Iranian cities would have fallout that would be largely dissipated in Iran or affect weak border states such as Afghanistan. In practice, Israel will virtually have to find some way to demonstrate to Iran that it can target Iran's cities. It will not have to demonstrate intent. An Iranian nuclear strike on Israel might not destroy Israel, but Israel could not ride out such attacks and would have every reason to launch a pattern of retaliation that would destroy most of Iran's population and its ability to recover within any foreseeable amount of time.

### **U.S. Deterrence**

The United States cannot leave a power vacuum in the Gulf. It is easy to talk about "withdrawing," but the Gulf is not Vietnam. Its location and the global dependence on Gulf energy exports will make it a critical U.S. strategic interest indefinitely into the future. This means the United States cannot ignore the unique security role that only it can perform in the region. Russia can still influence some of Iran's neighbors, but the United States still can play a unique role in working with Turkey, Afghanistan, Pakistan, and Iraq. Seeking regional action to both give Iran incentives for good behavior and clear collective deterrents to opportunism is going to be just as critical as broader international action.

The United States is also the only power other than Israel that can deter and defend against a serious Iranian military threat in the near to midterm. This deterrence can take a largely conventional form until Iran requires significant nuclear forces. The United States can maintain a high degree of deterrence-related warfighting capability by keeping its preventive and preemptive military options to strike at Iran's nuclear and missile facilities constantly up-to-date, work with its allies to prepare, and maintain the necessary capabilities and strength to secure the Gulf.

Turkey and Pakistan are strong enough to deter Iranian conventional and asymmetric attacks, but Iraq, Afghanistan, and the southern Gulf States are not. The United States needs to maintain the kind of military presence in the Gulf that makes it clear to Iran that it cannot take military action without the fear or reality of an American response. The United States must play a critical role in deterrence and containment.

The United States needs to work with the southern Gulf States to maintain the conventional military options that can ensure that Iran cannot block the flow of Gulf oil for more than a few days or weeks, be ready for limited action against any low-level Iranian adventures, be able to act quickly enough to prevent clashes from becoming war,

and build up its regional allies. In the right political and strategic context, military containment and deterrence are both carrots *and* sticks. They deter without threatening, and they make diplomatic and economic incentives more attractive.

Once Iran has significant nuclear capabilities, however, the United States may have to deploy nuclear armed forces targeted on Iran. The United States should not leave the southern Gulf States, Turkey, and Israel vulnerable to Iranian attack without Iran's knowledge that any actual Iranian strike would be suicidal.

In fact, the United States should strongly consider making extended deterrence an option that covers the entire Middle East, including Israel, and do so in ways that leave Iran in no doubt as to the prospect of U.S. retaliation. Hopefully, Iran will never choose to really play the nuclear card. If it does, it must be certain that if it does play the game, the consequences will be suicidal. It must know long in advance that it will lose in ways from which it can never recover.

### **Regional Deterrence**

As for regional options, Pakistan and India already have nuclear weapons. Other powers may follow. Even Iranian nuclear ambiguity may prove to be enough to trigger Saudi, Egyptian, and Turkish efforts to become nuclear powers, and actual deployment of nuclear-armed Iranian forces would provide a much stronger incentive for such action. Saudi Arabia has already said that it has examined nuclear options and rejected them, but this is no certainty and much depends on Iranian action.

Regional powers might show restraint if the United States provides the same form of extended deterrence it once provided to Germany during the Cold War. But, any form of broad regional nuclear arms race would be a nightmare for all concerned. The end result would be a far more threatening mix of CBRN capabilities in the Gulf region and region. It would extend the near certainty of an Israeli-Iranian nuclear arms race to one where Israel and its Arab neighbors would consider targeting and deterring each other and raise the potential threat of nuclear alliances and polarization between Sunni and Shi'ite states.

### **Missile Defense and Other Defensive Options**

Iran's neighbors, Europe, the United States, and Israel have important options for defense. Israel has already developed and deployed missile defenses and has long possessed advanced air defense capabilities. Most southern Gulf States have or are acquiring advanced surface-to-air missile systems such as the Patriot, and many seem likely to buy the U.S.-made Patriot PAC-3 or Theatre High-Altitude Area Defense (THAAD) missile defense systems over time. The United States is acquiring the ability to project naval forces with Standard SM-2 or SM-3 missile defense, and the PAC-3 and THAAD. Russia already offers the S-300 surface-to-air missile system in configurations with significant missile defense capabilities and is developing the S-400 with substantially more advanced air and ballistic missile defense capabilities.

This would allow any power in the region to create a significant mix of anti-air, antiballistic missile, and anticruise missile capabilities over the next decade. These capabilities could be reinforced by U.S. power projection capabilities and by the provision of U.S. intelligence and warning data. The United States can detect Iranian

ballistic missile launches and has already agreed to provide real-time warning to some regional powers.

It should be stressed, however, that defenses are always relative and are as subject to arms races as offensive systems. Iran will probably be able to deploy decoys and warheads with limited maneuver or “spiral” capabilities by the time it can deploy a nuclear-armed missile force. Iran could launch saturation attacks using both short- and longer-range missiles against Gulf and other neighboring states. Larger and more powerful missiles can be used to launch mixes of multiple warheads and decoys and to increase closing velocities in ways that reduce the area coverage and probability of intercept of missile defenses. Iran can develop mixes of ballistic and cruise missiles to create more complicated patterns of attack.

Iran will have enough aircraft, UAVs, unmanned combat air vehicles, drones, and decoys to potentially saturate local air defenses—particularly if the southern Gulf States and Iraq do not develop truly integrated air defense systems. It can attack coastal targets by having a ship or even small vessel move into the area or a port. This is a critical potential threat and deterrent if it involves a critical oil loading facility, water desalination plant, or port city. There are also reports that Iran has already experimented with SCUD launchers from commercial ships. Effective air and missile defenses could also increase Iran’s willingness to conduct covert or proxy nuclear and biological attacks.

It should be stressed that whatever defenses are deployed, much will depend on the overall architecture of the entire air-missile-naval-counter-infiltration systems that defending nations deploy, and the level of integration or interoperability involved. Simply buying ballistic missile defense fire units, for example, will at best involve uncertain point defense capabilities and might well simply mean acquiring expensive and ineffective “toys.”

Creating wide area air and missile defenses that include the right mix of overall fire unit deployment and locations, wide area interceptors, warning, and battle management systems is a very different story. This will be particularly true if missile defenses are integrated with air defense systems and are integrated or truly interoperable with neighboring and U.S. missile and air defense systems. Iran’s options for saturation, bypass, and “end runs” will be much more limited.

It is also important to note that civil and passive defenses and a mix of sensors and reporting systems that can quickly detect and characterize the nature of a nuclear and biological attack also offer important defensive options. Even a limited fallout shelter program could sharply reduce the casualties from an Iranian attack on most of the regions large, spread out, cities. Redundant and/or netted water facilities, energy export facilities, port facilities, and power grids could also reduce the impact of an Iranian attack—as could stockpiling components to replace or partially substitute for critical infrastructure nodes and facilities.

The problem with all of these options, however, is that they are likely to reduce—not eliminate—the horrifying consequences of any nuclear or biological attack or exchange. They also can provoke a dual in which Iran seeks to increase its attack options in size and capability to match each increase in defense capability.

## The Only Way to Win Is Not Play

The danger in any analysis of this kind is that it may be viewed as alarmist or as crying wolf at a time when Iran's actions are uncertain, and many of the risks described are years in the future—if they materialize at all. *Once again, it must be stressed that this analysis deals with possibilities—not probabilities—and is not a prediction.* The paths described here, however, are ones that other nations have already taken. Their logic is scarcely inevitable, but it is a historical reality.

These paths also are easiest to avoid when they have not yet been taken, or when the risk they pose can be avoided or mitigated by dialog, diplomacy, and even limited forms of arms control such as transparency, inspection, and confidence-building measures. It is also important to look beyond the next stage in proliferation and consider the mid- and long-term course it may take. The wolf may not be at the door or near the flock, but wolves do exist.

It is also important for Iran, Israel, and any other nuclear power to fully understand that actions produce reactions. Nuclear and biological weapons virtually force some form of response in kind. They also are not status symbols or tools that somehow guarantee security simply because their use can be so devastating. History does have long periods of peace and mutual deterrence; it also has periods of sudden and untended escalation to nearly total war.

Iranian officials need to seriously consider where their actions will take Iran if it does succeed in proliferating. It acquires only significant leverage over its neighbors or the United States if they do not respond. If they do respond, they can outspend, outdeploy, and outkill any capabilities Iran can create. They also can respond in kind to Iran's build of asymmetric warfare capabilities, and Iran gains only a tenuous advantage—if any—in using asymmetric attacks in conjunction with nuclear capabilities if it does not face a nuclear threat in response. Proliferation may offer Iran a more convincing deterrent to outright invasion, but this risk has always been more a matter of war scares and rhetoric than a reality, and it also involves a nuclear threat that is so risky that it may be seen as a bluff that can be called.

During the Cold War, a U.S. movie called *War Games* (1983) raised a point that Iran and other potential proliferators need to carefully consider, as do all who consider military options centered around such risks.<sup>xlvii</sup> The movie highlighted the fact that any U.S.-Soviet nuclear exchange had to be so costly to both sides that there was no way either side could gain an advantage. Iran might well wish to consider a line of dialog from the movie: “strange games...the only way to win is not to play.”

---

<sup>i</sup> This explanation is adapted from “Nuclear Weapons Design,” Wikipedia, [http://en.wikipedia.org/wiki/Nuclear\\_weapon\\_design](http://en.wikipedia.org/wiki/Nuclear_weapon_design). All nuclear weapons design data are deliberately chosen to be nominal and available in open source material. The concepts presented a broadly correct, but a deliberate effort has been made to avoid any “how to” level of accuracy.

<sup>ii</sup> This explanation is adapted from “Nuclear Weapons Design,” Wikipedia, [http://en.wikipedia.org/wiki/Nuclear\\_weapon\\_design](http://en.wikipedia.org/wiki/Nuclear_weapon_design). All nuclear weapons design data are deliberately chosen to be

---

nominal and available in open source material. The concepts presented a broadly correct, but a deliberate effort has been made to avoid any “how to” level of accuracy.

<sup>iii</sup> Energy Information Agency (EIA), *International Energy Outlook, 2008*, Washington, Department of Energy, June 2008, p. 207.

<sup>iv</sup> The key problems are dispersion and the lethality of the dispersed material. For further details, see Anthony H. Cordesman, “Radiological Weapons as a Means of Attack,” CSIS Burke Chair, November 8, 2001, [http://www.csis.org/index.php?option=com\\_csis\\_pubs&task=view&id=1288](http://www.csis.org/index.php?option=com_csis_pubs&task=view&id=1288); Centers for Disease Control and Prevention, “Frequently Asked Questions About Dirty Bombs,” <http://www.bt.cdc.gov/radiation/dirtybombs.asp>. Nuclear Regulatory Commission, “Fact Sheet on Dirty Bombs,” <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/dirty-bombs.html>. A model of potential “worst case” attacks is summarized in Testimony of Dr. Henry Kelly, President Federation of American Scientists, before the Senate Committee on Foreign Relations, March 6, 2002, FAS, <http://www.fas.org/ssp/docs/030602-kellytestimony.htm>.

<sup>v</sup> The Report of the Commission on the Prevention of WMD Proliferation and Terrorism, *World at Risk*, New York, Vintage Books, December, 2008, [documents.scribd.com/docs/2avb51ejt0uadzxm2wpt.pdf](http://documents.scribd.com/docs/2avb51ejt0uadzxm2wpt.pdf) or [www.globalsecurity.org/wmd/library/report/2008/wmd-prolif-terror-commission.htm](http://www.globalsecurity.org/wmd/library/report/2008/wmd-prolif-terror-commission.htm), pp. xvi, xvii, 11-13.

<sup>vi</sup> David E Sanger, “U.S. Rejected Aid for Israeli Raid on Iranian Nuclear Site,” *The New York Times*, 11 January 2009.

<sup>vii</sup> For a sample of unclassified satellite imagery, see David Albright, Paul Brannan, and Jacqueline Shire, “Can military strikes destroy Iran’s gas centrifuge program? Probably not,” Institute for Science and International Security (ISIS), August 7, 2008, <http://www.isis-online.org/>. ISIS has other publications at the same location showing a wider range of satellite pictures.

<sup>viii</sup> Information for Iran’s key nuclear facilities drawn from numerous open sources including (but not limited to): multiple media outlets; [www.fas.org](http://www.fas.org); [www.nti.org](http://www.nti.org); <http://www.globalsecuritynewswire.org/gsn/>; [www.globalsecurity.org/](http://www.globalsecurity.org/) GlobalSecurity.org; <http://www.globalsecurity.org/wmd/world/iran/nuke-fac.htm>; [www.iranwatch.org](http://www.iranwatch.org); IAEA reporting; <http://www.wisconsinproject.org/countries/iran/nuke-miles.htm>, <http://www.isis-online.org/>; Frank Barnaby, “World Air Strikes Work?,” Oxford Research Group, March 2007, pp. 9 and 12..

<sup>ix</sup> ROBIN HUGHES, “Iranian Nuclear Facilities Digging in with 10,000 m2 of Reinforced Concrete Tunnels: Tehran Takes Steps to Protect Nuclear Facilities,” *Jane’s Defence Weekly*, January 25, 2006.

<sup>x</sup> ROBIN HUGHES, “Iranian Nuclear Facilities Digging in with 10,000 m2 of Reinforced Concrete Tunnels: Tehran Takes Steps to Protect Nuclear Facilities,” *Jane’s Defence Weekly*, January 25, 2006.

<sup>xi</sup> ROBIN HUGHES, “Iranian Nuclear Facilities Digging in with 10,000 m2 of Reinforced Concrete Tunnels: Tehran Takes Steps to Protect Nuclear Facilities,” *Jane’s Defence Weekly*, January 25, 2006.

<sup>xii</sup> “Iran Will Destroy Israeli Nuke Facilities If Attacked,” *Agence France Press*, 18 August 2004, available at: <http://www.rense.com/general56/kjune.htm>; T. Orszaak-Land, “Iran Threatens to Abandon the NPT,” *Jane’s Islamic Affairs Analyst*, October 1, 2004.

<sup>xiii</sup> DAVID E. SANGER, “Cheney Says Israel Might ‘Act First’ on Iran,” *The New York Times*, 21 January 2005, available at: <http://www.nytimes.com/2005/01/21/politics/21cheney.html>.

<sup>xiv</sup> Target Iran - Air Strikes - 2004 Developments, [GlobalSecurity.org](http://www.globalsecurity.org/military/ops/iran-strikes-2004.htm), available at: <http://www.globalsecurity.org/military/ops/iran-strikes-2004.htm>.

<sup>xv</sup> “Iran Report,” RFE/RL, Vol. 9, No. 2, January 23, 2006.

<sup>xvi</sup> “Israel said to be studying Iran attack,” *UPI*, 4 December 2008; “Israel ‘prepared to attack’ Iran nuclear plants,” *Times online* 4 December 2008; Tim Butcher, “Israel willing to go it alone on Iran attack,” *The Telegraph*, 4 December 2008; Yaakov Katz, “IDF preparing options for Iran strike,” *The Jerusalem Post*, 4 December 2008;

<sup>xvii</sup> David E Sanger, “U.S. Rejected Aid for Israeli Raid on Iranian Nuclear Site,” *The New York Times*, 11 January 2009.

<sup>xviii</sup> Barbara Opall-Rome, “Why Israel won’t strike Iran’s nuclear facilities alone,” *Defense News*, May 2, 2005.

<sup>xix</sup> Con Coughlin, “Israel seeks all clear for Iran strike,” *Daily Telegraph*, February 24, 2007.

<sup>xx</sup> Shlomo Brom, “Is the Begin Doctrine Still a Viable Option for Israel?” in Henry Sokolski and Patrick Clawson, ed, *Getting Ready for A Nuclear Iran*, Strategic Studies Institute, October 2005.

<sup>xxi</sup> <http://www.globalsecurity.org/military/world/israel/f-15i-specs.htm>.

---

<sup>xxii</sup> <http://www.globalsecurity.org/military/world/israel/f-15i-specs.htm>.

<sup>xxiii</sup> Photos at <http://www.fas.org/man/dod-101/sys/smart/gbu-28.htm>.

<sup>xxiv</sup> Federation of American Scientists, "Guided Bomb Unit-28 (GBU-28) BLU-113 Penetrator," <http://www.fas.org/man/dod-101/sys/smart/gbu-28.htm>

<sup>xxv</sup> Kenneth R. Timmerman, "War Within Range," *FrontPageMagazine.com*, 5 January 2006, available at: <http://www.frontpagemag.com/Articles/Read.aspx?GUID=920D7D04-E360-48BB-AEDC-004767D4600D>; and "Timmerman on Iran," *MissileThreat.com*, 9 January 2006, available at: <http://www.missilethreat.com/archives/id.577/detail.asp>.

<sup>xxvi</sup> World Tribune, "U.S. rushing bunker-busters to Israel," July 24, 2006, <http://www.worldtribune.com/worldtribune/06/front2453941.0722222222.html>., The Hashmonean, "Special delivery please: Israel requests 'Iran Busters,'" July 22, 2006, <http://hashmonean.com/2006/07/22/special-delivery-please-israel-requests-iran-busters/>. Other reports indicate that the weapon has a casing made out of an approximately 16-foot (5-meter) section of artillery barrel that is 14.5 inches (37 cm) in diameter. These barrels are made of extremely strong hardened steel to withstand the repeated blasts of artillery shells. There are nearly 650 pounds (295 kg) of tritonal explosive inside this casing. Tritonal is a mix of TNT (80 percent) and aluminum powder (20 percent). The aluminum improves the brisance of the TNT — the speed at which the explosive develops its maximum pressure. The addition of aluminum makes tritonal about 18 percent more powerful than TNT alone. A laser-guidance assembly is attached to the front of the barrel the bomb homes in on the illuminated spot. The guidance assembly steers the bomb with fins that are part of the assembly. (See GBU-28 at [howstuffworks.com](http://howstuffworks.com).)

<sup>xxvii</sup> Associated Press, "US agrees to sell Israel bunker-busters," *International Herald Tribune*, September 15, 2008,

<sup>xxviii</sup> The 113 kg. bomb is reported to have the same penetration capabilities as a normal 900 kg. bomb, but only has 22.7 kg. of explosives. It is 1.75 meters long. According to the *Jerusalem Post*, US tests showed the bomb was capable of penetrating at least 90 cm. of steel-reinforced concrete. The GBU-39 can be used in adverse weather conditions and has a standoff range of more than 110 km. due to pop-out wings.

<sup>xxix</sup> Peter Brookes, "Iran-Israel Confrontation Brewing?" *Heritage Foundation*, *Military.com*, 29 September 2004, available at: [http://www.military.com/Opinions/0,,Brookes\\_092904,00.html](http://www.military.com/Opinions/0,,Brookes_092904,00.html).

<sup>xxx</sup> Uzi Mahnami and Sarah Baxter, "Revealed: Israel plans nuclear strike on Iran", *The Sunday Times*, January 7, 2007.

<sup>xxxi</sup> <http://www.globalsecurity.org/military/systems/munitions/blu-109-specs.htm>.

<sup>xxxii</sup> <http://www.globalsecurity.org/military/systems/munitions/jdam.htm>.

<sup>xxxiii</sup> <http://www.globalsecurity.org/military/systems/munitions/blu-116.htm>.

<sup>xxxiv</sup> <http://www.globalsecurity.org/military/systems/munitions/agm-130.htm>.

<sup>xxxv</sup> NewsMax.com Wires, "U.S. Outfitting B-2's with Monster Bunker Buster Bombs - Iran May Be Target," July 27, 2007; Lisa Burgess, "New Bunker-Buster Fitted Aboard Stealth B-2 Bomber," *Mideast Stars and Stripes*, January 5, 2008, <http://www.military-quotes.com/forum/new-bunker-buster-fitted-aboard-t51220.html>. The US experimented with the use of nuclear weapons to penetrate buried targets as early as 1998, and dropped B61-11 bomb casings that penetrated 15-25 feet before the point it would detonate. See Senior Airman Adam Stump. "B-2 successfully drops improved bunker buster bomb," 354th Fighter Wing Public Affairs, Eielson Air Force Base, Mar 26, 1998, [http://www.fas.org/nuke/guide/usa/bomber/n19980326\\_980417.html](http://www.fas.org/nuke/guide/usa/bomber/n19980326_980417.html).

<sup>xxxvi</sup> Robin Huges, "Tehran takes steps to protect nuclear facilities," *Jane's Defense Weekly*, 25 January 2006.

<sup>xxxvii</sup> December 20, 2002, edition of Fox News' The Big Story with John Gibson; April 12 edition of Fox News' The O'Reilly Factor; <http://mediamatters.org/items/200604140006>.

<sup>xxxviii</sup> "Iran Says Russia Delivering S-300 Air Defense Systems," *Moscow Times*, December 22, 2008, <http://www.themoscowtimes.com/article/1009/42/373338.htm>; Saed Bannoura, "Russia to Sell Iran S-300 Surface-to-Air Missile System," *IMEMC & Agencies*, December 22, 2008, <http://www.imemc.org/article/58108>.

<sup>xxxix</sup> Ibid.

<sup>xl</sup> "Iran Takes Russian Air Defense System," *BBC*, 22 December 2008, available at: <http://www.military.com/news/article/iran-takes-russian-air-defense-system.html>.

<sup>xli</sup> "Iran: Air Force," *Global Security*, October 7, 2008, <http://www.globalsecurity.org/military/world/iran/airforce.htm>; "Tomcat In Service with Iran," December 28, 2007, [http://home.att.net/~jbaugher1/f14\\_6.html](http://home.att.net/~jbaugher1/f14_6.html).

---

<sup>xlii</sup> Ewen MacAskill and Simon Tisdall, "Iran's message to the west: back off or we retaliate," *The Guardian*, 2 February 2006, available at: <http://www.guardian.co.uk/world/2006/feb/02/iran.nuclear>.

<sup>xliii</sup> "IAEA chief says Israeli strike on Iran would be 'insane'," *Khaleej Times*, May 17, 2009.

<sup>xliv</sup> Jahangir Arasli, "Obsolete Weapons, Unconventional Tactics, and Martyrdom Zeal: How Iran Would Apply its Asymmetric Warfare Doctrine in a Future Conflict," George C. Marshall European Center For Security Studies, Occasional Paper Series No. 10, April 2007.

<sup>xlv</sup> Just how much over time is unclear. See Roger Stern, "The Iranian Petroleum Crisis and United States National Security," *PNAS*, *PNAS* 2007; 104,377-382, *PNAS.org*. Originally published on December 26, 2006, and updated to March 2007.

<sup>xlvi</sup> There are no reliable sources on Israeli forces. For good unclassified analysis, see the FAS, "Israel: Special Weapons Guided," <http://www.fas.org/nuke/guide/israel/index.html>; CDI, "Nuclear Weapons Database: Israeli Nuclear Delivery System," <http://www.cdi.org/issues/nukef&f/database/isnukes.html>; SPRI, "Israeli nuclear forces, 2006," [www.sipri.org/contents/expcon/Israel.pdf](http://www.sipri.org/contents/expcon/Israel.pdf), and NTI, "Country Overviews: Israel: Profile and NTI: Issue Brief: WMD in the Middle East," ([www.nti.org/e\\_research/profiles/israel/index.html](http://www.nti.org/e_research/profiles/israel/index.html)). There are also far more speculative reports like Michael Carmichael, "Israel's plans to Wage Nuclear War on Iran: History of Israel's Nuclear Arsenal, Hundreds of nuclear warheads under the control of Israel's defense establishment," *Global Research*, January 15, 2007, <http://www.globalresearch.ca/index.php?context=viewArticle&code=CAR20070115&articleId=4477>; and PMA, "Israel Has Sub-Based Atomic Arms Capability," June 15, 2002, [www.converge.org.nz/pma/cra0532.htm](http://www.converge.org.nz/pma/cra0532.htm).

<sup>xlvii</sup> "WarGames" was released in June 1983, was directed by John Badham, and starred Matthew Brodrick, Danby Coleman, John Wood, and Ally Sheedy. The plot revolves around a US decision to turn nuclear retaliation over to a computer that cannot distinguish between the exchange it can trigger and the reality of nuclear war, comparing such an exchange to a game of tic-tac-toe of which no one can win.