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The US, Israel, the Arab States and a Nuclear Iran

Part One: Iranian Nuclear Programs

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September 23, 2008

Nuclear Uncertainty

- **Must plan to deal with possible Iranian force with unknown weapons characteristics, delivery systems, basing, and timelines.**
 - **Technology base now exists, enrichment to fissile levels is only limiting factor.**
 - **No “Osirak case”: Iran no longer dependent on imports, or large central facilities.**
- **Already a key factor in Iranian capability to conduct “wars of intimidation.”**
- **Cannot predict timeframe for nuclear threat. Worst case is 2009, but could well be 2011-2015.**
- **Chemical and biological options as well.**

Technology Base

- **Declared chemical weapons state; probable biological weapons program.**
- **Centrifuge (U-235) and Plutonium (Pu-239) enrichment, reactor, and processing.**
- **Uranium machining**
- **Polonium (neutron initiator) research.**
- **Work with high explosive lenses and imports of triggering devices/technology.**
- **Possible acquisition of advanced nuclear fissile weapons design data from AQ Khan and Swiss sources.**

Confusion Over the US NIE

- **Not say Iran was not moving towards nuclear weapon.**
 - **Did say evidence that halted formal efforts at weapons development in 2003. (When US “victories” in Iraq and Afghanistan seemed most threatening to Iran,**
 - **Made it clear that Iran was pursuing enrichment technology that was the sole remaining barrier to Iran acquiring nuclear weapons.**
- **Since NIE was issued, new evidence has surfaced of weapons development efforts beyond initial “laptop” and “Green Salt” disclosures.**
- **Iran has also been discovered to have completed development of a new, far more advanced centrifuge.**
- **Iran has announced two new long-range missiles, and a “space” program that can be adapted to missile development.**

DNI's March 2008 Summary - I

Over the past year we have gained important new insights into **Tehran's** activities related to nuclear weapons and the Community recently published a National Intelligence Estimate on Iranian intent and capabilities in this area. I want to be very clear in addressing the Iranian nuclear capability. First, there are three parts to an effective nuclear weapons capability:

1. Production of fissile material
2. Effective means for weapons delivery
3. Design and weaponization of the warhead itself

We assess in our recent NIE on this subject that warhead design and weaponization were halted, along with covert military uranium conversion- and enrichment-related activities. Declared uranium enrichment efforts, which will enable the production of fissile material, continue. This is the most difficult challenge in nuclear production. Iran's efforts to perfect ballistic missiles that can reach North Africa and Europe also continue.

We remain concerned about Iran's intentions and assess with moderate-to-high confidence that Tehran at a minimum is keeping open the option to develop nuclear weapons. We have high confidence that Iranian military entities were working under government direction to develop nuclear weapons until fall 2003. Also, Iranian entities are continuing to develop a range of technical capabilities that could be applied to producing nuclear weapons. Iran continues its efforts to develop uranium enrichment technology, which can be used both for power reactor fuel and to produce nuclear weapons. And, as noted, Iran continues to deploy ballistic missiles inherently capable of delivering nuclear weapons, and to develop longer-range missiles. We also assess with high confidence that even after fall 2003 Iran has conducted research and development projects with commercial and conventional military applications—some of which would also be of limited use for nuclear weapons.

We judge with high confidence that in fall 2003, Tehran halted its nuclear weapons design and weaponization activities, as well as its covert military uranium conversion and enrichment-related activities, for at least several years. Because of intelligence gaps, DOE and the NIC assess with only moderate confidence that all such activities were halted. We assess with moderate confidence that Tehran had not restarted these activities as of mid-2007, but since they comprised an unannounced secret effort that Iran attempted to hide, we do not know if these activities have been restarted.

We judge with high confidence that the halt was directed primarily in response to increasing international scrutiny and pressure resulting from exposure of Iran's previously undeclared nuclear work. This indicates that Iran may be more susceptible to influence on the issue than we judged previously.

DNI's March 2008 Summary - II

We do not have sufficient intelligence information to judge confidently whether Tehran is willing to maintain the halt of its nuclear weapons design and weaponization activities indefinitely while it weighs its options, or whether it will or already has set specific deadlines or criteria that will prompt it to restart those activities. We assess with high confidence that Iran has the scientific, technical and industrial capacity eventually to produce nuclear weapons. In our judgment, only an Iranian political decision to abandon a nuclear weapons objective would plausibly keep Iran from eventually producing nuclear weapons—and such a decision is inherently reversible. I note again that two activities relevant to a nuclear weapons capability continue: uranium enrichment that will enable the production of fissile material and development of long-range ballistic missile systems.

We assess with moderate confidence that convincing the Iranian leadership to forgo the eventual development of nuclear weapons will be difficult given the linkage many within the leadership see between nuclear weapons development and Iran's key national security and foreign policy objectives, and given Iran's considerable effort from at least the late 1980s to 2003 to develop such weapons.

We continue to assess with moderate-to-high confidence that Iran does not currently have a nuclear weapon. We continue to assess with low confidence that Iran probably has imported at least some weapons-usable fissile material, but still judge with moderate-to-high confidence it has not obtained enough for a nuclear weapon. We cannot rule out that Iran has acquired from abroad—or will acquire in the future—a nuclear weapon or enough fissile material for a weapon. Barring such acquisitions, if Iran wants to have nuclear weapons it would need to produce sufficient amounts of fissile material indigenously—which we judge with high confidence it has not yet done.

Iran resumed its declared centrifuge enrichment activities in January 2006, despite the 2003 halt in its nuclear weapons design and weaponization activities. Iran made significant progress in 2007 installing centrifuges at Natanz, but we judge with moderate confidence it still faces significant technical problems operating them.

- **We judge with moderate confidence that the earliest possible date Iran would be technically capable of producing enough highly enriched uranium (HEU) for a weapon is late 2009, but that is very unlikely.**
- **We judge with moderate confidence Iran probably would be technically capable of producing enough HEU for a weapon sometime during the 2010-2015 time frame. INR judges Iran is unlikely to achieve this capability before 2013 because of foreseeable technical and programmatic problems. All agencies recognize the possibility that this capability may not be attained until after 2015.**

DNI's March 2008 Summary - III

We know that Tehran had a chemical warfare program prior to 1997, when it declared elements of its program. We assess that Tehran maintains dual-use facilities intended to produce CW agent in times of need and conducts research that may have offensive applications. We assess Iran maintains a capability to weaponize CW agents in a variety of delivery systems.

We assess that Iran has previously conducted offensive BW agent research and development. Iran continues to seek dual-use technologies that could be used for biological warfare.

Extract from J. Michael McConnell, Director of National Intelligence, Annual Threat Assessment of the Intelligence Community for the Senate Armed Services Committee, 27 February 2008

300 miles
500 km

TURKEY

TURKMENISTAN

CASPIAN SEA

Lashkar A'bad



Tehran

Sites circled in red
unknown pre-mid 2002

IRAQ



Arak



Isfahan



Natanz



Saghand

IRAN



Ardekan

MW Megawatts

Uranium processing facility

Uranium mines

Heavy-water facility

Research reactors / research facilities

Uranium enrichment facility

Light-water reactor (under construction)

MIDDLE EAST

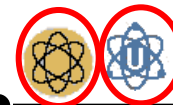
AFGHANISTAN

PAKISTAN

KUWAIT



Bushehr



Gachin

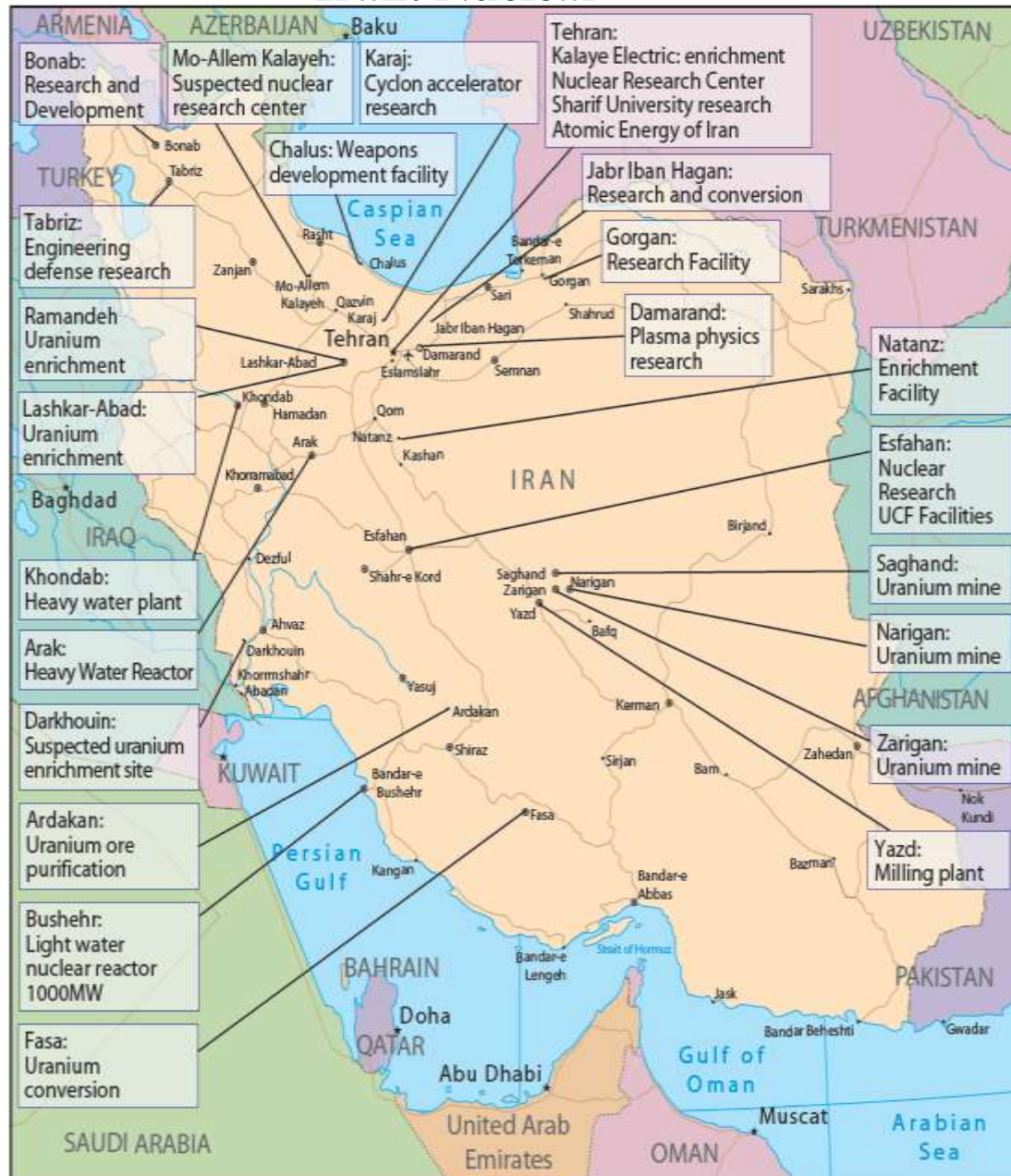
SAUDI ARABIA

BAHRAIN

QATAR

Gulf of Oman

Iran: Nuclear



Iran: Nuclear



Iran: Nuclear Enrichment



Bushehr Reactor Complex



Arak Reactor's Uncertain Purpose

- **Iran claims the heavy-water reactor under construction at Arak, is intended for the production of medical isotopes.**
- **In a May 5, 2008, presentation by Ambassador Soltanieh claimed on May 5, 2008 that it would replace an “outdated” HEU-fueled research reactor in Tehran in operation since 1967.**
- **Such a reactor, however, produces spent fuel that contains plutonium much better suited for nuclear weapons than the fuel rods that can be removed from**
- **light-water moderated reactors, such as the Bushehr reactor.**
- **Iran can also operate such a reactor with natural uranium, which means that it will not be dependent on supplies of enriched uranium.**
- **Iran has a plant for producing heavy water. According to El Baradei’s**
- **February report, “satellite imagery appears to indicate” that the plant is operating.**
- **Iran is continuing work on a fuel manufacturing plant which, when complete, will first produce fuel for the Arak reactor.**

Arak 40 MWth Heavy Water Reactor

Foundation for reactor and containment structure

Foundation for reactor ventilation stack

Auxiliary building foundation (for Laboratory/Hot cells?)

Arak 40 MWth Heavy Water Reactor

Foundation for reactor and containment structure

New excavation

Foundation for reactor ventilation stack

Auxiliary building foundation (for Laboratory/Hot cells?)

4,000 Centrifuges and Counting

- **July:** Ahmadinejad states Iran has more than 5,000 centrifuges running but IAEA, which visits Iranian nuclear sites, later says he may have overstated the number by at least 1,000.
- **August 29, 2008:** Iran's official IRNA news agency says the government now has nearly 4,000 centrifuges operating in its uranium enrichment plant. IRNA also quotes Deputy Foreign Minister Ali Reza Sheikh Attar as saying Iran is installing 3,000 more centrifuges at the plant in Natanz.
- Iran says it plans to move toward large-scale uranium enrichment that will ultimately involve 54,000 centrifuges.
- No hard data exist on actual number of centrifuges running, reliability, output, or ability to run to produce high levels of enriched material over time.
- Mix of IR-1 and small tests of higher capacity of IR-2 and IR-3 models.
- Two other types seem to be in development, including a much larger variant.

Vehicle Entrance Ramp
(before burial)

Bunkered underground
production halls

Admin/engineering
office area

DigitalGlobe Quickbird commercial satellite image

20 SEP 02

Vehicle Entrance Ramp
(after burial)

Bunkered underground
Centrifuge cascade halls

Helicopter
pads

New security
wall

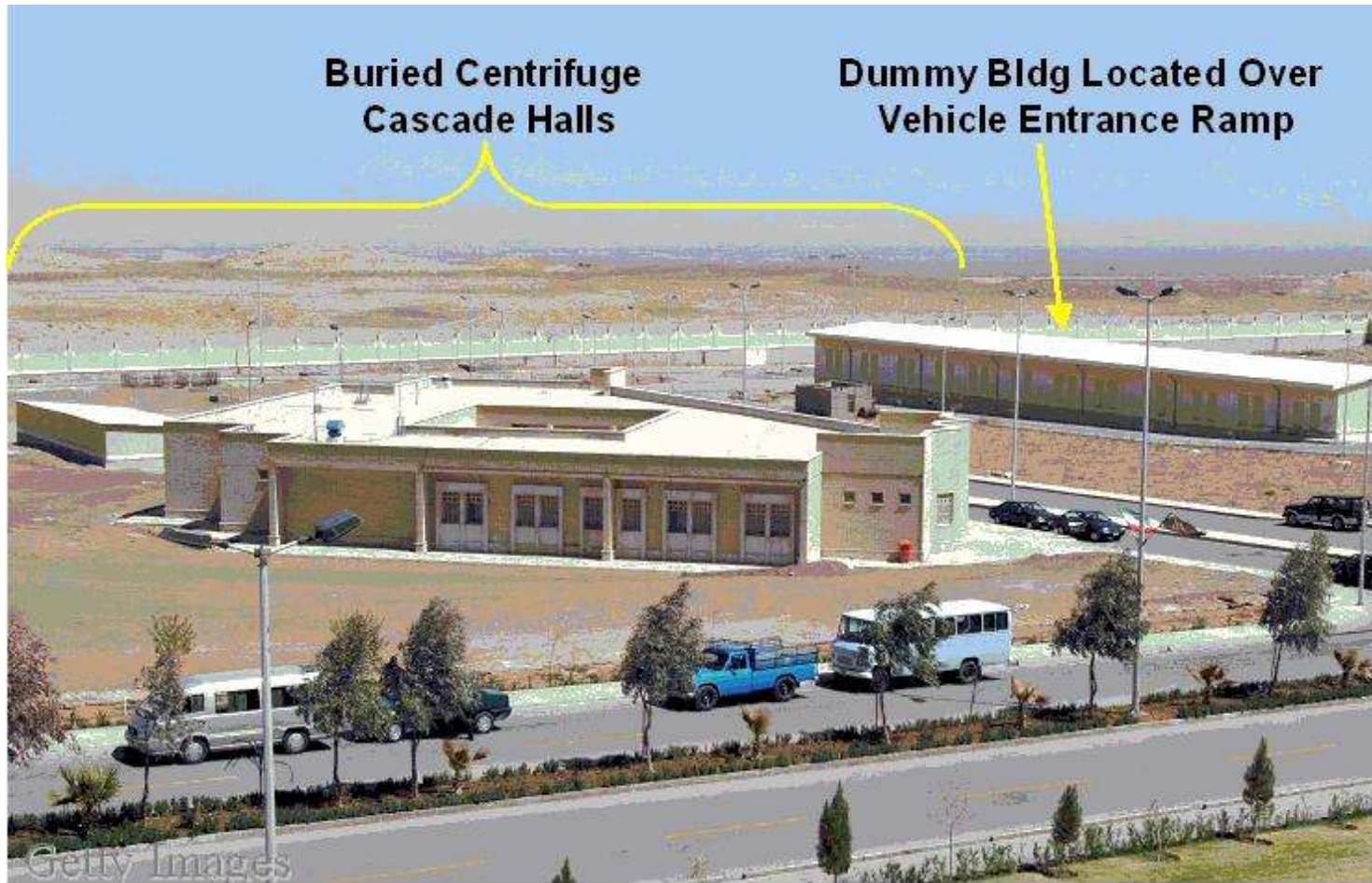
Dummy building
concealing tunnel
entrance ramp

Admin/engineering
office area

DigitalGlobe Quickbird commercial satellite image

21 JUL 04

Effective Concealment



Dispersed Target Base - Centrifuges: Carbon Rotors - NE Tehran



Source: David Albright, Paul Brannan, and Jacqueline Shire, Can military strikes destroy Iran's gas centrifuge program? Probably not, Institute for Science and International Security,

Dispersed Target Base - Centrifuge Assembly - Kalaye, Tehran



Source: David Albright, Paul Brannan, and Jacqueline Shire, Can military strikes destroy Iran's gas centrifuge program? Probably not, Institute for Science and International Security, August 7, 2008

Dispersed Target Base - Centrifuge Cutting Tools - Mashhad



Image Credit: GoogleEarth
Image Date: July 7, 2006

Source: David Albright, Paul Brannan, and Jacqueline Shire, [Can military strikes destroy Iran's gas centrifuge program? Probably not](#), Institute for Science and International Security,

Dispersed Target Base - Centrifuge & Missile Parts - Isfahan



Source: David Albright, Paul Brannan, and Jacqueline Shire, [Can military strikes destroy Iran's gas centrifuge program? Probably not](#), Institute for Science and International Security,

Dispersed Target Base - Uranium: Conversion - Isfahan



Source: David Albright, Paul Brannan, and Jacqueline Shire, [Can military strikes destroy Iran's gas centrifuge program? Probably not](#), Institute for Science and International Security,

How Much is Enough?

Amount of Fissile Material Need to Build a Basic Fission (Non-Boosted) Weapon

Highly Enriched Uranium HEU (90% U-235)	Simple gun-type weapon	90-110 lbs/40-50 kg
	Simple implosion weapon	33lbs/15 kg.
	Sophisticated implosion weapon	20-26lbs/9-12kg
Weapons Grade Plutonium	Simple implosion weapon	14lbs/6 kg
	Sophisticated implosion weapon	4.5-9lbs/2-4 kg

Extract from the unclassified estimates in Union of Concerned Scientists, “Preventing Nuclear Terrorism Fact Sheet,” April 2004, and work by Abdullah Toucan

Nuclear Weapons Technology

- **In 2004, Swiss investigators seized computer files and documents from the Swiss nationals Friedrich, Marco, and Urs Tinner.**
- **The computer files, containing over 1,000 megabytes of information, were encrypted and difficult to decipher. Nonetheless, Swiss investigators found the designs of smaller, more sophisticated nuclear weapons than the design found in Libya.**
- **Why did these smugglers associated with the notorious Pakistani nuclear engineer Abdul Qadeer Khan have these designs, unless they had sold or intended to sell them for Khan?**
- **Moreover, these computers were unlikely to be the only place where the Tinnings stored the designs. A senior IAEA official doubted that the Tinnings were the only ones who had the designs found on their computers...Others were bound to have received the digitized designs, he added.**
- **But who has them and what have they already done with them? How can authorities recover these designs if they are not sure who has them, this official lamented?**
- **How will authorities learn if Iran, North Korea, or even terrorists bought these designs? What will the Tinnings do with any files they stored elsewhere?**

May 26, 2008 IAEA Report - I

- **Between December 12, 2007 and May 6, 2008, Iran introduced 2,300 kg of uranium hexafluoride (UF₆) into the operating cascades at the Fuel Enrichment Plant. This compares to a total of 1,670 kg of UF₆ introduced during the entire period from February to December 2007.**
- **At Iran's stated rates of feeding uranium hexafluoride into P-1 centrifuges, and assuming continuous operation, the centrifuges are running at about 50 percent of their capacity, a significant increase over previous rates.**
- **In addition to the 18 cascades containing some 3,000 P-1 centrifuges, Iran is beginning to install a second module of 3,000 centrifuges, of which three cascades are either enriching or under vacuum. Installation of an additional 15 cascades is continuing, although a schedule of completion is unknown. Iran does not appear to be rushing to install the second module of centrifuges at this time.**
- **Iran is now testing advanced centrifuges at the Natanz pilot fuel enrichment plant. It has installed two or three types of next-generation centrifuges: the IR-2 ... and possibly a longer centrifuge. According to senior officials close to the IAEA, these centrifuge designs are modifications of the P-2 centrifuge obtained from A.Q. Khan in the 1990s.**
- **After testing, Iran is expected to decide which design to mass produce for deployment in the underground halls of the Natanz fuel enrichment plant. These centrifuges are expected to have greater enrichment output and perform better in operation.**

May 26, 2008 IAEA Report - II

- Iran has installed IR-2 centrifuges both as single machines and in a ten-machine cascade. It has installed a few single IR-3 centrifuges. There may be cooled and much larger variants.
- IAEA states that Iran's alleged studies on the green salt project, high explosives testing and the missile re-entry vehicle project remain a matter of serious concern. Despite Iran's recent agreement with the IAEA to address these issues, Iranian officials continue to insist that the documents are forged and the allegations are baseless.
- Where Iran acknowledges the factual basis of some of the information, it insists that the work had nothing to do with the development of nuclear weapons.
- The report annotated listing of 18 documents that the IAEA has shown to Iran, outlining its alleged work on green salt, high explosives testing and a missile re-entry vehicle...Among these, according to senior officials close to the IAEA, high explosives studies and the re-entry vehicle work are the areas most in need of clarification and cooperation from Iran.

September 15, 2008 IAEA Report - I

- **IAEA reports that Iran is making significant progress on developing and operating its centrifuges, and that Iran continues to resist efforts to address substantively its alleged nuclear weapons related work, which the IAEA says remains of serious concern.**
- **A senior official described the current situation as being “gridlocked.”**
- **Since the Director General’s previous report, Iran has continued to operate the original 3000-machine IR-1 unit¹ at the Fuel Enrichment Plant (FEP). In addition, installation work has continued on four other units. On 30 August 2008, five 164-machine (IR-1) cascades of Unit A26 were being fed with UF₆ and another cascade of that same unit was in vacuum without UF₆; installation of the remaining 12 cascades at that unit is continuing (GOV/2008/15, para. 2).**
- **As of 30 August 2008, 5930 kg of UF₆ had been fed into the operating cascades since 12 December 2007. This brings the total amount of UF₆ fed into the cascades since the beginning of operations in February 2007 to 7600 kg. Based on Iran’s daily operating records, as of 30 August 2008, Iran had produced approximately 480 kg of low enriched UF₆.**
- **Iran has installed 2 or 3 types of next generation centrifuges: the IR-2, IR-3, and possibly a longer centrifuge. These centrifuges are expected to have greater enrichment output and perform better in operation. Iran is feeding significantly more U₆ into its IR-2 centrifuges, stepping up its developmental activities on this more advanced centrifuge.**
- **At the Pilot Fuel Enrichment Plant (PFEP), between 16 May and 25 August 2008, Iran fed a total of approximately 30 kg of UF₆ into the 10-machine IR-2 cascade and the single IR-1, IR-2 and IR-3 centrifuges. Another 139 centrifuges in a 162-machine IR-1 cascade are in vacuum, but are not being fed with UF₆.**

September 15, 2008 IAEA Report - II

- **As of 3 August 2008, approximately 28 tons of uranium in the form of UF₆ had been produced at the Uranium Conversion Facility (UCF) since 8 March 2008. This brings the total amount of uranium in the form of UF₆ produced at UCF since March 2004 to 342 tons.**
- **On 30 March 2007, the IAEA requested Iran to reconsider its decision to suspend the implementation of the modified text of its Subsidiary Arrangements General Part, Code 3.1. There has been no progress on this issue.**
- **The IAEA requested in December 2007, but has not yet received, preliminary design information for the nuclear power plant that is to be built in Darkhovin.**
- **On 2 April 2008, the Agency requested Iran to provide, as a transparency measure, access to additional locations related, inter alia, to the manufacturing of centrifuges, R&D on uranium enrichment, and uranium mining and milling (GOV/2008/15, para. 13). Iran has not yet agreed to the Agency's request.**
- **There remain a number of outstanding issues, identified in the Director General's last report to the Board (GOV/2008/15, para. 14), which give rise to concerns about possible military dimensions to Iran's nuclear programme.**

September 15, 2008 IAEA Report - III

- **The IAEA, in a series of meetings held in Tehran on 7–8 and 18–20 August 2008, highlighted areas where additional information was necessary. They encouraged Iran, as a matter of transparency, to address the substance of the allegations with a view to dispelling the doubts which naturally arise, in light of all of the outstanding issues, about the exclusively peaceful nature of Iran’s nuclear programme. To that end, over the course of the meetings, the IAEA made a number of concrete proposals for addressing the alleged studies.**
- **The IAEA believes that Iran could, as a matter of transparency, assist them in their assessment of the alleged studies by providing it with access to documents, information and personnel to demonstrate, as Iran asserts, that these activities were not nuclear related. Unfortunately, Iran has not yet provided the requested information, or access to the requested documentation, locations or individuals.**
- **The IAEA is still awaiting responses to a number of procurement related questions which may shed light, inter alia, on the role of the military related entities and their staff in the procurement of items for Iran’s nuclear programme and related technical activities in support of that programme. With regard to the production of nuclear related components by companies related to defense industries, Iran’s response of 23 May 2008 did not provide any new information. Iran has thus far declined to address these issues.**

September 15, 2008 IAEA Report - IV

- **As indicated in the Director General’s previous report, the IAEA currently has no information — apart from the uranium metal document — on the actual design or manufacture by Iran of nuclear material components of a nuclear weapon or of certain other key components, such as initiators, or on related nuclear physics studies (GOV/2008/15, para. 24). Nor has the Agency detected the actual use of nuclear material in connection with the alleged studies. However, unless Iran undertakes as a measure of transparency, in accordance with its obligations under Security Council resolution 1803 (2008)6 and other related resolutions, to resolve substantively the outstanding issues, the IAEA will not be in a position to progress in its verification of the absence of undeclared nuclear material and activities in Iran. Only through the expeditious resolution of these outstanding issues can doubts arising there from about the exclusively peaceful nature of Iran’s nuclear programme be dispelled, particularly in light of the many years of clandestine nuclear activities by Iran.**
- **There is important new information obtained by the IAEA related to possible assistance from a foreign expert to Iran’s alleged nuclear weapons effort. According to the report, the IAEA has obtained information indicating that experimentation on the “symmetrical initiation of a hemispherical high explosive charge suitable for an implosion type nuclear device” may have involved the “assistance of foreign expertise.” The IAEA has asked Iran to clarify this issue, and according to the senior official, continues to pursue this matter with Iran and other countries.**

September 15, 2008 IAEA Report - V

- **The report annotated listing of 18 documents that the IAEA has shown to Iran, outlining its alleged work on green salt, high explosives testing and a missile re-entry vehicle...Among these, according to senior officials close to the IAEA, high explosives studies and the re-entry vehicle work are the areas most in need of clarification and cooperation from Iran.**
- **IAEA reports that Iran has provided access to declared nuclear material and has provided the required nuclear material accounting reports in connection with declared nuclear material and activities. However, Iran has not implemented the modified text of its Subsidiary Arrangements General Part, Code 3.1 on the early provision of design information.**
- **IAEA states that it has not been able to make any substantive progress on the alleged studies and other associated key remaining issues which remain of serious concern. Adding that Iran needs to provide the IAEA with substantive information to support its statements and provide access to relevant documentation and individuals. Unless Iran provides such transparency, and implements the Additional Protocol, the IAEA will not be able to provide credible assurance about the absence of undeclared nuclear material and activities in Iran.**
- **Contrary to the decisions of the Security Council, Iran has not suspended its enrichment related activities, having continued the operation of PFEP and FEP, and the installation of new cascades and the operation of new generation centrifuges for test purposes. Iran has also continued with the construction of the IR-40.**

Statements By Iranian President Mahmoud Ahmadinejad in Response to September 15, 2008 IAEA Report

- Numerous news agencies have reported on the statements made by Iranian President Ahmadinejad following the September 15, 2008 IAEA report, including the AFP, AP, and Reuters among others.
 - "If anybody dares to breach the boundaries of the Iranian nation, the Iranian nation's holy land and Iran's legal interests, our armed forces ... will break his hand before he can pull the trigger," Ahmadinejad told a military parade on Sept. 21.
 - "Today, Iran is not in a position to show even the smallest flexibility against the bullying of the enemies. History has shown that those who wish ill for Iran will gain nothing but regret," and added that threats made against Iran's nuclear facilities amounted to only "psychological warfare."
 - "The enemies of humanity ... had imagined that by military attack and economic and scientific sanctions they could break down our revolution and our nation," he said, adding that Iran's enemies had "lost hope".
 - "Those who deprived us of the simplest defensive technology and put economic sanctions on Iran, today ... they should look carefully and see the Iranian nation's armed forces and the defensive achievements of the Iranian nation," he said.
 - Ahmadinejad also said that sanctions only help Iran achieve self-sufficiency. "Those who once imposed sanctions, today should open their eyes and see our nation's technical achievements."
 - "Whatever they do, Iran will continue its activities. Sanctions are not important," he said. "The era of (uranium enrichment) suspension has ended."
 - Ahmadinejad said the IAEA report had confirmed the peaceful nature of Iran's nuclear work and that Tehran had cooperated with the Vienna-based U.N. agency with "full transparency".

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The US, Israel, the Arab States and a Nuclear Iran

Part Two: Iranian Missile Programs and Missile Defense Options

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September 23, 2008

Iranian Delivery Systems:

Ballistic Missiles and Other Threats

The Range of Delivery Options

- **Ballistic missiles are only one approach.**
- **Iran has acquired some Soviet cruise missiles that were nuclear armed by FSU.**
- **In near-term, air strikes present major penetration problems but are more accurate and reliable and solve serious warhead design and weight problems.**
- **US and other countries build force postures on de facto one-way missions.**
- **Covert delivery will always be an option: Container, GPS, off-shore “rain out”.**

Iran: Missile Sites



Stages of Development of Iran's Missiles

Designation	Stages	Progenitor Missiles	Propellant	Range (Km)	Payload (Kg)	IOC (Year)	Inventory
Mushak-120	1	CSS-8, SA-2	Solid	130	500	2001	?
Mushak-160	1	CSS-8, SA-2	Liquid	160	500	2002	?
Mushak-200	1	SA-2	Liquid	200	500	NA	0
Shahab-1	1	Soviet SSN-4, N Korean SCUD B	Liquid	300	987-1,000	1995	250-300
Shahab-2	1	Soviet SSN-4, N Korean SCUD C	Liquid	500	750-989	?	200-450 (these are very high estimates)
Shahab-3	1	N Korea Nodong-1	Liquid	1,300	760-1,158	2002	25-100
Shahab-4	2	N Korea Taep'o-dong-1	Liquid	3,000	1,040-1,500	NA	0
Ghadr 101	multi	Pakistan Shaheen-1	Solid	2,500	NA	NA	0
Ghadr 110	multi	Pakistan Shaheen-2	Solid	3,000	NA	NA	0
IRIS	1	China M-18	Solid	3,000	760-1,158	2005	NA
Kh-55	1	Soviet AS-15 Kent, Ukraine	jet engine	2,900-3,000	200kg nuclear	2001	12
Shahab-5	3	N Korea Taep'o-dong-2	Liquid	5,500	390-1,000	NA	0
Shahab-6	3	N Korea Taep'o-dong-2	Liquid	10,000	270-1,220	NA	0

Source: Adapted from [Iran Special Weapons Guide](http://www.globalsecurity.org/wmd/world/Iran/missile.htm), Global Security.org, available at: <http://www.globalsecurity.org/wmd/world/Iran/missile.htm>

Recent Iranian Missile Developments

- **Iran working on extended-range variant of the Shahab-3 and a new 2,000 km medium-range ballistic missile (the “Ashura”)**
- **In February 2008, Iran declared it had successfully launched an “exploratory” space rocket – analysis shows resemblance to Shahab-3 ballistic missile**
- **In November 2006 and July 2008, Iran orchestrated the launches of several short- and medium-range ballistic missiles capable of striking Israel and U.S. bases in the Middle East**
- **Status of July 2008 launch unclear. Iran claims new version of Shahab. Most experts disagree. Ranges reported of 1,090, 1,250, and 2,000 miles.**
- **Report 25-100 “Shahab 3” missiles in service. Claims Shahab A and Shahab B will be withdrawn from service and replaced with solid fueled missiles.**
- **Launch rocket claim capable of carrying a satellite into orbit on August 17, 2008. First stage consisted of a Shahab 3 booster, topped by a liquid-fueled second stage and possibly a small solid-fueled third stage.**

Source: Lt Gen Trey Obering, USAF, Director, Missile Defense Agency , Missile Defense Program Overview, Pentagon News Briefing, 15 JUL 08

“Shahab 3” & EMP Debate - I

- “Shahab 3” has undergone extensive development and modification.
- Original seems to be scaled up design based on Scud, possibly derived from North Korean No Dong and similar to Russian R-5 or SS-3. North Korean may have delivered 5-12 missile assemblies and four TEL vehicles during 1994-1997, and possibly a total of 20 missile assemblies by 2002.
- Production reported to have begun as early as 1998, with claimed IOC of 1999, and handover to IRGC in July 2003.
- First test in 1998 using North Korean engines. Has problems with booster engines. Some reports first tested own engines in July and August 2002.
- Test a two stage missile in 2000 with a liquid fuel first stage and solid fuel second stage.
- Reports in 2002 developing longer range Scud 3A with range of 1,500 to 1,800 KM. reports first tests from TEL in 2004.
- Had conducted 8 tests by July 2003, with maximum potential range of 1,300 KM.
- Iran has tested Scud firing from cargo ship in Gulf. Has also had a number of high apogee Shahab 3 tests from Khorramabad which destroyed the missile at high altitudes. This may have been to keep missile safely in Iranian territory. Some believe Iran is developing an EMP launch capability.
- Reports in 2004 developing longer range Scud 3B with range of 2,000 to 2,500 KM. Claim tests in September and October 2004 at ranges of 2000 KM.

“Shahab 3” & EMP Debate - II

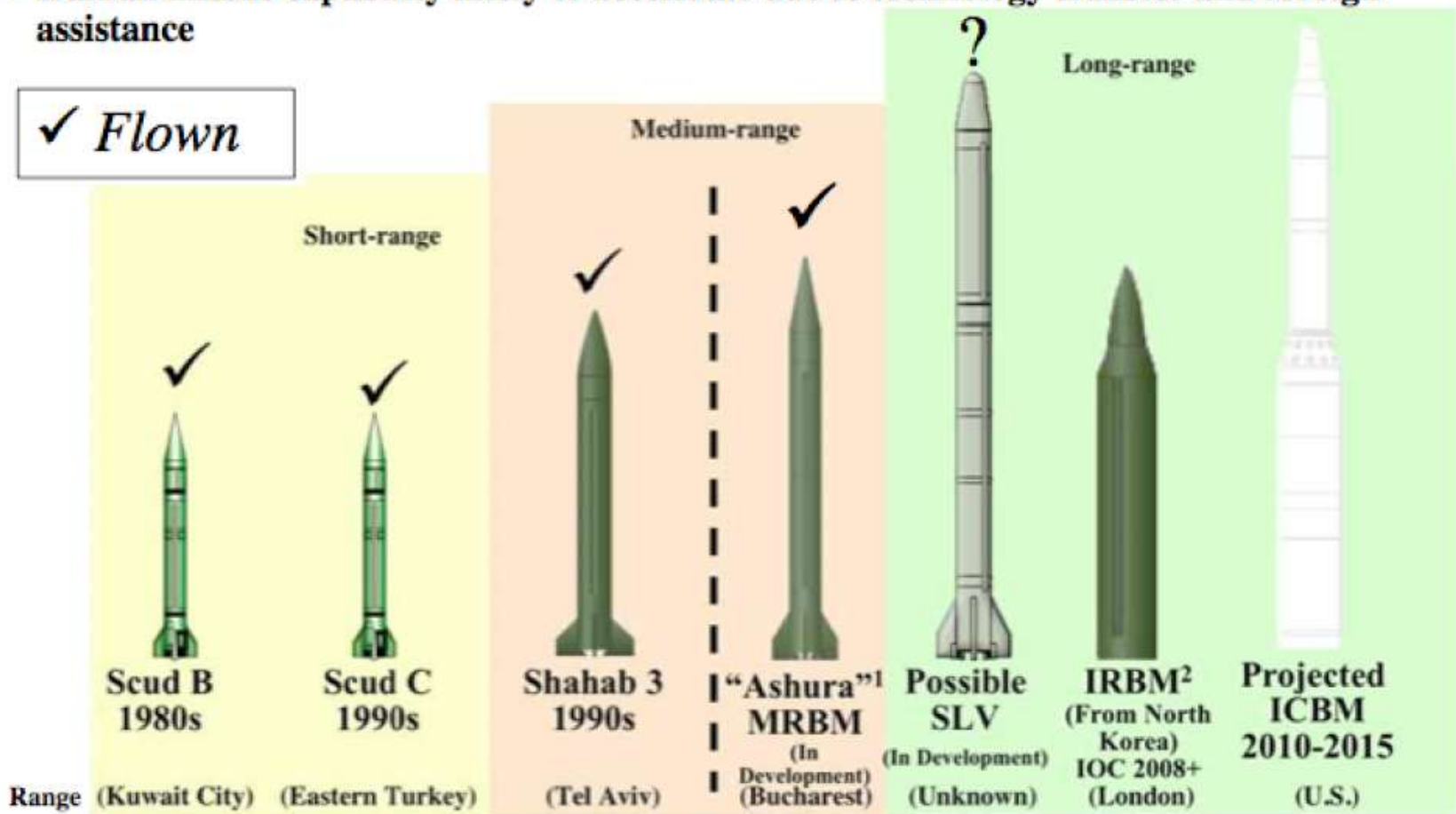
- **Test solid propellant motor in May 2005, but nature of motor unclear.**
- **Report test of Fajr 3 missile in March 2006. Four missiles tests in 2006, one claimed to be Fajr.**
- **Reports that Shahab 3A and 3B became operational in 2007.**
- **Televised test of Shahab in July 2008, no details as to type.**
- **Report test of satellite launch vehicle on August 17, 2008.**
- **Reports IRGC has missiles in five sites with underground storage, launch pad, support facilities, and mobile TEL deployment capability.**
- **2 operational brigades with 20 missiles reported in May 2004. Report had 6 brigades with 30-50 missiles in 2006. One reports can now produce up to 12 missiles per month.**
- **No real data on range payload or CEP. CEPs various reported as 4,000, 1,000, 400 meters.**
- **Reports of longer-range Shahab 4 since 1997. No tests, Many reports of sale of long-range ballistic missile technology or designs. (SSN-6, Tapeo Dong 2, etc.)**
- **Iran has KH55 cruise missiles. No data on actual development or test of long range cruise missiles.**

Source: Jane's Sentinel series, “Shahab 3/4, July 18, 2007 and new reports.

Iranian Missile Developments

- Iranian missile capability likely to accelerate due to technology transfer and foreign assistance

✓ *Flown*

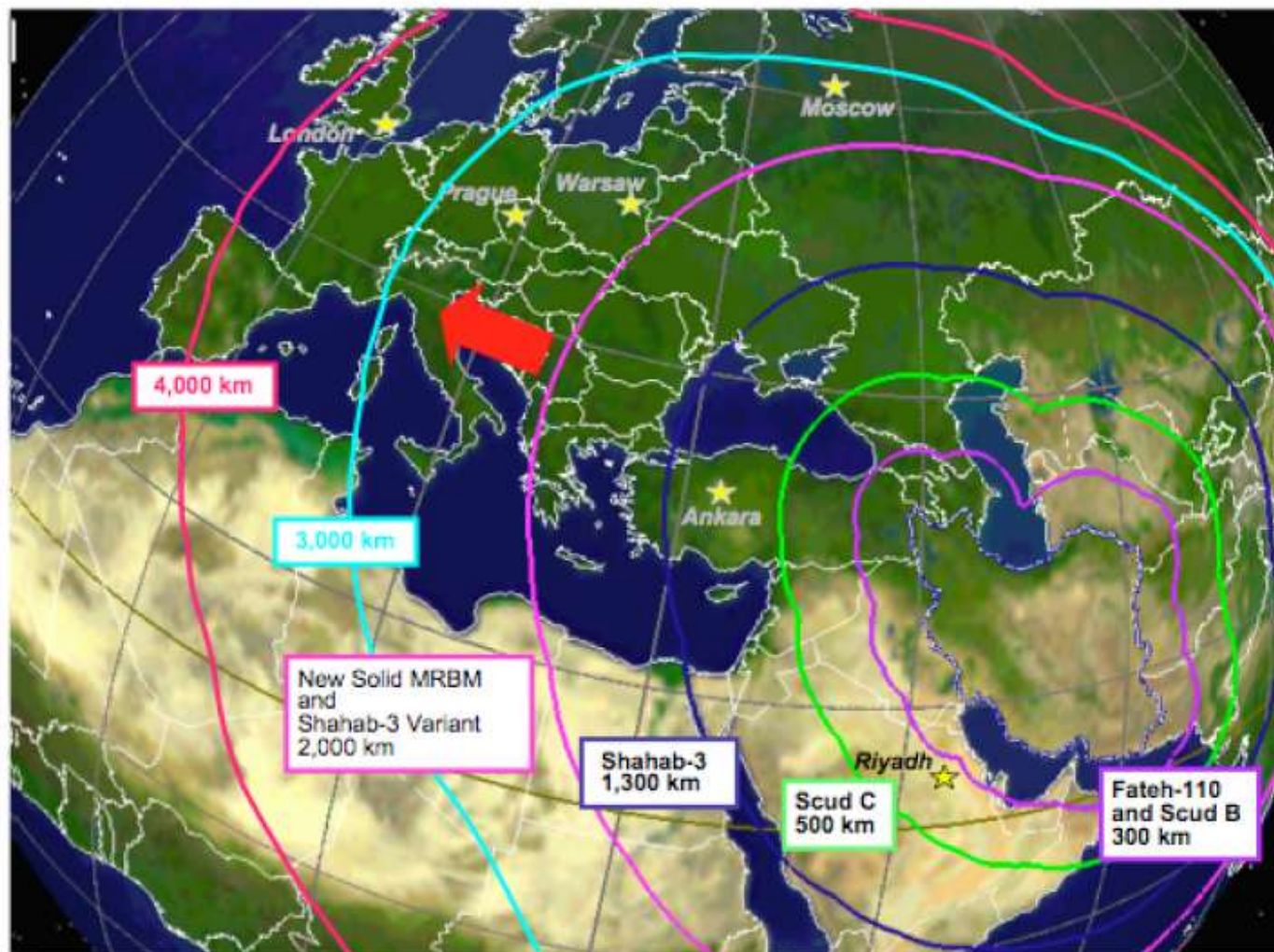


1. Gen Maples Testimony, 27 FEB 08; Agentstvo Voenyrykh Novostey, 27 NOV 07; Arms Control Today, January/February 2008
 2. Agence France-Presse, 16 DEC 05

“Iran continues to develop and acquire ballistic missiles that can hit Israel and central Europe” – General Maples, Director of U.S. Defense Intelligence Agency

Growth in Iranian Missile Range

“If you would like to have good relations with the Iranian nation ... bow down before the greatness of the Iranian nation and surrender. If you don't accept [to do this], the Iranian nation will later force you to surrender and bow down.” – Mahoud Ahmadinejad, President of Iran, 1 OCT 06



Ballistic Missile Defense:

US Progress and Future Options

Strengths and Limits of BMD/TMD

- **Strengths:**
 - Deals with key emerging Iranian threat.
 - Denies high probability of successful Iranian strikes.
 - Key symbol of unity and deterrence
- **Weaknesses:**
 - No defense against covert capability.
 - Separate systems needed for air and cruise missile defense.
 - High system cost.
 - “Betting on the come:” Uncertain cost benefits
 - Effective “system of systems” requires GCC and other country cooperation and integration.

Options for Missile Defense

Sensors



Defense Support Program



Space Tracking and Surveillance System



Sea-Based Radars



Forward-Based Radar With Adjunct Sensor



Midcourse X-Band Radar



Early Warning Radar



Airborne Laser



Kinetic Energy Interceptor



Aegis Ballistic Missile Defense / Standard Missile-3



Multiple Kill Vehicle



Ground-Based Midcourse Defense



Terminal High Altitude Area Defense



Sea-Based Terminal



Patriot Advanced Capability-3

Command, Control, Battle Management & Communications



NMCC USSTRATCOM USNORTHCOM USPACOM USEUCOM USCENTCOM

Designated Lead Service:

Army

Navy

Air Force

TBD

Build-up of US Missile Defense: July-December 2008



Proposed NATO System



(2012)

Schedule

- Construction Start 3QFY10
- Integration Start 4QFY11
- Operational Capability 3QFY12



(2013)

Schedule

- Construction Start 4QFY09
- Integration Start 2QFY12
- Operational Capability 3QFY12 (FCD 2QFY13)



Why Poland and Czech Republic
 - Azimuthal range
 - Range from Iran



(TBD)

Approved for Public Release
 D8-MDA-3707 (15 JUL 08)

US Test Developments - I

35 Of 43 Terminal And Midcourse Hit-To-Kill Intercepts In The Atmosphere And Space Since 2001

Hit-To-Kill Since 2001

Since September 2005

**Terminal High Altitude Area Defense
(5 of 5)**



- ✓
- ✓
- ✓
- ✓
- ✓

- July 12, 2006
- January 26, 2007
- April 5, 2007
- October 27, 2007
- June 25, 2008

VM313

**Aegis Ballistic Missile Defense
(13 of 15)**



- ✓
- X
- ✓
- ✓
- ✓
- ✓
- ✓
- ✓

- November 11, 2005
- December 7, 2006
- June 22, 2006
- April 26, 2007
- June 22, 2007
- August 31, 2007
- November 6, 2007
- December 17, 2007

VM339C

**Ground-based Midcourse Defense
(6 of 9)**



- ✓
- ✓

- September 1, 2006
- September 28, 2007

VM348C

Note: Patriot PAC-3 (11 of 14)

Blast Fragmentation

**Aegis Sea-Based Terminal
(2 of 2)**



- ✓
- ✓

- May 24, 2006
- June 5, 2008

VM377

US Test Developments - II

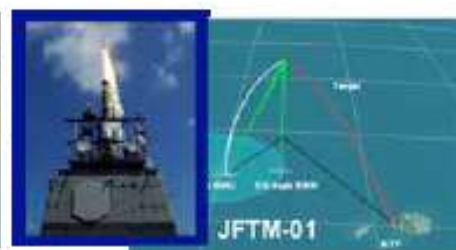
- 11 of 11 successful hit-to-kill intercepts in 2007 and 2008 to date against medium- and short-range missiles using land- and sea-based defenses, including
 - Ground-based midcourse defense intercept of long-range target in operationally realistic conditions
 - First intercept of separating warhead – THAAD
 - First simultaneous destruction of two short-range ballistic missiles at sea
 - First sea-based intercept by an ally



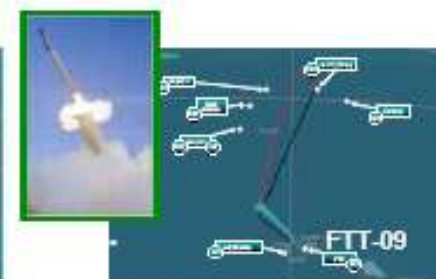
June 22, 2007



September 28, 2007



December 17, 2007



June 25, 2008

Director DoD OT&E Assessment on Test Realism

- **Aegis BMD meets all DOT&E criteria, *except* testing against complex countermeasures (dynamic target and penetration aids)**
 - Operational interceptor, sensor, and fire control software
 - Threat representative target *and* unannounced target launch
 - Operationally realistic warfighter tactics, techniques and procedures
 - Warfighter participation
 - End-to-end test
- **Ground-based Midcourse Defense meets all DOT&E criteria, *except* testing against complex countermeasures and *unannounced target launch***
 - Operational interceptor, sensor, and fire control software
 - Threat representative target
 - Operationally realistic warfighter tactics, techniques and procedures
 - Warfighter participation
 - End-to-end test for a single engagement group using a single sensor – modeling and simulation runs have demonstrated other engagement sequences

US Test Goals



Intercept against target with countermeasures: EKV verification with dual sensors integrated

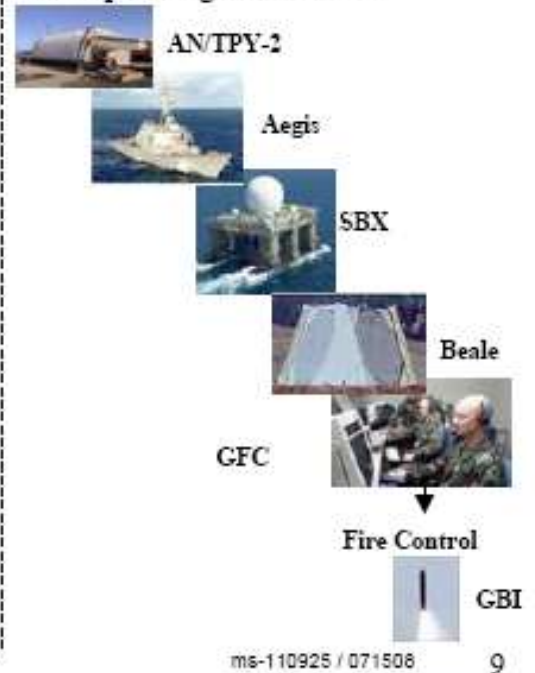
Simulated intercept using sensors offline



Simulated intercept against target with complex countermeasures using multiple integrated sensors



Live intercept against target with complex countermeasures using multiple integrated sensors



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The US, Israel, the Arab States and a Nuclear Iran

Part Three: Iranian CBRN Options

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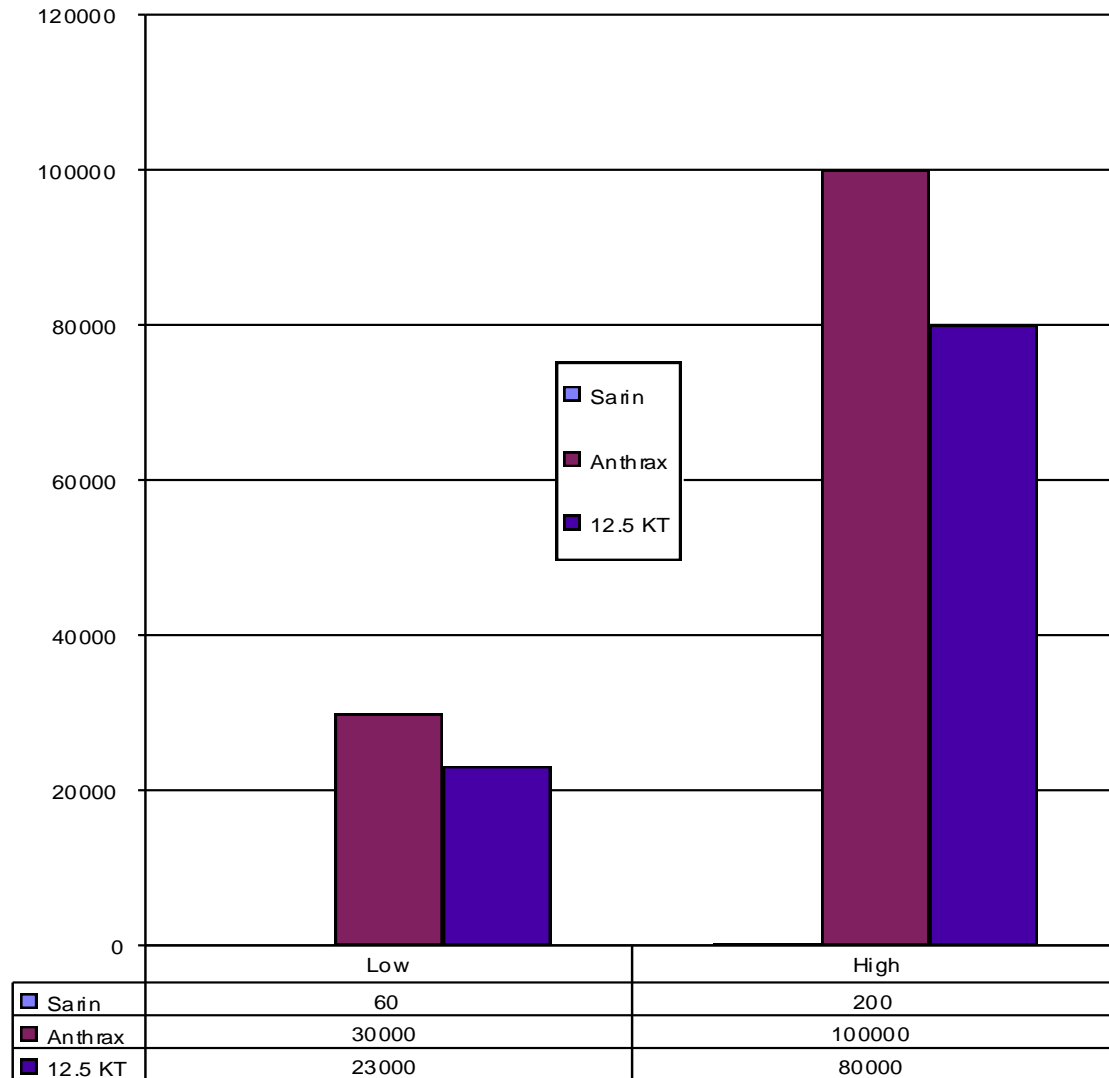
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CBRN Prompt (48-hour) Killing Effect in an Urban Environment

The Relative Killing Effect of Chemical vs. Biological vs. Nuclear Weapons



Q₅₀ for Some Types of BW - Open-Air Deployment

- **Plague (liquid): 3.5-4.5 liter/sq.km**
- **Tularemia (dry): 3.0-4.0 kg/sq.km**
- **Anthrax (dry, old version): 15-20 kg/sq.km**
- **Anthrax (dry, new version): 4.5-5.0 kg/sq.km**
- **Anthrax (liquid): 5.0-5.5 liter/sq.km**
- **Brucellosis (dry): 3.5-4.5 kg/sq.km**
- **Glanders/Melioidosis (liquid): 4.5-5.5 liter/sq.km**
- **Smallpox (liquid): 3.5-4.0 liter/sq.km**
- **Marburg (dry): less than 1.0 kg/sq.km**

New Types of Biological Weapons

- ***Binary biological weapons*** that use two safe to handle elements that can be assembled before use. This could be a virus and helper virus like Hepatitis D or a bacterial virulence plasmid like E. coli, plague, Anthrax, and dysentery.
- ***Designer genes and life forms***, which could include synthetic genes and gene networks, synthetic viruses, and synthetic organisms. These weapons include DNA shuffling, synthetic forms of the flu – which killed more people in 1918 than died in all of World War I and which still kills about 30,000 Americans a year – and synthetic microorganisms.
- ***"Gene therapy" weapons*** that use transforming viruses or similar DNA vectors carrying Trojan horse genes (retrovirus, adenovirus, poxvirus, HSV-1). Such weapons can produce single individual (somatic cell) or inheritable (germline) changes. It can also remove immunities and wound healing capabilities.
- ***Stealth viruses*** can be transforming or conditionally inducible. They exploit the fact that humans normally carry a substantial viral load, and examples are the herpes virus, cytomegalovirus, Epstein-Barr, and SV40 contamination which are normally dormant or limited in infect but can be transformed into far more lethal diseases. They can be introduced over years and then used to blackmail a population.
- ***Host-swapping diseases***: Viral parasites normally have narrow host ranges and develop an evolutionary equilibrium with their hosts. Disruption of this equilibrium normally produces no results, but it can be extremely lethal. Natural examples include AIDS, Hantavirus, Marburg, and Ebola. Tailoring the disruption for attack purposes can produce weapons that are extremely lethal and for which there is no treatment. A tailored disease like AIDS could combine serious initial lethality with crippling long-term effects lasting decades.
- ***Designer diseases*** involve using molecular biology to create the disease first and then constructing a pathogen to produce it. It could eliminate immunity, target normally dormant genes, or instruct cells to commit suicide. Apoptosis is programmed cell death, and specific apoptosis can be used to kill any mix of cells.

Non-State Actor CBR(N?)

- **Independent, Proxy, False Flag, or Trigger Force?**
- **Access likely to be more critical in determining capability than ability to create own weapons, but highly lethal BW and genetic weapons may be becoming “off the shelf” option.**
- **Many of same twists as covert State Actor attacks:**
 - **Bypasses defenses.**
 - **Plausible deniability?**
 - **Exploits special vulnerability of “one bomb” states.**
 - **Psychological and political impacts as important as direct killing effects.**
 - **False flag and proxy options clear.**
 - **Buying time may limit risk of retaliation.**
 - **Allows to exploit “slow kill” nature of biological strikes. Achieve “line source” effects**
 - **Covert forces in place can restrike or escalate.**
- **Unclear Non-State Actors are deterrable by any form of retaliation.**

State Actor Covert Bioterrorism, Suitcase Nuclear

- **Bypasses defenses.**
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- **Unclear Non-State Actors are deterrable by any form of retaliation.**

State Actor Covert Bioterrorism, Small or “Suitcase” Nuclear

- **Bypasses defenses.**
- **Plausible deniability?**
- **Exploits special vulnerability of “one bomb” states.**
- **Psychological and political impacts as important as direct killing effects.**
- **False flag and proxy options clear.**
- **Buying time may limit risk of retaliation.**
- **Allows to exploit “slow kill” nature of biological strikes. Achieve “line source” effects**
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- **Target potentially faces major weakening of conventional capabilities without ability to counter-escalate.**

Possible Terrorist/Covert/Irregular Deployment of Biological Weapons

- **Use of infected vectors (mosquitoes, fleas, lice, etc.)**
- **Contamination of food and water supplies**
- **Contamination of various articles (letters, books, surfaces, etc.)**
- **Use of different aerosolizing devices and approaches to contaminate inner spaces of various buildings (line and point sources)**
- **Use of different aerosolizing devices and approaches for open-air dissemination (line and point sources)**
- **Inner- and outer-space explosive dissemination including suicide bombers**
- **Terrorist/Sabotage methods of infecting crops and livestock**

WME: “Weapons of Mass Effectiveness”

- **Theoretical possibility, give precision long-range strike capability.**
- **Target mix varies with attacker’s motives.**
- **Broad possible target base in MENA area, varying sharply by country.**
 - **Desalination**
 - **Major power plants, nuclear power plants.**
 - **Water purification and distribution.**
 - **Refinery**
 - **High value, long-lead time oil, gas, and petrochemical facilities.**
 - **Ethnic and sectarian high value targets.**
 - **Leadership elite: Royal family, president, etc.**

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The US, Israel, the Arab States and a Nuclear Iran

Part Four: Military Options for Dealing with the Iranian Threat

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Dealing with Nuclear Uncertainty

- **Decide proper mix of five basic military options:**
 - **Prevention/preemption,**
 - **Active and passive defense,**
 - **Containment**
 - **Acquiring own nuclear weapons, and/or**
 - **US extended deterrence.**
- **Can wait for diplomacy for time being, but need to start considering future options.**
 - **Ballistic and cruise missile defenses maybe cost-effective simply to deal with conventional threat.**
 - **A number of systems offer both improved air and missile defense.**
 - **Need quiet talks with US on containment options; extended deterrence.**
 - **Open support for IAEA and diplomatic options key passive approach.**

Possible “Wars”

- **Israeli prevention, preemption of Iran.**
- **US prevention, preemption of Iran.**
- **Arms Race; War of Intimidation.**
- **Crisis “management.”**
- **Iranian-Israeli Exchange.**
- **Syrian “Wild Card”**
- **Iran nuclear, US conventional.**
- **Iran nuclear, US nuclear.**
- **State actor covert bioterrorism, suitcase nuclear.**
- **Non-State Actor CBR(N?).**
- **Weapons of Mass Effectiveness**

Strike on Iran?

- **Timelines: Acquisition? Deployment? Modernization?**
- **Targeting intelligence?**
- **Dispersal, hardening, concealment?**
- **Hardening vs. Attack Lethality**
- **SEAD: Penetration? Suppression? Kill?**
- **Range-payload, refuel, recovery**
- **Restrike? Penetration corridor enforcement?**
- **LOW? LUA? Covert?**

Israeli Prevention, Preemption of Iran

- **Uncertain “Window of Opportunity.”**
- **Prevention option vanishes once mature, dispersed Iranian force exists, but**
 - **Prevention may stimulate massive covert, dispersed effort.**
 - **One shot, limited target base, and not want waste option on low value targets.**
 - **No “green lights” from US or Arab neighbors (?)**
- **Preemption becomes radically different once Iran has nuclear armed force.**
 - **Time urgent, and must deny capability for single retaliatory strike.**
 - **Once Iran has launch on warning. Launch under attack may be impossible.**
 - **Special nature of Israeli target base can push to preempt.**
 - **Much of “ride out” capability may rest on Arrow, PAC-3, confidence in intelligence and warning. Israel’s own LOW/LUA capabilities.**
- **Deterrence/Prevention is Different Kind of Option**
 - **Take Israeli force “out of the closet.”**
 - **Existential counterforce targeting against Iran: Maximum of 10 Iranian cities of Tabriz, Qazvin, Tehran, Esfahan, Shiraz, Yazd, Kerman. Qom, Ahwaz, Kermanshah versus greater Tel Aviv, Haifa,**

US Prevention, Preemption of Iran

- **Uncertain “Window of Opportunity.”**
- **Prevention option vanishes once mature, dispersed Iranian force exists, but**
 - **Prevention may stimulate massive covert, dispersed effort.**
 - **Can range from nuclear only to broader nuclear, SSM, C4I, SAMs. Can be “suppression” rather than “pinpoint.” Less need for nukes against hard targets.**
 - **Restrikes and follow-ons much easier than for Israel.**
 - **No “green lights” Arab neighbors (?)**
- **Preemption becomes radically different once Iran has nuclear armed force.**
 - **Time urgent, and must deny capability for single retaliatory strike.**
 - **May be impossible once Iran has launch on warning, launch under attack capability.**
 - **Vulnerability of oil, Gulf cities, Israeli target base can push to preempt.**
 - **Much of “ride out” capability may rest on TMD in both Arab states and Israel, PAC-3, confidence in intelligence and warning..**
- **Deterrence/Prevention is Different Kind of Option**
 - **Adopt same “Extended Deterrence” Option once used for NATO.**
 - **Existential counterforce targeting against Iran: Maximum of 10 Iranian cities of Tabriz, Qazvin, Tehran, Esfahan, Shiraz, Yazd, Kerman. Qom, Ahwaz, Kermanshah versus greater Tel Aviv, Haifa,**

The Restrike Issue

- **Nuclear target base in initial strike: Just nuclear, known vs. suspected nuclear, collateral damage limits?**
- **100 sorties in one shot strike versus much large package ? 1,200-2,000+ sorties and cruise missiles over time?**
- **Other targets: Ballistic missiles, military industries, air defenses, C4I/BM/IS&R?**
- **Accuracy of prestrike calculations of targeting, lethality, vulnerability, and /recovery-alternative capability**
- **Damage assessment takes days to months to never.**
- **Restrikes probably necessary to get major effects but present major political problems.**
- **May need years of sustained restrike coverage.**
- **US strike and restrike calculations or forced aftermath to Israeli strikes.**
- **Impact on NNPT/IAEA.**
- **Reaction of Russia and China, Gulf allies, other states.**

Iranian Post-Strike/ Parallel Iranian Options

- **IR-2, IR-3, IR-3 “cooled,” IR-4**
- **Folded centrifuge**
- **Concealed heavy water reactor**
- **LWR cannibalization**
- **LWR download**
- **Dirty weapons**
- **Basic biological**
- **Genetic engineered weapons**

Key Mid-Term Force Posture Decisions - I

- **US and/or Israel**
 - **Prevent, preempt, contain, deter, retaliate, mutual assured destruction.**
- **Iran: Potential/ambiguity, Break Out, Test, Bomb in Basement, Credible Force**
- **Iran and Israel:**
 - **In reserve (secure storage), launch on warning (LOW), launch under attack (LOA), ride out and retaliate**
 - **Continuous alert, dispersal**
 - **Point, wide area defense goals**
 - **Basing mode: sea basing, sheltered missiles.**
 - **Limited strike, existential national, multinational survivable.**
- **US:**
 - **Level of defensive aid.**
 - **Ambiguous response**
 - **Clear deployment of nuclear response capability.**
 - **Extended deterrence. Assured retaliation.**

Key Mid-Term Force Posture Decisions - II

- **Gulf:**
 - **Passive (wait out), defensive, or go nuclear.**
 - **Ballistic, cruise missile, air defense.**
 - **Seek extended deterrence from US**
- **Syria:**
 - **Link or decouple from Iran.**
 - **Passive (tacit threat) or active (clear, combat ready deployment).**
- **Non-State Actor:**
 - **Tacit or covert capability.**
 - **Proven capability.**
 - **Deployment mode: Hidden, dispersed, pre-emplaced**

Arms Race; “War of Intimidation”

- Open ended race that can last for decades
- Iranian “War of Intimidation”
 - Effectiveness is as much political and perceptual as military
 - Search for excessive leverage or influence is major risk.
 - Can range from “bomb in the basement” to well structured existential threats to Israel and neighboring states.
 - Probably need 20-60 nuclear armed missiles for true existential threat.
 - Impact grows with asymmetric threats, proxy war capability, regional influence over states like Iraq, Syria, and Lebanon, credibility of proxy or covert attack.
- Much depends on regional and US response.
 - Israel and US capability to preempt is factor, but main issue may be Israel ability to clearly develop mutual assured destruction; US capability to deploy *credible* level of extended deterrence.
 - Defensive options like TMD, anticruise missile, and air defense *could* be critical.
 - Vulnerability of oil, Gulf cities, Israeli target base can push to preempt.
 - Much of “ride out” capability may rest on TMD in both Arab states and Israel, PAC-3, confidence in intelligence and warning.
 - Deterrence and lack of vulnerability depend on overall mix of military capabilities, not just response to Iranian proliferation
- Blocs more dangerous than nations
 - Iran-Iraq-Syrian linkage ?.
 - Problem of non-state actors, covert operations.

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The US, Israel, the Arab States and a Nuclear Iran

Part Five: Iranian Capabilities to Respond to a Preventive Attack

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September 23, 2008

Near-Term Iranian Response: Air and Missile Defense Capabilities

Iran's Current Air/Missile Defenses

- US never delivered integrated system before fall of Shah.
- Only modern short-range point defense systems are 29 TOR-M, which also have cruise missile and terminal air munitions defense capability.
- Other short-range systems mix of older Russian systems, SHORADs, and aging – possible inactive British and French systems. (FM-80 Crotale, 30 Rapier, 15 Tigercat) Seeking to reverse engineer captured Iraqi Crotales as Shahab Yhaqeb.
- 150+ IHawk MIM-23B, 45 SA-2 variants, 10 SA-5 Gammon.
- Medium to long-range systems are low capability or obsolescent.
- Hawks and I Hawks do not have capable ECM. Date back to 1960s and 1970s.
- Various versions of SA-2 obsolete. Iran developing own Sayyed-1 improved version.
- Reports in 2000 seeking to upgrade old Standard RIM-66 SM-1 missiles.
- Radar sensor and battle management/C4I systems have major limitations.
- Less than 30 export versions of MiG-29, some not operational.
- F-14s have not have ability to use primary air defense missile since 1979-1980.

TOR-M Short Range Air Defense

- Russia has delivered an undetermined number — possibly 29 — Tor-M1 systems (originally built for Greece) to the Islamic Republic of Iran, along with service contracts with an approximate value of \$700,000,000.
- The Tor is low- to medium-altitude, short-range surface-to-air missile system designed for engaging airplanes, helicopters, cruise missiles, precision guided munitions, unmanned aerial vehicles and ballistic targets. NATO reporting names are SA-15 Gauntlet and SA-N-9 Gauntlet. It is designed to protect targets from attack day or night in any weather, not only by shooting down attacking aircraft but also by destroying any munitions before they reach their target.
- From the start the Tor system was designed to provide air defence against modern and future threats equipped with precision guided weapons like the AGM-86 ALCM.
- Tor missile system was accepted into service on the 19th March 1986. The Tor-M1 air has an additional fire control channel allowing two targets to be engaged at once, an improved optical channel, computer, ECM protection and warhead. The Tor-M1-1 or Tor-M1V has improved network connectivity and ECM functions. The latest variant — the Tor-M2E — has improved fire control radar coverage and four guidance channels allowing four missiles to be guided at any one time, plus a new wheeled chassis as well as a new digital computer system and a new all weather optical tracking system.
- Each 9K331 vehicle is a completely autonomous transporter, launcher, and radar unit TLAR that carries a modern phased array radar and 8 missiles stored vertically, ready to fire.
- Target tracking range is 24 km (15 miles), engagement range is up to 12 km (7.5 miles) with minimum range varying between 10-2000 m (328-5,621 feet), depending upon version.
- Effective altitude is 10-6000 m (33-20,000 ft).
- The digital computers allow for a high degree of automation, similar to the US Patriot missile system. Target threat classification is automatic. The system can be operated with little operator input, if desired. It is equipped with NBC (nuclear, biological and chemical) protection.

S-300 (SA-10), S-400 (SA-12)

- **Two advanced Russian air and TMD defense systems. Can combine with recent TOR-M1 point defense systems delivered to Iran in 2006-2007.**
- **S-300 “Grumble”** developed by Russian Almaz Central Design Bureau since 1980. Now roughly comparable in performance to the U.S. MIM-104 Patriot PAC-1 system. PMU2 model has limited ballistic missile defence capability. Has CLAM SHELL 3D continuous wave pulse Doppler target acquisition radar, the FLAP LID A I-band multi-function phased-array trailer-mounted engagement radar with digital beam steering. Guidance radar capable of engaging up to six targets simultaneously, with two missiles assigned per target to ensure a high kill probability.
- **S-300PMU2 *Favorit* missile** has larger warhead and better guidance with a range of 200 km, versus the 150 km of previous versions. Uses new 96L6E autonomous mobile radar, which works in conjunction with the 83M6E2 control post and S-300MPU2 launchers. The new 48N6E2 missile accelerates up to 1,900 m/s in 12 sec time, and then approaches the target from above. The 48N6E2 differs from the older 48N6E in having a new warhead specially designed for destroying ballistic missiles, with a warhead weight of 145 kg versus 70-100 kg. The S-300PMU2 *Favorit* can engage targets flying from 10 m to 27 km above the surface at a speed of up to 10,000 km/h. It is claimed that it has a kill ratio ranging from 0.8 to 0.93 against aircraft and from 0.8 to 0.98 against Tomahawk-class cruise missiles.
- **S-400 “Triumf” is developmental ballistic missile defense system. Current status unclear.** Some Russian sources claim can hit modern and future attack aircraft at a distance of 400 km: tactical and strategic aviation jets, cruises of the Tomahawk type and other missiles”, and counter use of “stealth” technology at all altitudes of their combat operation and at maximum distances. In the opinion of general designer Vladimir Svetlov, Triumf is the world's first system which can selectively work with the use of several types of missiles. “The long-range missile has no analogues. It eclipses the American Patriot -3 system by around 100 percent, as does the French Aster.

Source: Adapted from material developed by Federation of American Scientists, <http://www.fas.org/nuke/guide/russia/airdef/s-300pmu.htm>, and Global Security, <http://www.globalsecurity.org/wmd/library/news/russia/1999/FTS1999050500067.htm>.

Near-Term Iranian Response: Conventional Capabilities and Options

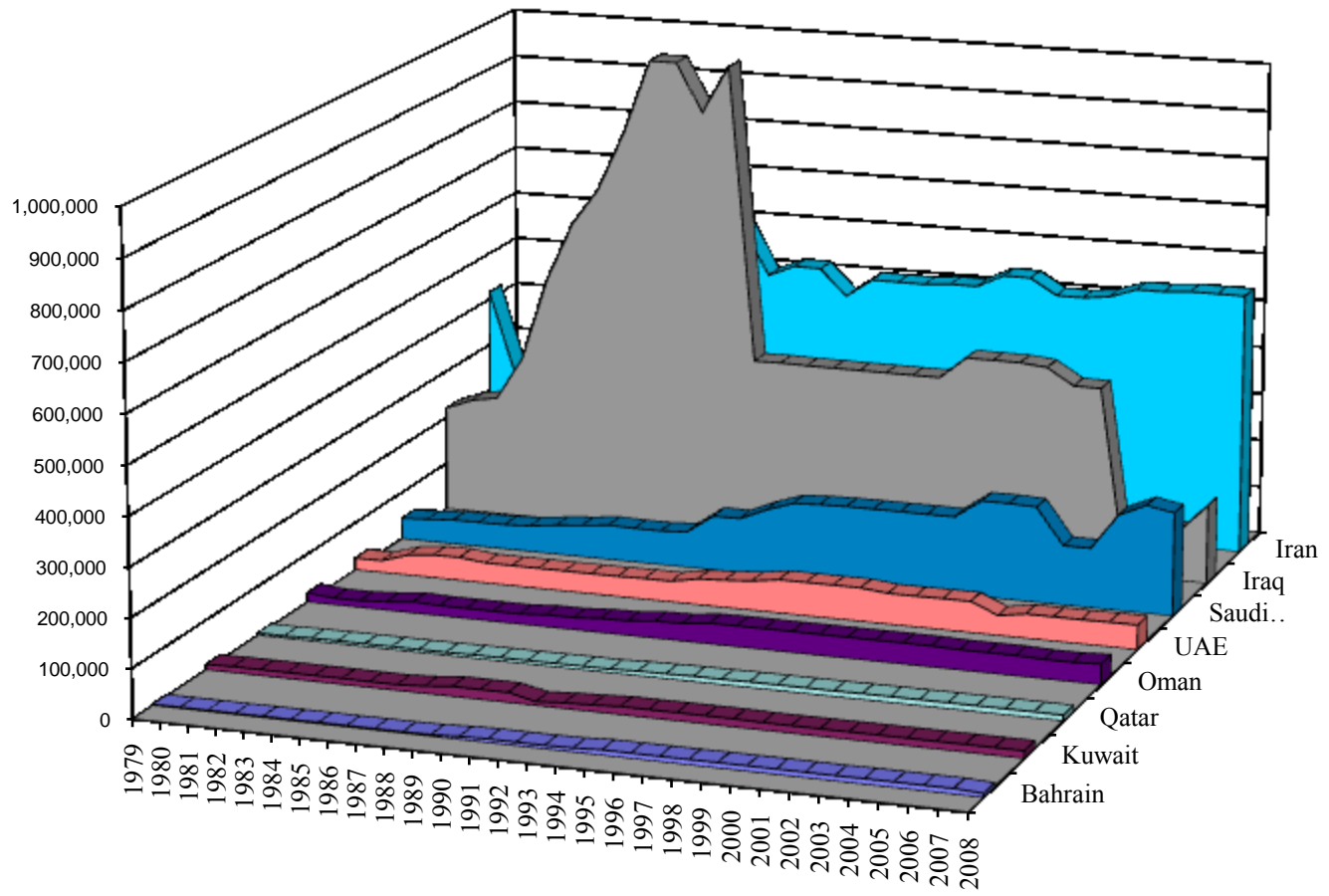
Land Force Threats

- **Iranian Threat to Kuwait and Iraq**
- **Iranian permissive amphibious/ferry operation.**
- **Iranian dominance of Iraq; Invited In to Replace US?**
- **Spillover of Iraqi Sunni-Shi'ite power struggles.**
- **Yemeni incursion into Saudi Arabia or Oman**

But:

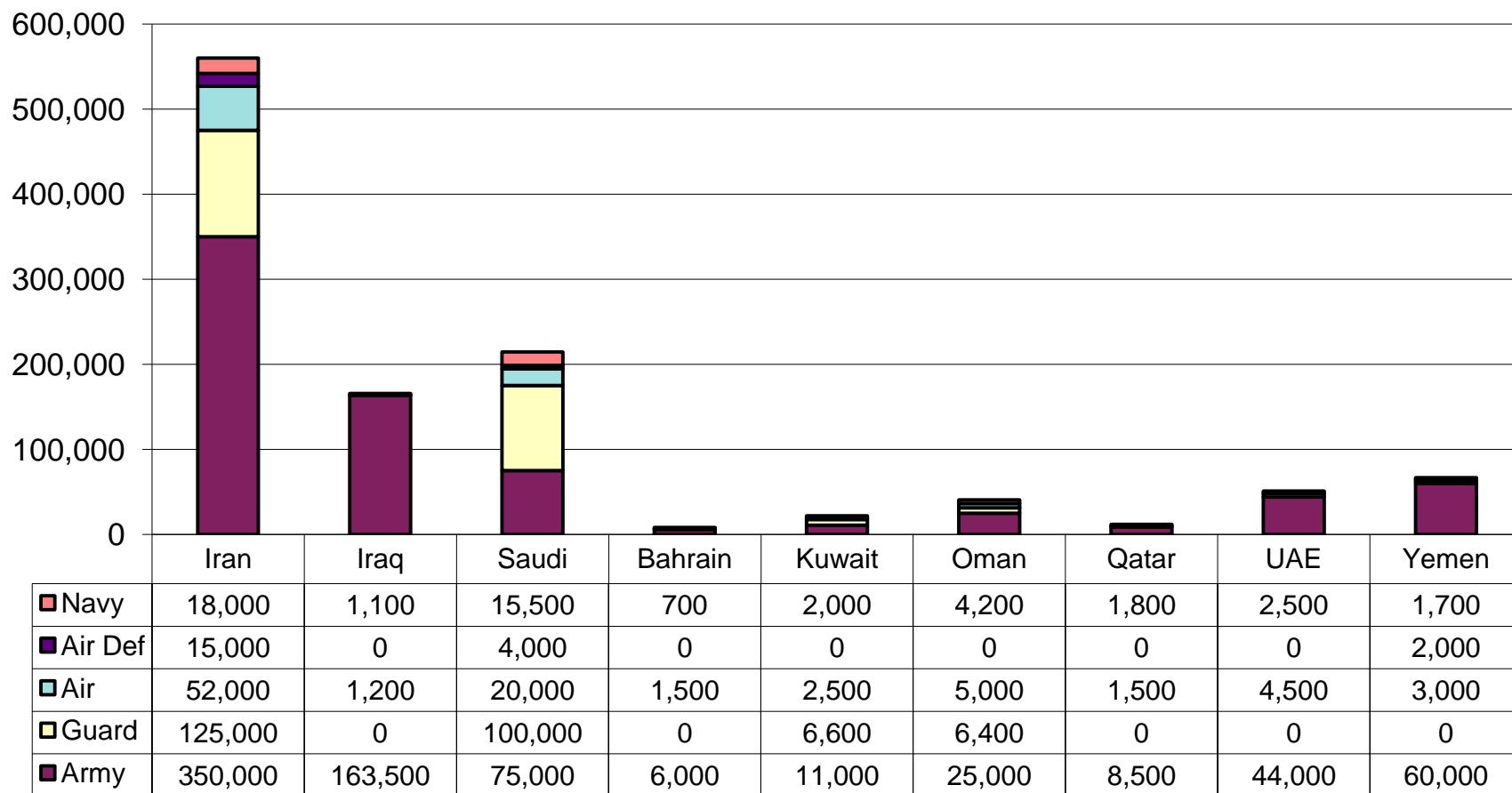
- ***Low near-term probability.***
- ***High risk of US and allied intervention.***
- ***Limited threat power projection and sustainability.***
- ***Unclear strategic goal.***

Con



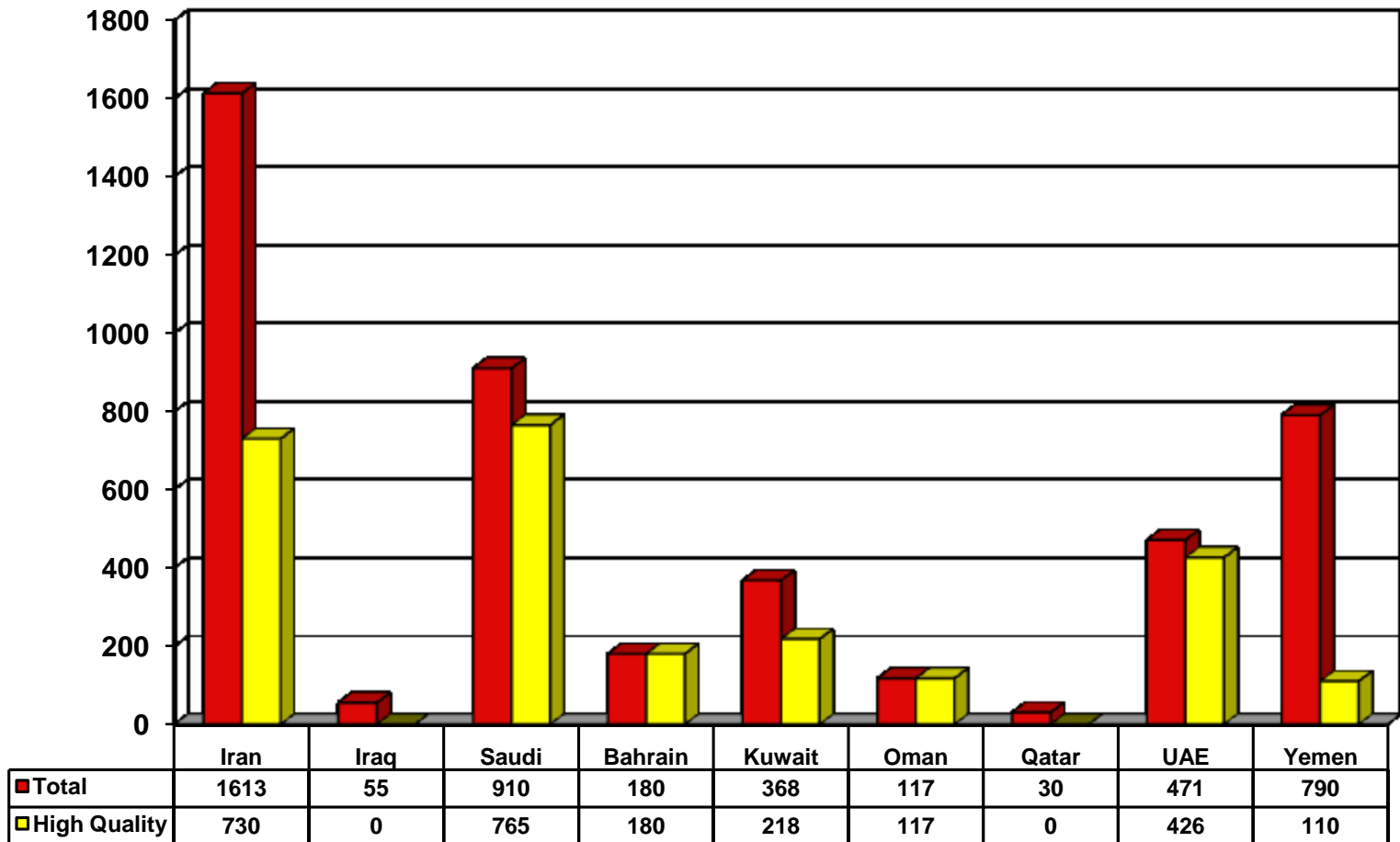
Derived from IISS, Military

Comparative Military Manpower in 2008

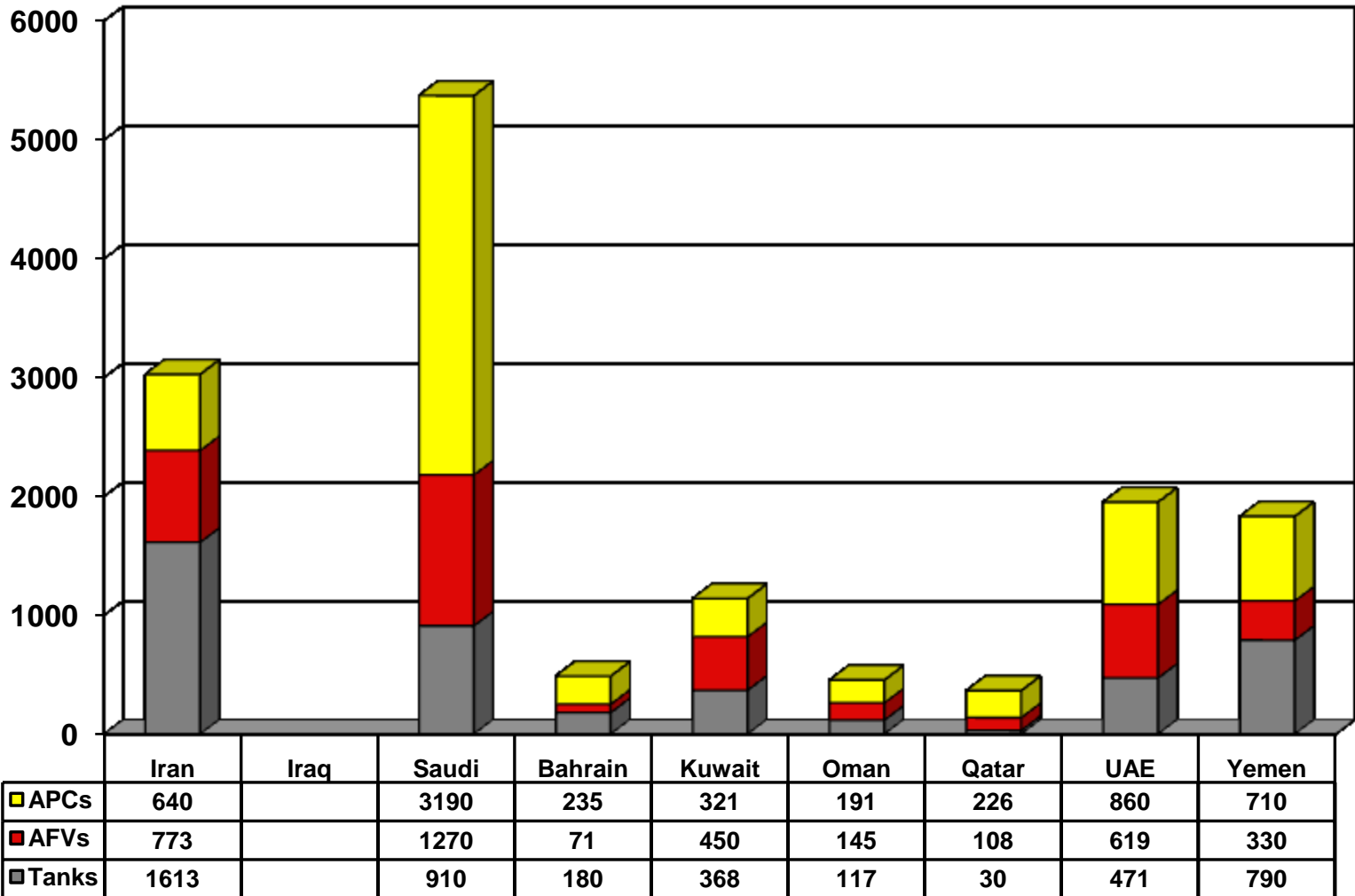


Derived from IISS, Military Balance, 2008

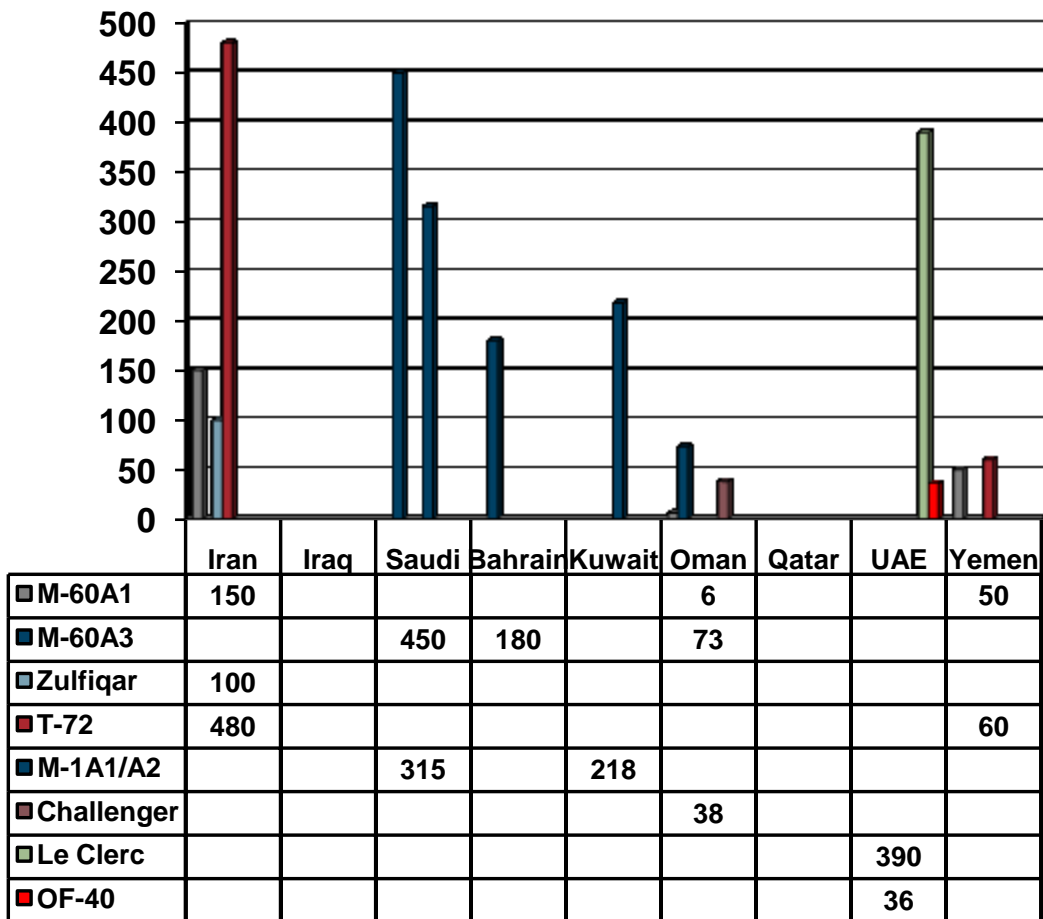
Comparative Total Gulf Tank Strength versus High Quality Tanks



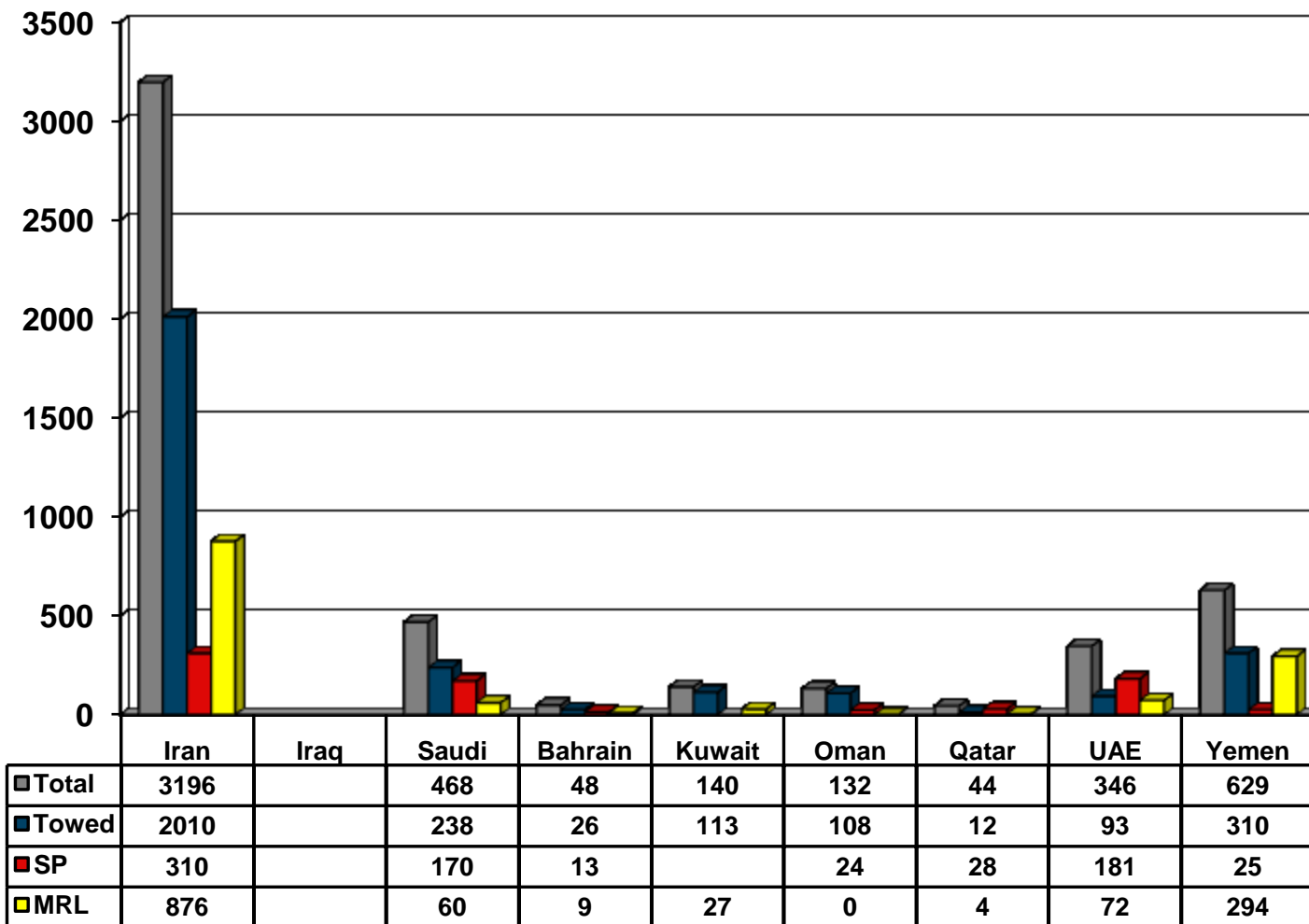
Comparative Total Armor Strength By Category



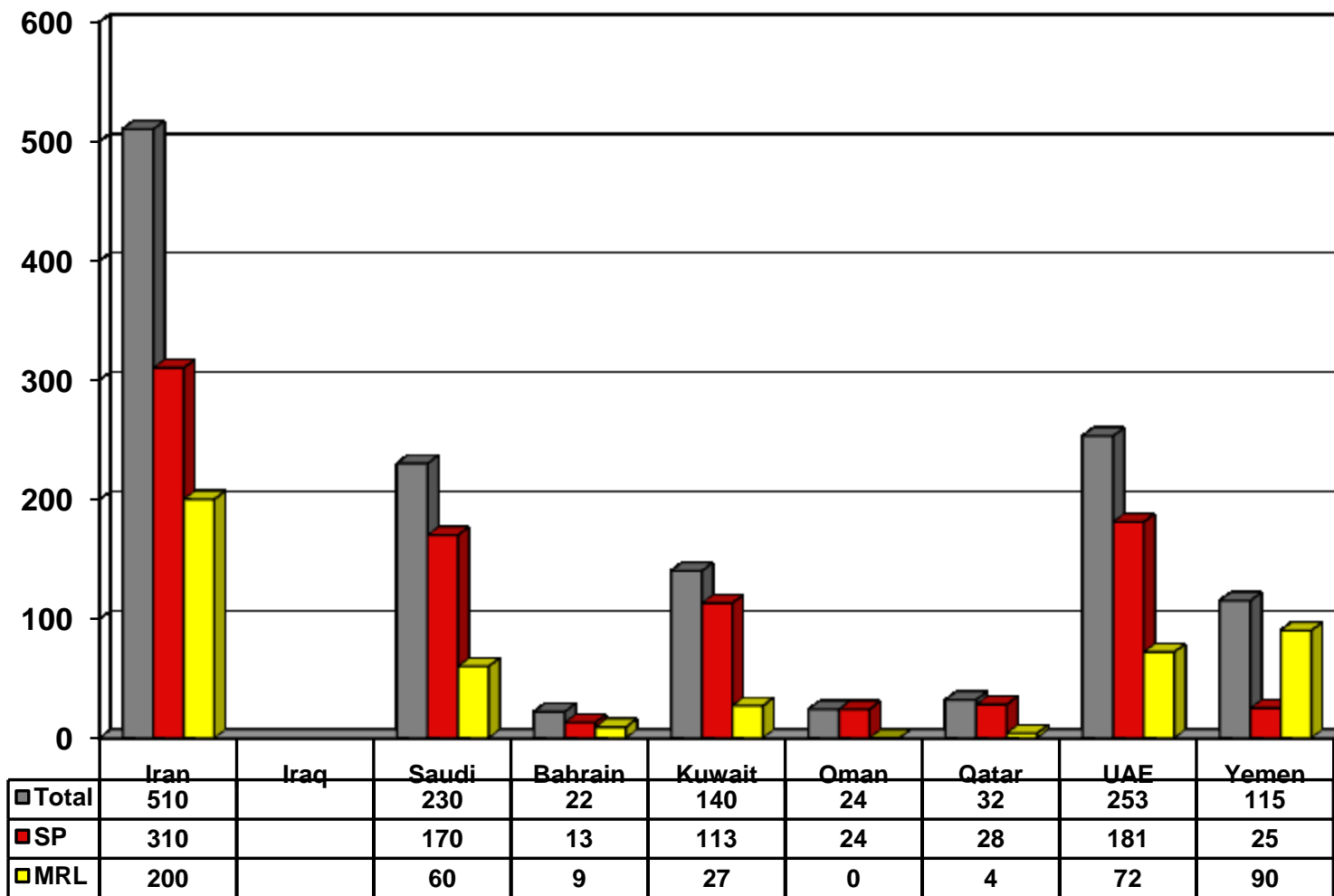
Comparative Gulf High Quality Tank Strength By Type



Comparative Artillery Strength By Category



Comparative Self-Propelled Rapid Maneuver Artillery Strength By Category



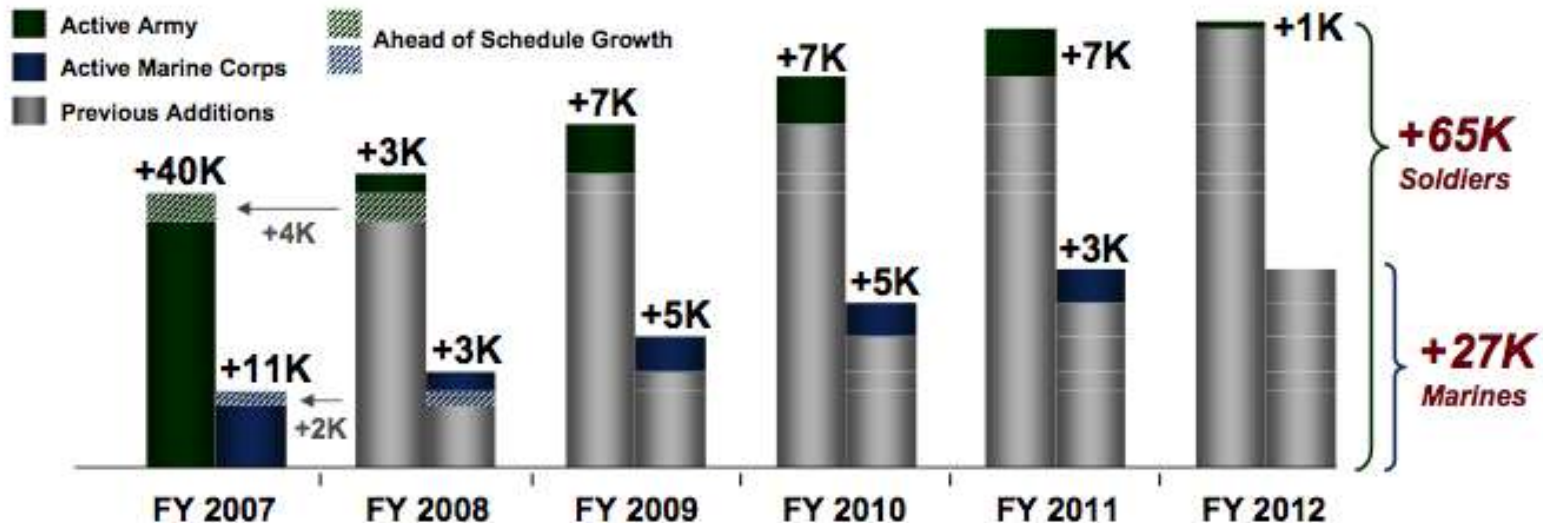
Keeping a Decisive US Qualitative Edge in US Forces and Arms Transfers to the Gulf (\$10.5B in FY087 & FY09)

Joint Ground Capabilities	Joint Maritime Capabilities	Joint Air Capabilities	Space-based Capabilities
<ul style="list-style-type: none"> - Future Combat Systems: <ul style="list-style-type: none"> • Ground and air systems - 119 Stryker Vehicles - 5,249 High Mobility Multi-purpose Wheeled Vehicles - 1,061 Heavy Tactical Vehicles - 3,187 Medium Tactical Vehicles - 29 M1A1 Abrams Tank Upgrades - Chemical Weapons Demilitarization 	<ul style="list-style-type: none"> - CVN 21 Carrier Replacement - 1 Virginia Class Submarine - 1 DDG-1000 Destroyer - 2 Littoral Combat Ships - 2 T-AKE Auxiliary Dry Cargo Ships - CVN Refueling Complex Overhaul - 2 Joint High Speed Vessels 	<ul style="list-style-type: none"> - 16 F-35 Joint Strike Fighters - 20 F-22A Raptors - 36 V-22 Ospreys - 23 F/A-18 Hornets - 22 E/A-18G Growlers - 16 CH-47 Chinooks - VH-71 Helicopter - KC-X Aerial Refueling Tanker - 59 Predators, Reapers and Warriors 	<ul style="list-style-type: none"> - 2 Space Based Infrared Systems - 4 Expendable Launch Vehicles - GPS Satellite - 1 Mobile User Objective System - Transformational Satellite - Advanced Extremely High Frequency Satellite - Wideband Global SATCOM - Ballistic Missile Defense
<p><i>Basic Research +\$0.3B in FY 2009 (+\$1.4B FY09-FY13)</i></p>			

Increase Ground Capabilities

+\$8.7B
FY08 - FY09

Army Active	42	Brigade Combat Teams (482.4K Soldiers)	➔	48	Brigade Combat Teams (547.4K Soldiers)
	12/12	Months Home Station / Months Deployed		24/12	Months Home Station / Months Deployed
Marine Corps Active	2.5	Marine Expeditionary Forces (175K Marines)	➔	3	Marine Expeditionary Forces (202K Marines)
	7/7	Months Home Station / Months Deployed		14/7	Months Home Station / Months Deployed



Source: FY 2009 DoD Budget Request; FY 2008 Budget; FY 2007 Supplemental

Numbers may not add due to rounding

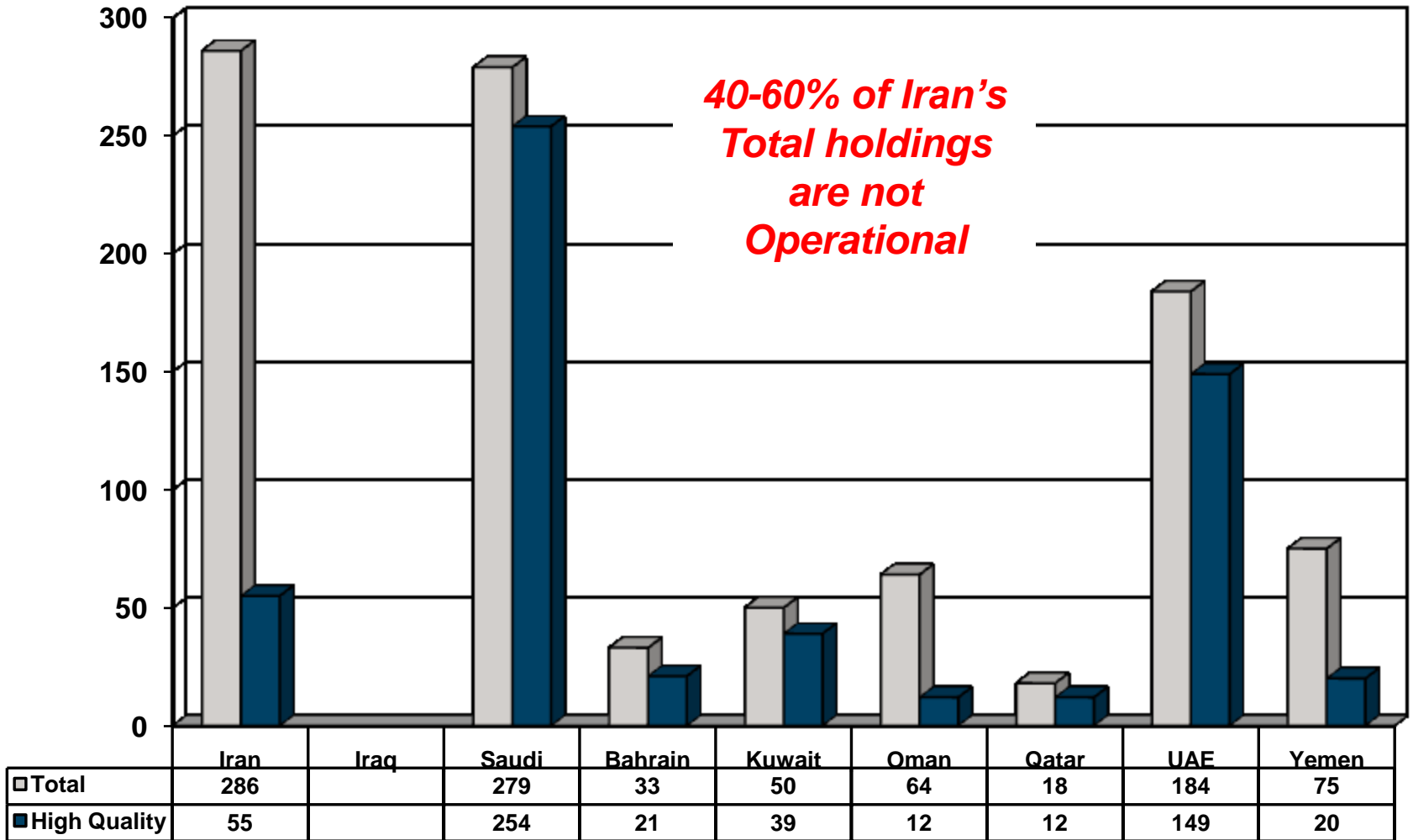
Air/Missile Threats

- **Precision air strikes on critical facilities: Raid or mass attack.**
- **Terror missile strikes on area targets; some chance of smart, more accurate kills.**
- **Variation on 1987-1988 “Tanker War”**
- **Raids on offshore and critical shore facilities.**
- **Strikes against tankers or naval targets.**
- **Attacks on US-allied facilities**

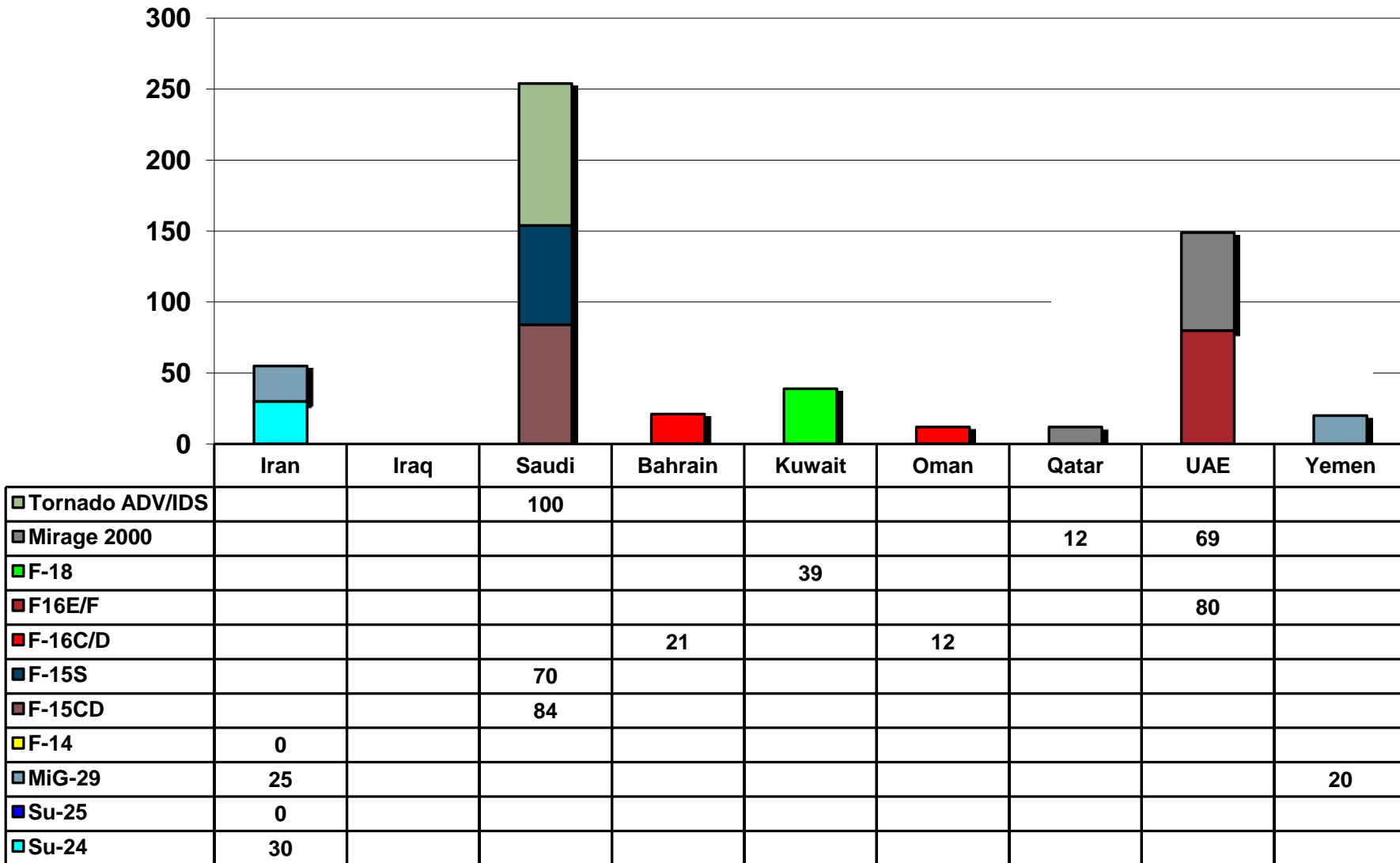
But:

- ***Low near-term probability.***
- ***High risk of US and allied intervention.***
- ***Limited threat power projection and sustainability.***
- ***Unclear strategic goal.***

Comparative Gulf Total & High Quality Combat Air Strength By Type



Comparative High Quality Combat Air Strength By Type



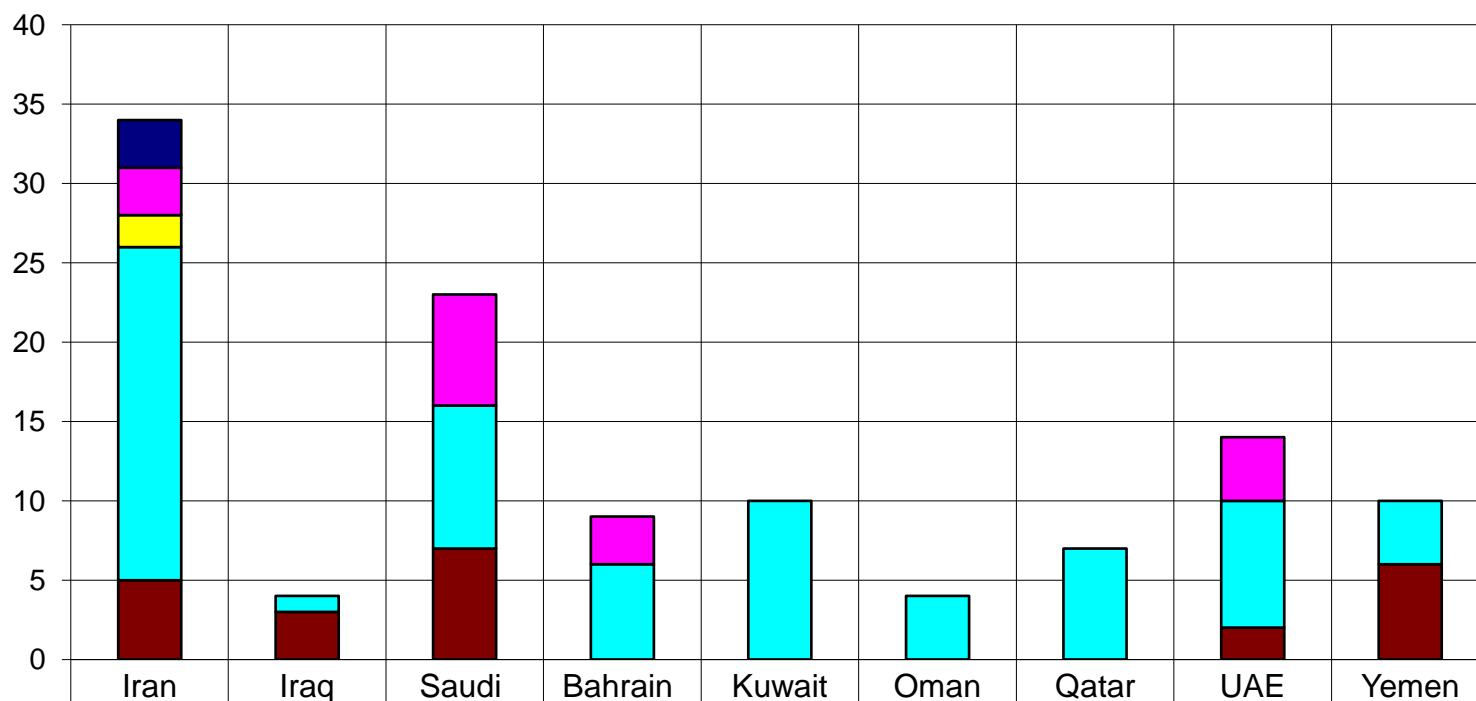
Naval Threats

- Iranian effort to “close the Gulf.”
- Iranian permissive amphibious/ferry operation.
- Variation on 1987-1988 “Tanker War”
- Raids on offshore and critical shore facilities.
- “Deep strike” with air or submarines in Gulf of Oman or Indian Ocean.
- Attacks on US facilities

But:

- *Low near-term probability.*
- *High risk of US and allied intervention.*
- *Limited threat power projection and sustainability.*
- *Unclear strategic goal.*

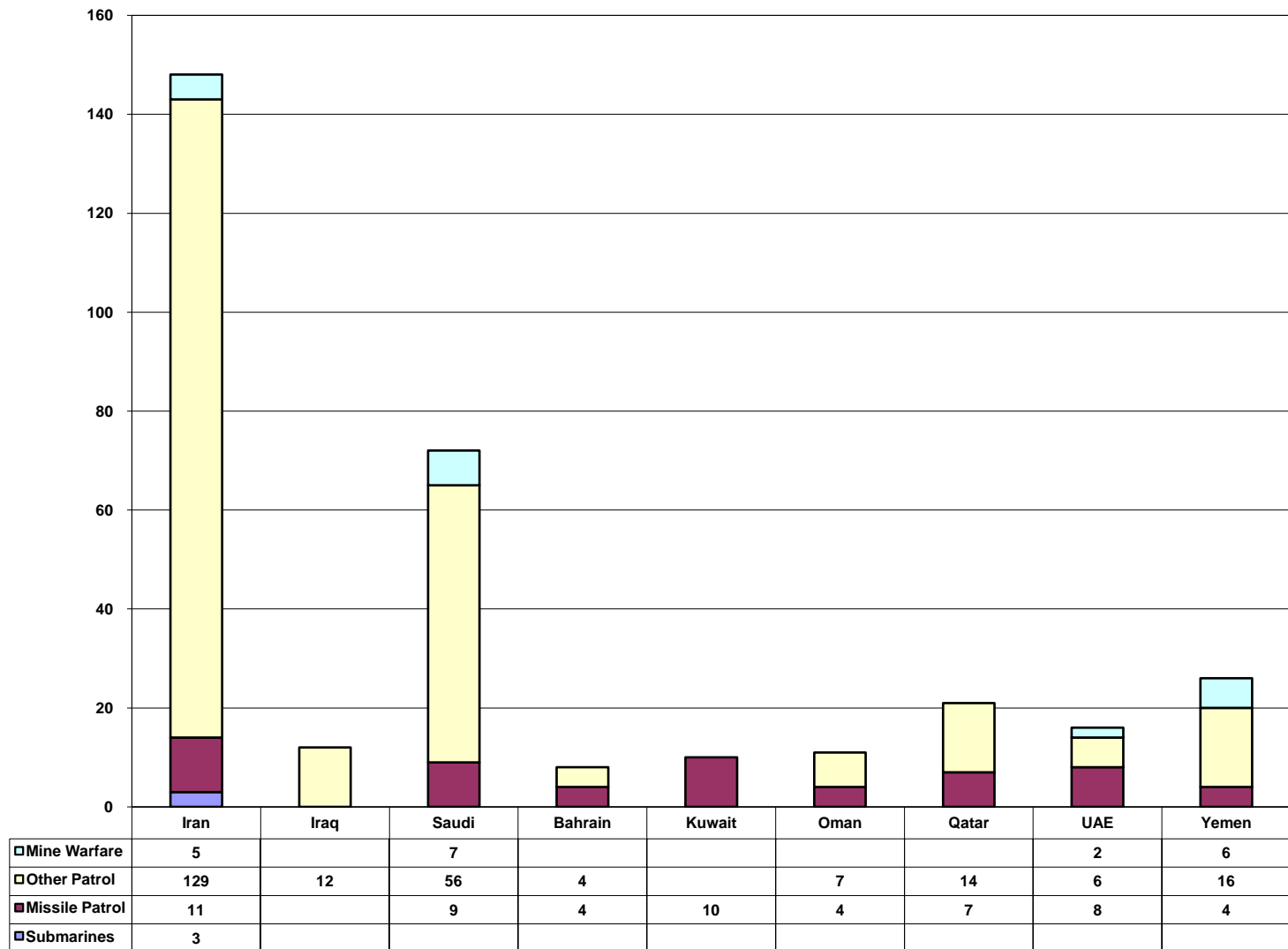
Comparative Major Naval Combat Ships



■ Submarines	3							
■ Major Missile Combat	3		7	3			4	
■ Major Other Combat	2							
■ Missile Patrol	21	1	9	6	10	4	7	8
■ Mine	5	3	7					2

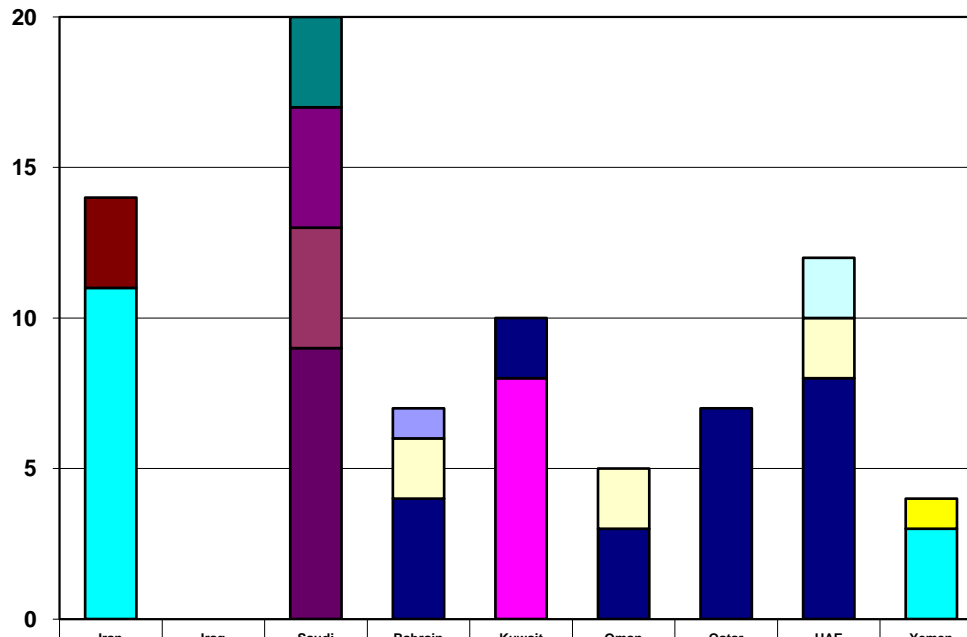
Derived from IISS, Military Balance, 2008

Key Ships for Asymmetric Warfare



Derived from IISS, Military Balance, 2008

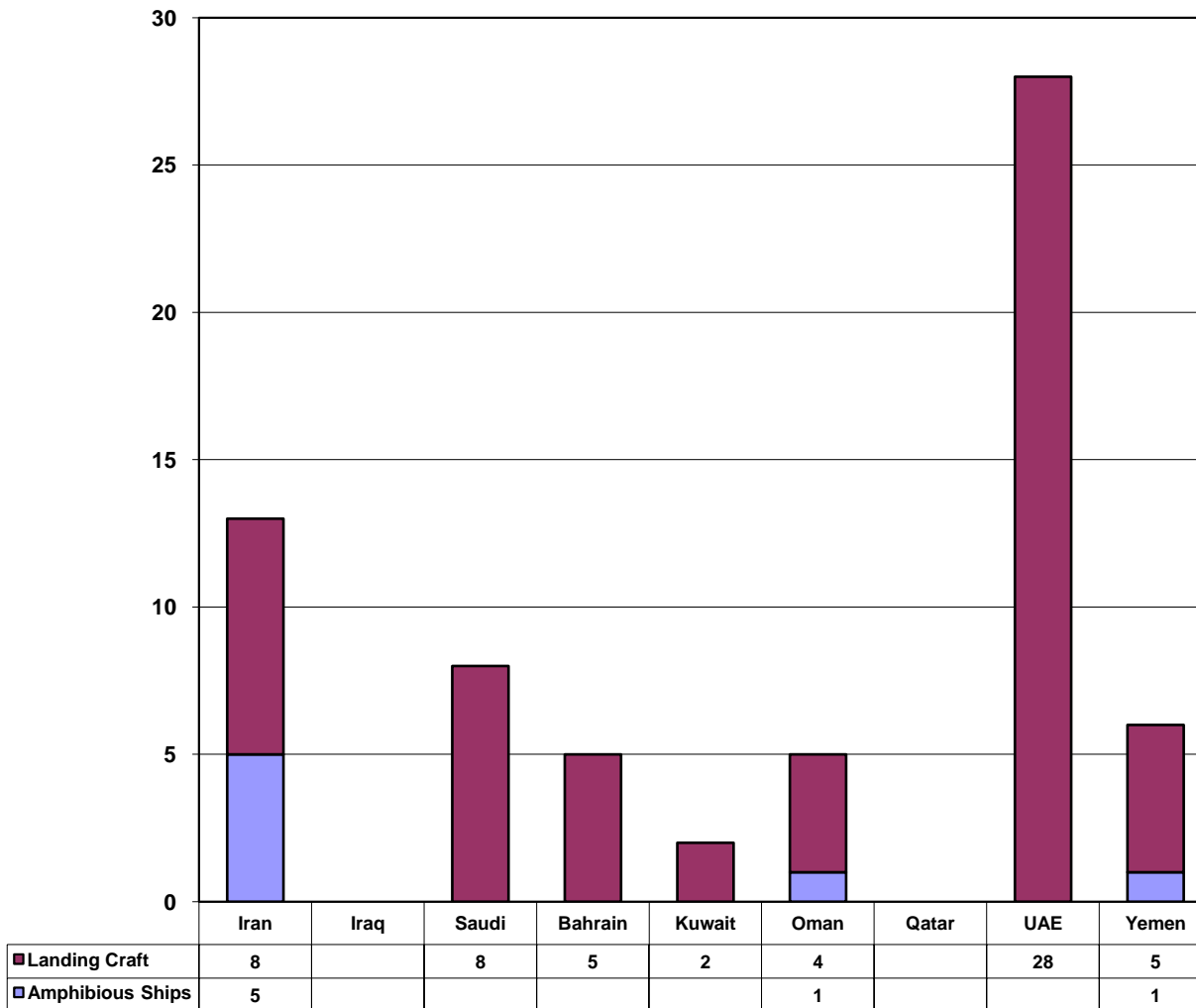
Anti-Ship Missile Ships



FRIGATES									
RGM-84A Harpoon SSM								2	
RGM-84C Harpoon SSM				1					
MM-40 Exocet Block II SSM			3						
Mk2 Otomat SSM			4						
CSS-N-4	3								
CORVETTES									
RGM-84C Harpoon SSM			4						
MM-40 Exocet SSM				2		2		2	
MISSILE PATROL CRAFT									
RGM-84C Harpoon SSM			9						
MM-40 Exocet SSM				4	2	3	7	8	
Sea Skua SSM					8				
SS-N-2C Styx SSM									1
CSS-N-4 Sardine SSM	11								3

Derived from IISS, Military Balance, 2008

Amphibious Ships & Landing Craft



Derived from IISS, Military Balance, 2008

Near-Term Iranian Response: Asymmetric Capabilities and Options

Most Likely Foreign Threats Are Not Formal Conflicts

- **Appeal to international community: victim of aggression, Israel, US.**
 - **Use to excuse withdrawal from IAEA or new levels of concealment.**
 - **Direct and indirect threats of using force. (I.e. Iranian efforts at proliferation)**
 - **Lash out with limited and largely symbolic missile strikes and halt.**
 - **Use of irregular forces and asymmetric attacks: Al Qa'ida in Iran, Taliban, Hezbollah, Hamas**
- Threat Gulf oil exports and tanker traffic.**
- **Other proxy conflicts using terrorist or extremist movements or exploiting internal sectarian, ethnic, tribal, dynastic, regional tensions.**
 - **Arms transfers, training in host country, use of covert elements like Quds force.**
 - **Harassment and attrition through low level attacks, clashes, incidents.**
 - **Limited, demonstrative attacks to increase risk, intimidation.**
 - **Strike at critical node or infrastructure.**

Planning for Asymmetric Warfare

- **Understands that deterrence and conflict prevention are as critical as defense.**
- **Broad mix of forces with capabilities for irregular warfare: Islamic Revolutionary Corps, Al Quds Force, and Basij are key.**
- **Mix of Naval Guards and regular Navy provides extensive capability in the Gulf.**
- **Have carried out extensive CPXs and FTXs experimenting with different types of asymmetric and irregular warfare.**
- **Increasingly emphasize joint warfare approaches that tie in paramilitary and security forces.**
- **Can use intervention in Afghan and Iraq conflicts, ties to Hezbollah and Hamas to fight proxy wars.**
- **Can exploit hardline and terrorist movements even if hostile to Iran if more hostile to US, Israel, and Gulf regimes.**

Some Tangible Examples

- **Iranian tanker war with Iraq**
- **Oil spills and floating mines in Gulf.**
- **Libyan “stealth” mining of Red Sea.**
- **Use of Quds force in Iraq.**
- **“Incidents” in pilgrimage in Makkah.**
- **Support of Shi’ite groups in Bahrain.**
- **Missile and space tests (future nuclear test?).**
- **Naval guards seizure of British boat, confrontation with US Navy, exercises in Gulf.**
- **Development of limited “close the Gulf” capability.**
- **Flow of illegals and smuggling across Yemeni border.**

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The Islamic Revolutionary Guards Corps

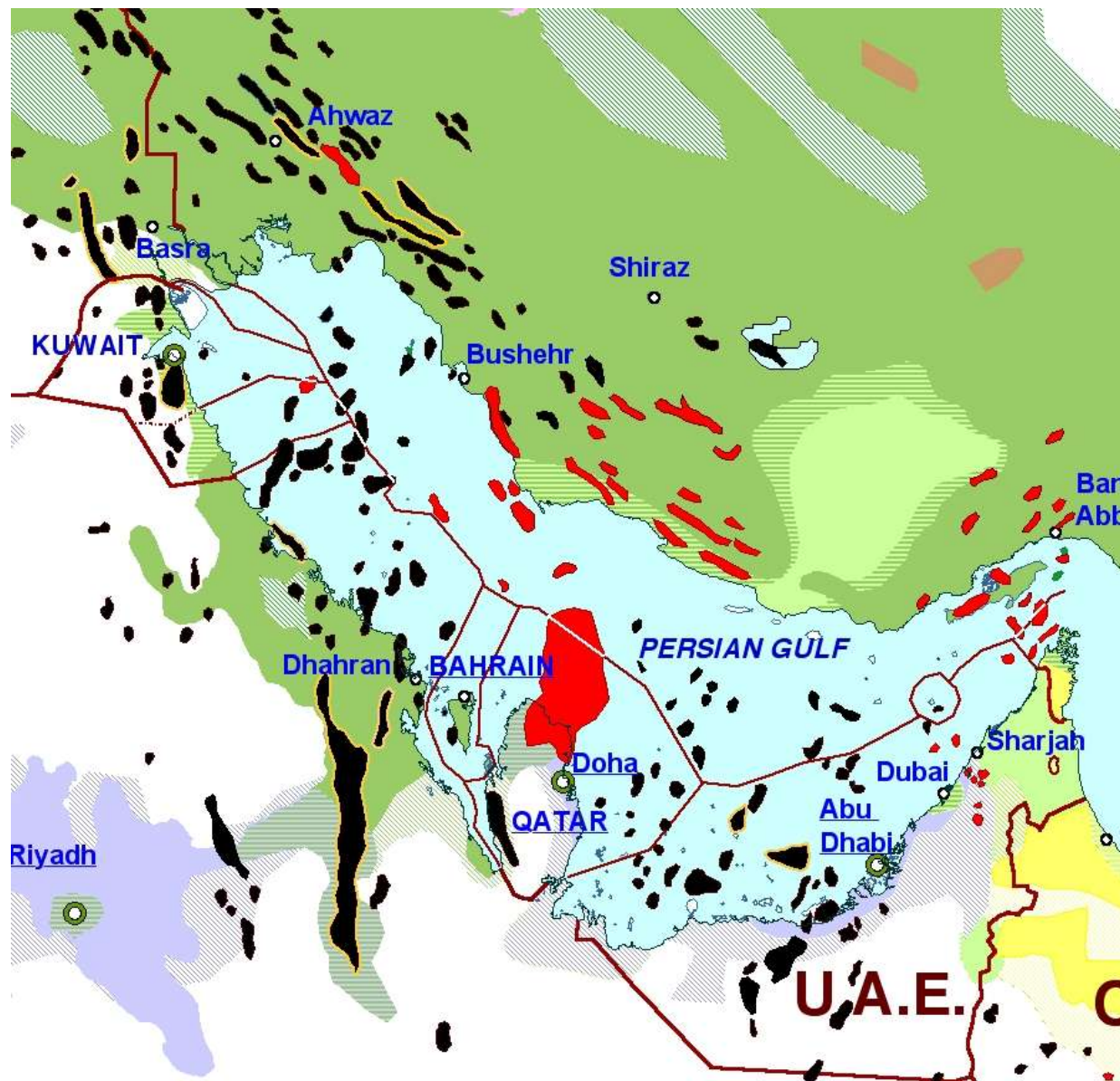
- **125,000+**, drawing on 1,000,000 Basij.
- **Key is 20,000 Naval Guards, including 5,000 marines.**
 - **Armed with HY-3 CSS-C-3 Seersucker (6-12 launchers, 100 missiles, 95-100 km), and 10 Houdong missile patrol boats with C-802s (120 km), and 40+ Boghammers with ATGMs, recoilless rifles, machine guns.**
 - **Large-scale mine warfare capability using small craft and commercial boats.**
 - **Based at Bandar e-Abbas, Khorramshar, Larak, Abu Musa, Al Farsiyah, Halul, Sirri.**
- **IRGC air branch reported to fly UAVs andUCAVs, and control Iran's strategic missile force.**
 - **1 Shahab SRBM Bde (300-500-700 km) with 12-18 launchers, 1 Shahab 3 IRBM Btn (1,200-1,280 km) with 6 launchers and 4 missiles each.**

MENA Oil Infrastructure



Source: http://www.eia.doe.gov/emeu/cabs/Persian_Gulf/images/pg_map.pdf

Vulnerability of Gulf Oil Fields



Primary Oil and Gas Deposits in the Middle East and the Shia Majority Areas.

- A Major Oil field
 - A Super-Giant Oil field
 - A Major Gas field
- Islam:
- Shiism (to include Alevis/Alawis)
 - Sunnism (Hanafi, Shafi'i, Maliki)
 - Wahhabism
 - Ibadism
 - Christianity
 - Judaism
 - Other
- Mixed population areas
 - Sparsely populated areas
 - Uninhabited areas

Source: M. Izady, 2006 <http://gulf2000.columbia.edu/maps.shtml>

Hormuz: Breaking the Bottle at the Neck



- 280 km long, 50 km wide at narrowest point.
- Traffic lane 9.6 km wide, including two 3.2 km wide traffic lanes, one inbound and one outbound, separated by a 3.2 km wide separation median
- Antiship missiles now have ranges up to 150 km.
- Smart mines, guided/smart torpedoes,
- Floating mines, small boat raids, harassment.
- Covert as well as overt sensors.

“Closing the Gulf” -I

- Land-based, long-range Seersucker, HY-2 Silkworm, CSS-C-3 anti-ship missiles based on land, islands: 12-36 batteries, 95-110 km range, LOS or hand-off radar targeting. **Sunburn? Iranian types?**
- Ship-based anti-ship missiles (C-802, CSS-N-4, and others: 120 km).
- 3 Kilo (Type 877) and unknown number of midget (Qadr-SS-3) submarines; smart torpedoes, (anti-ship missiles?) and smart mine capability.
- Raids with 8 P-3MP/P-3F Orion MPA and combat aircraft like F-4E with anti-ship missiles:(C-801K (8-42 km), and others).
- “Swarming” GCC, US, UK, French ships with multiple types of attacks and large numbers of simultaneous attacks by small craft, missiles, etc.

“Closing the Gulf” -II

- **Attacks on tankers, shipping, offshore facilities, critical shore facilities like oil export, power, and desalination by elements of 20,000 IRGC naval guards.**
- **Use of 5 minelayers, amphibious ships, small craft. (200+ ships & craft. Can use Dhows and commercial vessels for minelaying, infiltration & raids.**
- **2,000+ mines, smart (MDM/UDM? MDM-6? influence) and dumb (M08, M26 contact) mines: Moored, bottom, free floating, and torpedo tube launched.**
- **Oil spills, sabotage, ATGMs and rocket launchers, manpads & shorads.**

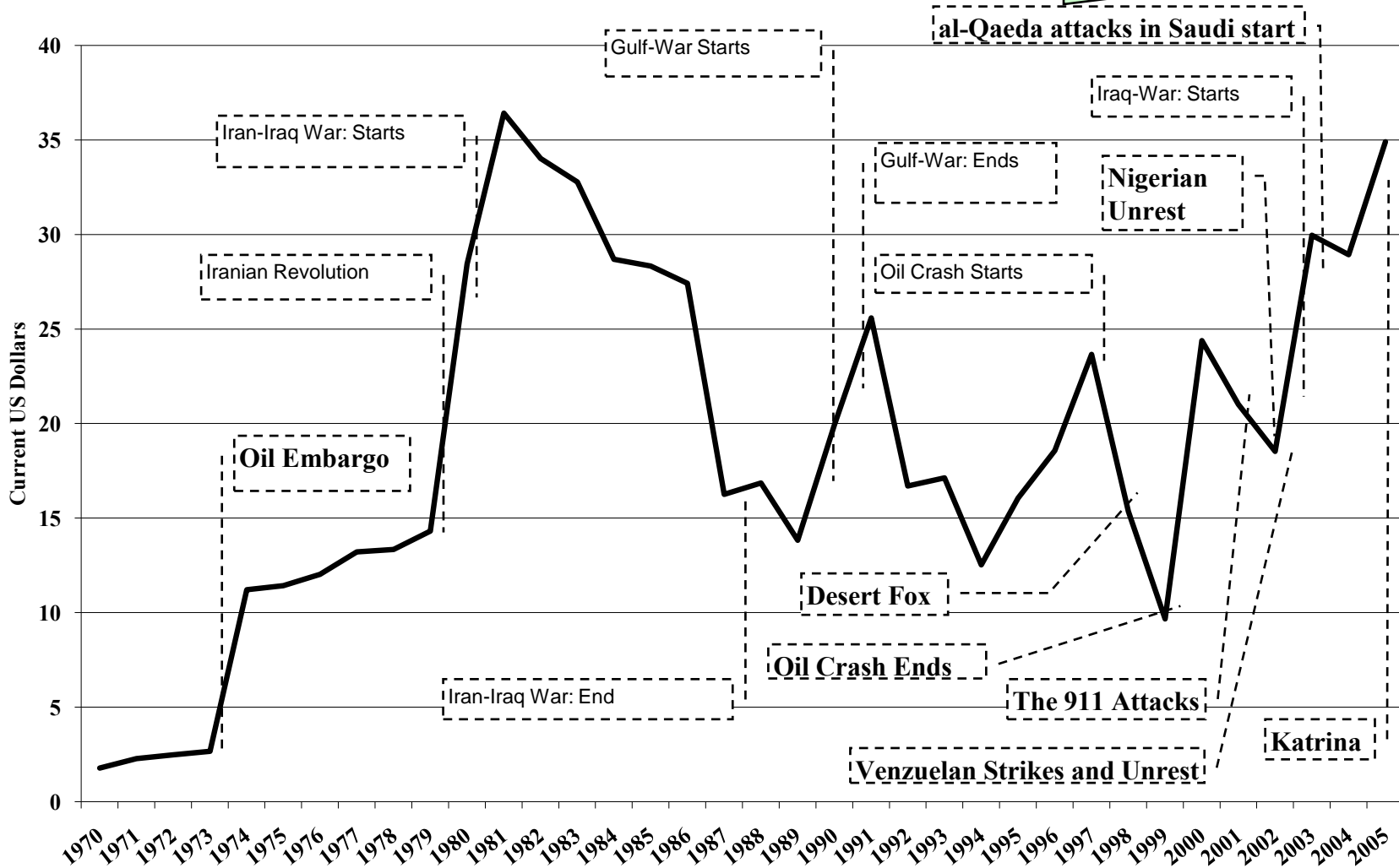
For a good unclassified analysis, see Caitlin Talmadge, “Assessing the Iranian Threat to the Strait of Hormuz,” [International Security](#), August 2008

Abu Musa, Tumbs, Hormuz: Factoids

- **34 miles (55 KM) wide at narrowest part.**
- **Channels consist of 2-mile (3.2 km) navigable channels for inbound and outbound traffic, separated by 2-mile wide buffer zone.**
- **40% of all globally traded oil supply.**
- **75%-plus of Japan's oil/**
- **13.4 MMBD of crude through Strait in May 2007**
- **Additional 2 MMBD of products and over 31 million tons of LNG.**
- **90% of all Gulf exports go through Strait.**
- **EIA predicts exports will double to 30-34 MMBD by 2020**
- **Gulf will export 40% of world's LNG by 2015.**

History of Oil Shocks: Pre-\$100 Oil

Overtimes: more incidents, more frequent volatility, higher risk of asymmetric attacks, and more geopolitical uncertainties.



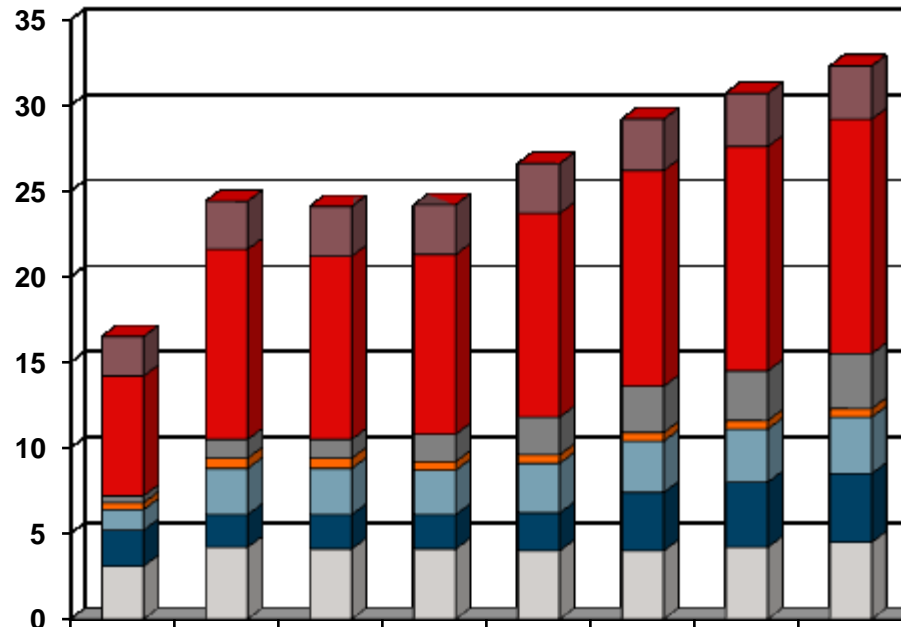
Source: EIA, "Crude Prices by Selected Type 1970-2005," <http://www.eia.doe.gov/emeu/aer/txt/ptb1107.html>.

Note: These prices are averages of several types: Saudi Light, Iranian Light, Libyan Es Sider, Nigerian Bonny Light, Indonesian Minas, Venezuelan Tia Juana light Mexico Maya, and UK Brent blend

Rising Output From Gulf Oil Producers: 2005-2030

(In MMBD in EIA/DOE reference case in IE0 2008)

Average world oil prices in 2030, then current dollars, are \$68 for low price case,, \$113 for reference case, and \$186 per barrel for high price case.

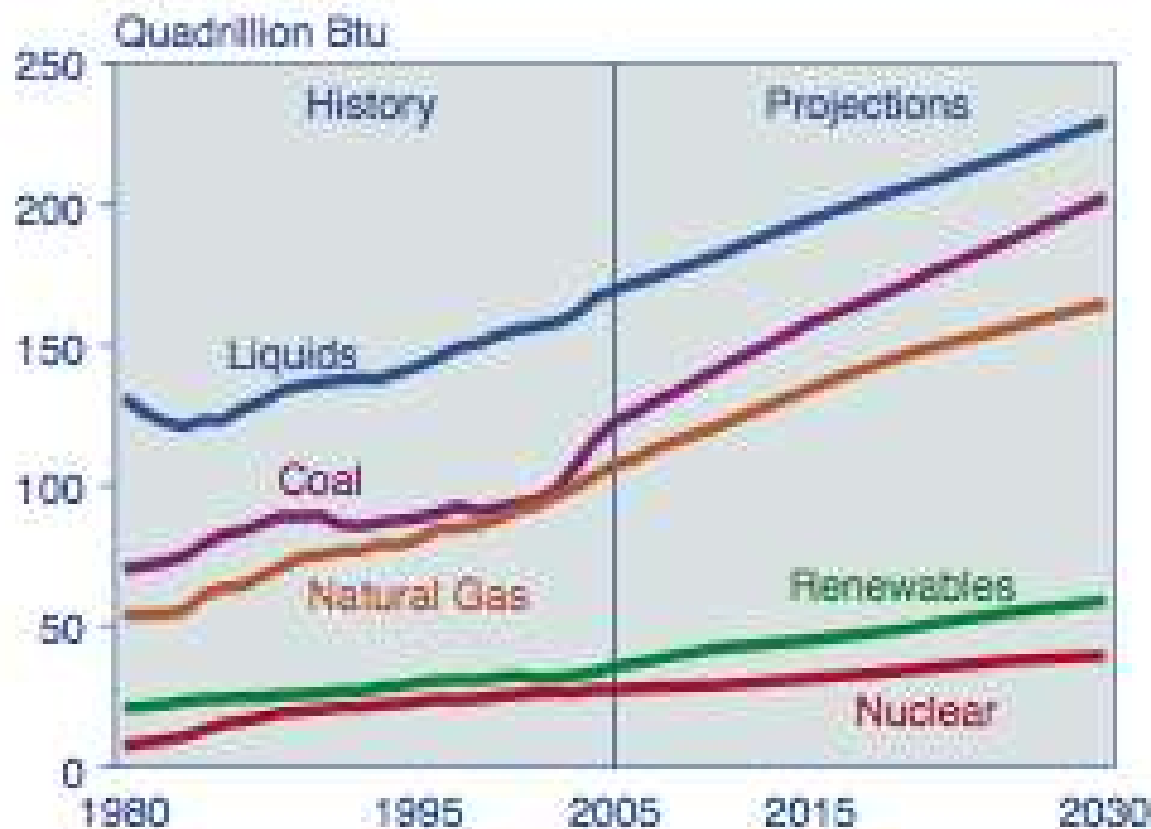


	1990	2005	2006	2010	2015	2020	2025	2030
■ Gulf as % of World	0	0	0	0	0	0	0	0
■ Gulf	0	0	0	0	0	0	0	0
■ UAE	2.3	2.8	2.9	2.9	2.9	3	3.1	3.1
■ Saudi Arabia	7	11.1	10.7	10.5	11.9	12.6	13.1	13.7
■ Qatar	0.4	1.1	1.1	1.6	2.2	2.7	2.9	3.2
■ Oman	0.4	0.6	0.6	0.5	0.5	0.5	0.5	0.5
■ Kuwait	1.2	2.7	2.7	2.6	2.9	3	3.1	3.3
■ Iraq	2.1	1.9	2	2	2.2	3.4	3.8	4
■ Iran	3.1	4.2	4.1	4.1	4	4	4.2	4.5

US EIA Estimate of Future Oil Prices

QuickTime™ and a
decompressor
are needed to see this picture.

World Energy Use: 1980-2030



Sources: 2005: Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. Projections: EIA, *World Energy Projections Plus* (2008).

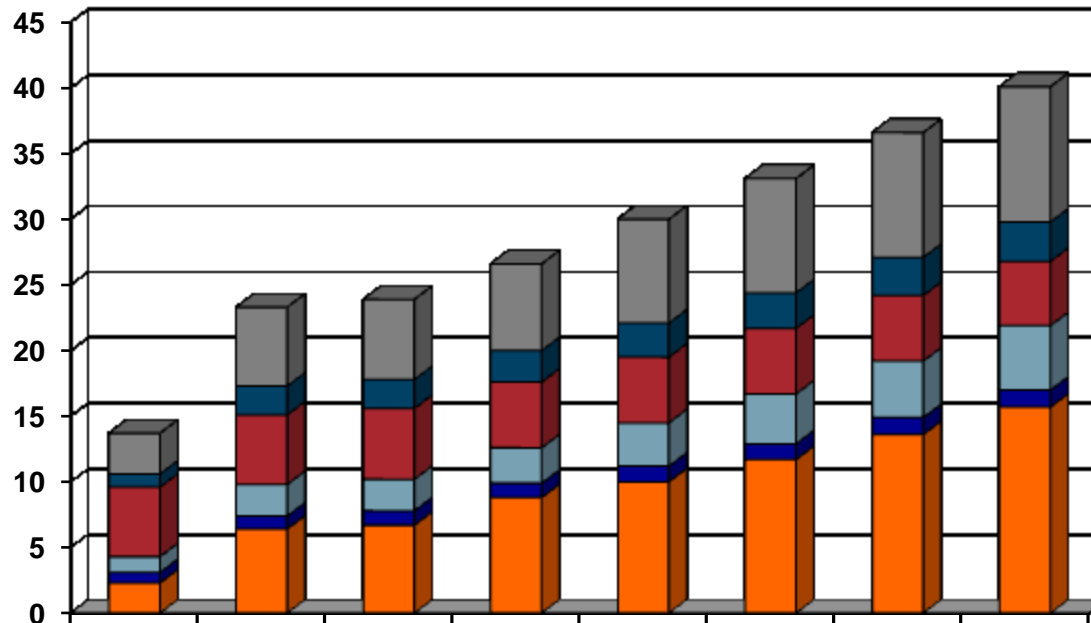
Net Import Share of U.S. Liquid Fuels Consumption, 1990-2030 – 2008 Estimate

Figure 90. Net import share of U.S. liquid fuels consumption, 1990-2030 (percent)



Growth of Total Asia Oil Demand

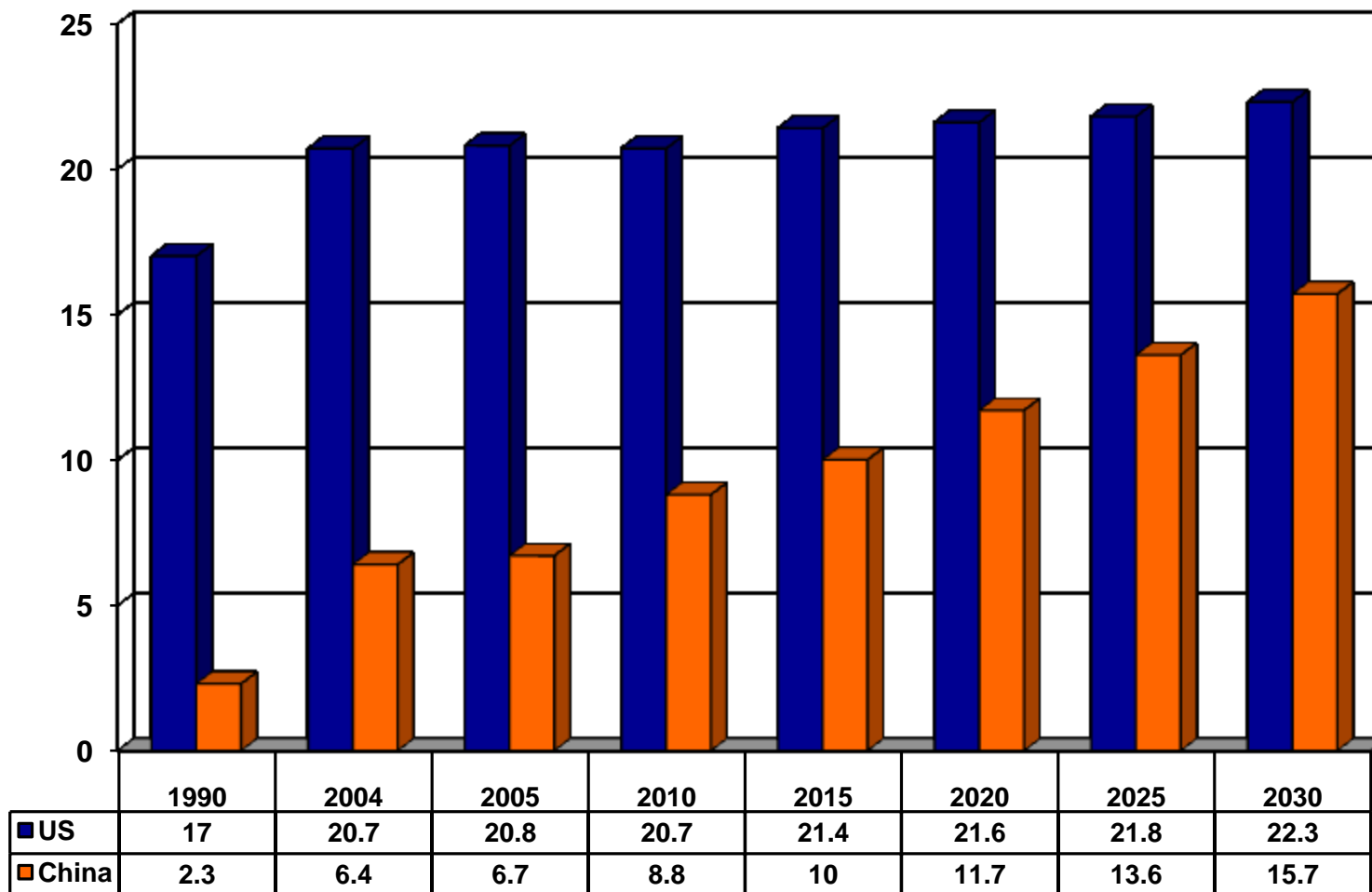
Consumption of Liquids in Millions of Barrels of Oil Equivalent: 2004 vs. 2030



	1990	2004	2005	2010	2015	2020	2025	2030
■ Other Asia	3.1	6	6.1	6.6	7.9	8.7	9.5	10.3
■ South Korea	1	2.2	2.2	2.4	2.6	2.7	2.9	3
■ Japan	5.3	5.3	5.4	5	5	5	5	4.9
■ India	1.2	2.4	2.4	2.7	3.3	3.8	4.3	4.9
■ Aus/Nz	0.8	1	1.1	1.1	1.2	1.2	1.3	1.3
■ China	2.3	6.4	6.7	8.8	10	11.7	13.6	15.7

Growth of Chinese and US Oil Demand

Consumption of Liquids in Millions of Barrels of Oil Equivalent



And, Energy Is Only Part of Problem

- **Critical dependence on desalination and key water system facilities. 30 major plants with no surplus capacity, and meeting only 60% of projected needs by 2020.**
- **Electric power critical to both economic and civil needs; grids often compartmented or limited in power transfer.**
- **Ports and air security critical to food imports.**
- **Some countries heavily dependent on security of domestic gas systems.**
- *Day to day use sometimes near total capacity.*
- *Poor response planning and long-lead time replacement for critical key components.*
- *Lack of systems integration and bypass capability at national and GCC level*

Meeting the Critical Infrastructure Security Challenge

- **Effective defense of the nation and Gulf waters/airspace.**
- **Joint military, paramilitary, law enforcement, and intelligence defense of critical facilities.**
- **Passive defense in terms of reducing critical vulnerabilities, redundancy, rapid repair and replacement, etc.**
- **Suitable response planning and planning for long-lead time replacement for critical key components.**
- **Systems integration and bypass capability at national and GCC level**

Most Likely Foreign Threats Are Not Formal Conflicts

- **Appeal to international community: victim of aggression, Israel, US.**
 - **Use to excuse withdrawal from IAEA or new levels of concealment.**
 - **Direct and indirect threats of using force. (I.e. Iranian efforts at proliferation)**
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The US, Israel, the Arab States and a Nuclear Iran

Part Six: The Warfighting Implications of An Iranian Nuclear Force

Anthony H. Cordesman
Arleigh A. Burke Chair in Strategy

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INTERNATIONAL STUDIES

Burke Chair
in Strategy

September 23, 2008

Key Actors in 2010-2020

- **Iran: Nuclear, CW, Long-Range ballistic and cruise missiles, strike aircraft, S-300/400 defenses.**
- **Israel: Nuclear (CW? BW?), Long-Range ballistic missiles, SLCMs/SSCs, air-launched cruise missiles, strike aircraft, Arrow, Patriot**
- **United States: Nuclear, ballistic missiles, SLBMs, SLCMs, Strike/bomber aircraft, ALCMs, Patriot, theater missile defenses.**
- **Gulf: Ballistic missiles, strike aircraft, Patriot/S-300/S-400, missile defenses.**
- **Syria: CW/BW, Ballistic missiles, strike aircraft, S-300.S-400.**
- **Non-State Actor: CW, BW, radiological, (loose nuke ?)**

Iran's Hypothetical Forces

- **Less than 50 nuclear weapons, most fission, possibly some boosted. 30 Nuclear warheads, 20 bombs.**
 - **Most 20-30 Kt, some 100 KT**
- **100 Shahab 3 and 3 ER on mobile TELs. 60 TELs.**
- **Su-24, F-14 convert, and Su-37 strike aircraft.**
- **Reverse engineered KH-55 cruise missiles.**
- **Mustard and persistent nerve gas, stable bombs, bombs and warheads with cluster munitions.**
- **Limited satellite targeting and damage assessment capability.**
- **Limited ballistic missile point defense capability with SA-300/SA-400**
- **Meaningful civil defense? No.**

Israel's Hypothetical Forces

- **200+ boosted and fusion weapons.**
 - **Most 20-100 Kt variable yield, some 1 Megaton.**
- **100 Jericho 1 and 2.**
- **30 Jericho ER.**
- **JSF, F15I, F-16I with nuclear-armed cruise missiles, advanced conventional precision strike capability.**
- **3 Dolphin submarines with nuclear armed SLCMs.**
- **High resolution satellite targeting and damage assessment capability.**
- **Moderate ballistic missile point and area defense capability with Arrow IV/V and Patriot PAC-3 TMD.**
- **CW? Assume Yes. BW? Assume No.**
- **Meaningful civil defense? CW only.**

US Hypothetical Forces

- **Variable yield boosted and fusion weapons.**
 - **Variable yield, 0.1 KT to 5 Megatons**
- **Ohio-class SSBNs with up to 24 Trident C-4 or D-5 SLBMs.**
- **B-52, B-1B, and B-2A with nuclear bombs and ALCMs.**
- **JSF F-35 Lightning II, F-22, F-15, F-18, F-16 with advanced conventional precision strike capability.**
- **Ohio, Los Angeles, Seawolf, Virginia SLCNs, with Tomahawk nuclear and conventionally armed missiles.**
- **High resolution satellite targeting and damage assessment capability.**
- **Ballistic missile point and (wide?) area defense capability with THAAD, Standard SM-2 and SM-3 (?), and Patriot PAC-3 TMD.**
- **CW? No. BW? No.**
- **Meaningful civil defense? Not Applicable.**

Syrian Hypothetical Forces

- **No nuclear weapons (?)**
- **Dusty Mustard Gas, Persistent nerve agents, in cluster bombs and warheads.**
- **Dry Anthrax micropowder biological weapons.**
- **30-60 Scud D (No Dong), 20 Scud C. (18 Scud B?)**
- **Su-24, Su-37 with conventional precision strike capability.**
- **No satellite targeting and damage assessment capability.**
- **S-300/S-400 defenses with limited ATBM capability.**
- **CW? No. BW? No.**
- **Meaningful civil defense? Not Applicable.**

Gulf Hypothetical Forces

- **No nuclear, CW, or BW weapons. (?)**
- **Pakistani wildcard.**
- **Saudis have replacement for CSS-2: E.g. 12 DF-21(CSS-5 IRBM).**
- **F-15, F-16, F-35II, Eurofighter with advanced conventional precision strike capability.**
- **Ballistic missile point and (wide?) area defense capability with THAAD, Standard SM-2 and SM-3 (?), S-300/S-400 and Patriot PAC-3 TMD.**
- **Meaningful civil defense? No.**

Non-State Hypothetical Forces

- **No nuclear weapons (?)**
 - **Loose nuke from FSU? Proxy transfer**
 - **Suit case nukes, nuke artillery round, ADM?**
- **Chemical**
 - **Mustard, blood agents, non-persistent nerve.**
- **Biological**
 - **Dry, coated, Anthrax micropowder equivalent.**
- **Radiological**
 - **Terror weapon capable of contamination, no wide area lethality.**
- **Crop sprayer UAV level of delivery system; knowledge of “line source” equivalent aerial delivery.**
- **Sabotage or seizure of state actor weapons?**

An 2015-2020 Israeli- Iranian Nuclear Exchange:

**Who Will Be an Existential
Threat to Whom?**

Introductory Cautions

- **Rational actors do not fight nuclear wars, but history is not written about rational actors behaving in a rational manner.**
- **Scenarios that follow are designed to test possible contingencies in warfighting, not create predictions or test the politics that could lead to war.**
- **Data are very nominal. Dealing with forces that may exist, of unknown capability.**
- **Nuclear and weapons effects data are extremely uncertain. Extrapolated from very limited and outdated examples.**
- **Direct killing effects are far better estimated than impact on long-term death rate and indirect casualty, political, and economic effects.**

Targeting and Existential Strikes

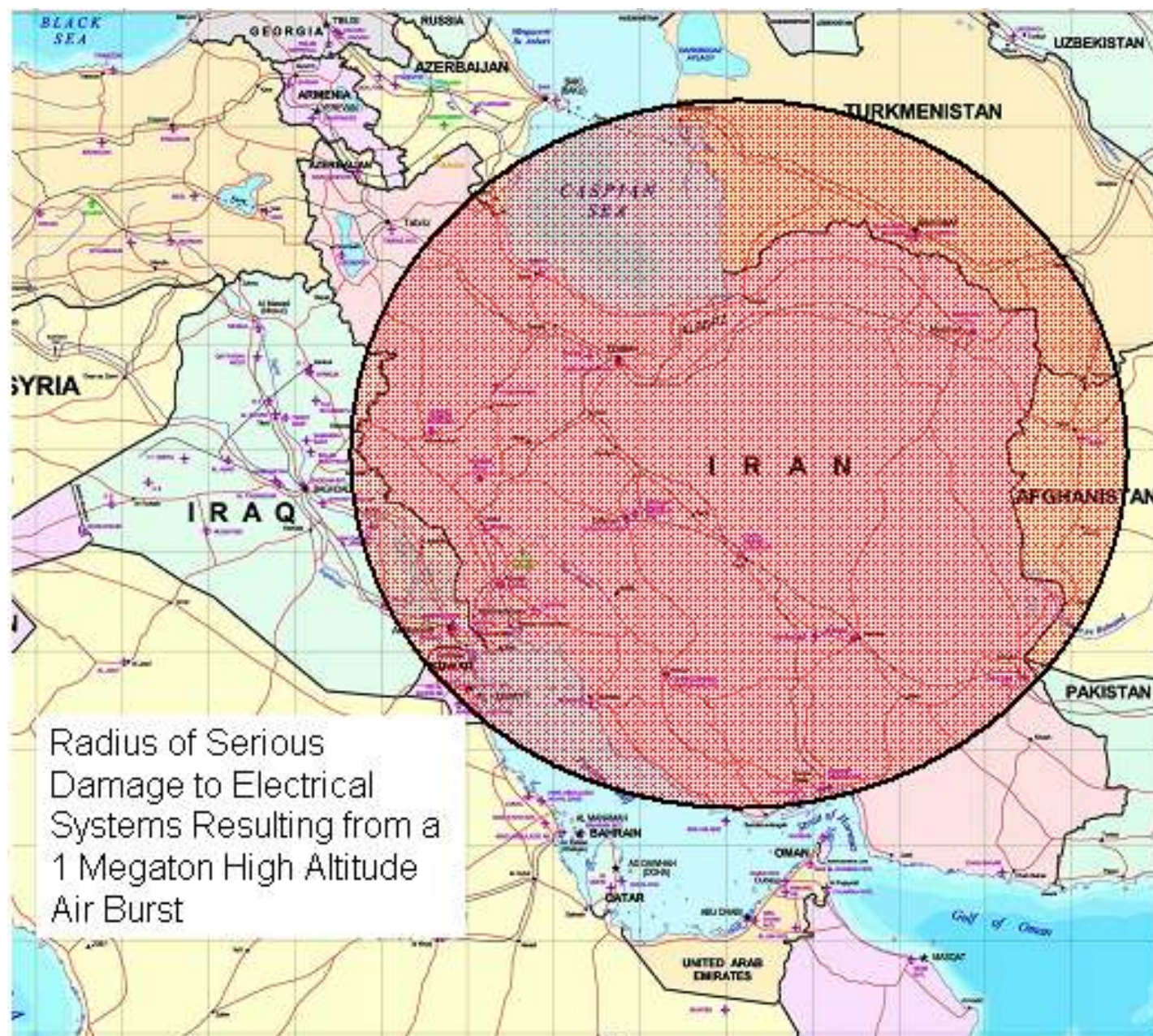
- **Technical targeting issues: CEP and reliability interact with yield**
 - The worse the accuracy and reliability, the more missiles needed to achieve a given level of damage.
 - Can easily require 3-5 devices per target, although “fratricide” limits actual ability to hit unless offset target to reduce or eliminate effect.
 - Yield is a critical factor. Simple fission weapons (10-20 KT) may need multiple strikes, where boosted (100 KT+) and fusion (500 KT, 1 MT, and up) do not.
 - Simple multiple reentry vehicle fission clusters can achieve same effect as thermonuclear weapons. MIRVing and MARVing can be far more effective.
- **Destroying the Enemy’s Existence as a Nation: “Existential targeting”**
 - Too few weapons for counterforce targeting once force dispersed, altered, or mobile.
 - Complex urban patterns complication issue: Coastal versus central cities, slope vs. basin formations, dust factors.
 - Airbursts increase some aspects of coverage, but ground bursts leave far more lasting effects. May lead to “offset” targeting if accuracy high enough.
 - Prompt kills only one aspect of impact. Even this hard to estimate.
 - Long-term kills and increased death rate are major lingering factors.
 - Continuity of government, sectarian and ethnic targeting key considerations.
 - Psychological and perceptual impacts critical.

Counterforce, Countervalue, Counterpopulation

- **Counterforce**
 - *Attack on enemy's military forces, particular strike and retaliatory capabilities.*
 - Too big, mobile and disperse a target base for nation with limited nuclear assets..
- **Countervalue**
 - *Attack on enemy's economy to punish, or deny recovery capability.*
 - Only in wealthy oil states can this be done without striking population.
 - Does not deal with anger, ideological extremism.
- **Counterpopulation**
 - *Attack on enemy's population to punish, deny recovery capability or destroy.*
 - Most destructive, best deterrent (?)
 - Easiest for powers with limited forces, limited weapons, seeking most deterrent.

Near Use to Warning Shot: Crisis “Management”

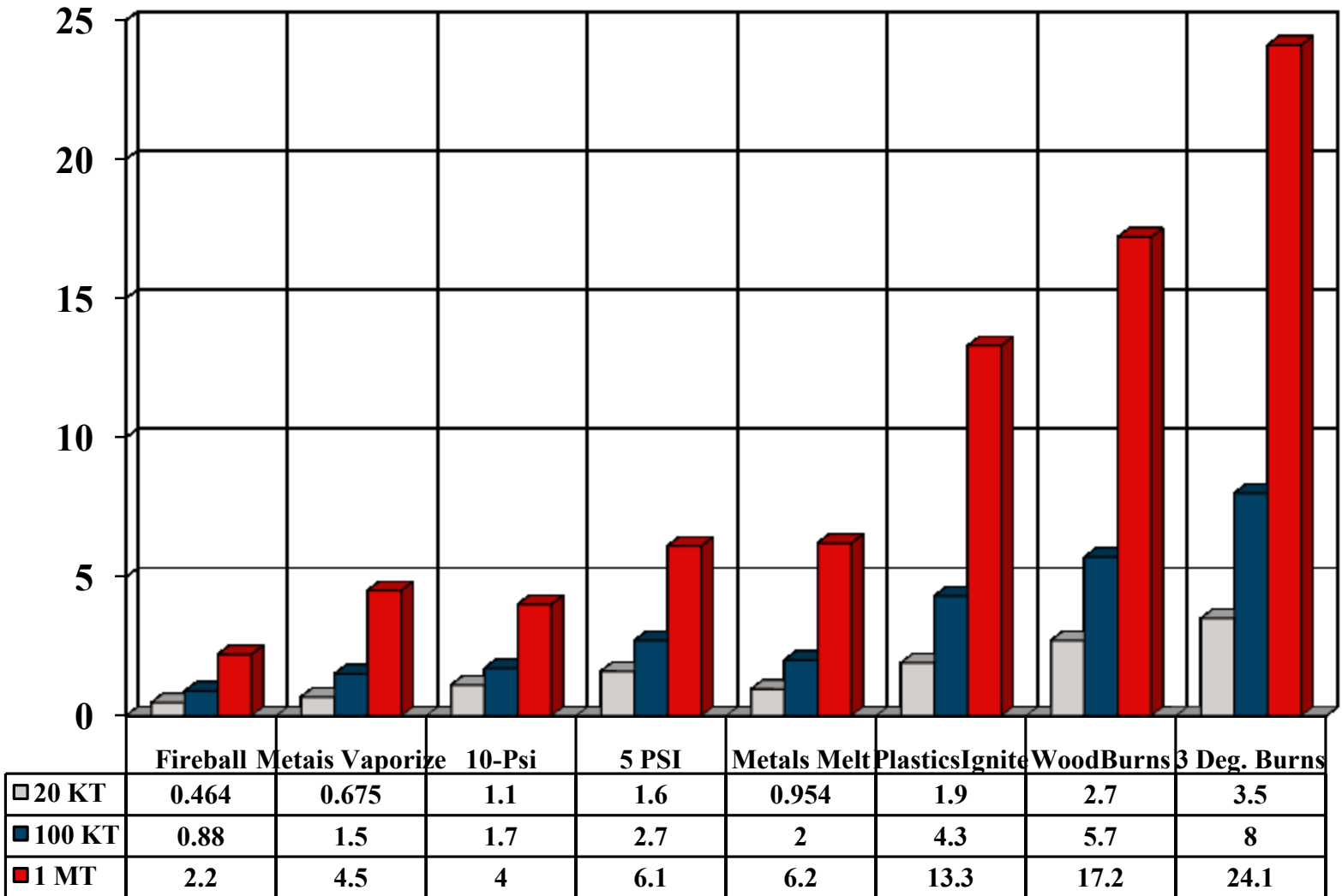
- **Escalatory crises can take on wide range from statements to warning use of weapons. No one scenario dominates.**
 - **Test or leak of nuclear/war plan data.**
 - **Going to new stages of alert.**
 - **Missile or nuclear tests.**
 - **Exercises**
 - **Movement of weapons, deployment of forces, talks of transfer to extremist groups.**
 - **“Safe” airburst to strike on low value target.**
- **“Bolt from the Blue; Strong Incentive Not to Warn**
 - **Catch opponent with forces undeployed or in vulnerable position: Warning systems and defenses at limited readiness.**
 - **If going counterpopulation, can strike an most dense population in target area.**
 - **Preserve maximum deniability if use covert or proxy attack**
- **Much depends on mix of force capabilities, war plans, leadership structure, IS&R and C4IBM.**
 - **Relative size, vulnerability, and capability of force can determine advantage and perception.**
 - **Good crisis and war planning prepares to both execute and management.**
 - **IS&R, C4IBM critical in building solid information base, mutual perceptions.**
 - **Demonstrative and limited use push the margin of restraint and credibility in region of “existential” strikes. LOW, LOA**
 - **Can preempt at any rung on the “escalation” ladder.**



Iranian-Israeli Exchange

- Assume mature, dispersed force on both sides. Preemption not an option
- Assume counterpopulation; counterforce and countervalue not an option.
- MAD-like environment; first strike of marginal or no benefit.
- **Iranian side:**
 - *Lower fission yields, less accurate force* into cluster targeting on Israel's two largest urban complexes.
 - Volley strike with all assets. Must seek to saturate or bypass Arrow and Israeli defenses.
 - Target to maximize casualties, clear attention to fall out, lasting effects.
 - Strike at Haifa and Ashdod-Tel Aviv-Yafo axis.
 - Inflict 200,000 to 800,000 prompt to 21-day dead; long term death rate cannot be calculated.
 - Iranian recovery not possible in normal sense of term.
- **Israeli side:**
 - Higher yields, more accurate force allow to strike all major Iranian cities.
 - Launch on confirmed warning from Israeli and US satellites.
 - Reserve strike capability to ensure no other power can capitalize on Iranian strike; target key Arab neighbors.
 - Launch at Syria if struck with CBRN weapons
 - Target to maximize casualties, clear attention to fall out, lasting effects.
 - Consider "Persian" ethnic strike option; send clear message cannot strike at Israel and survive.
 - Inflict 16,000,000 to 28,000,000 prompt to 21-day dead; long term death rate cannot be calculated.
 - Israeli recovery *theoretically* possible in population and economic terms.

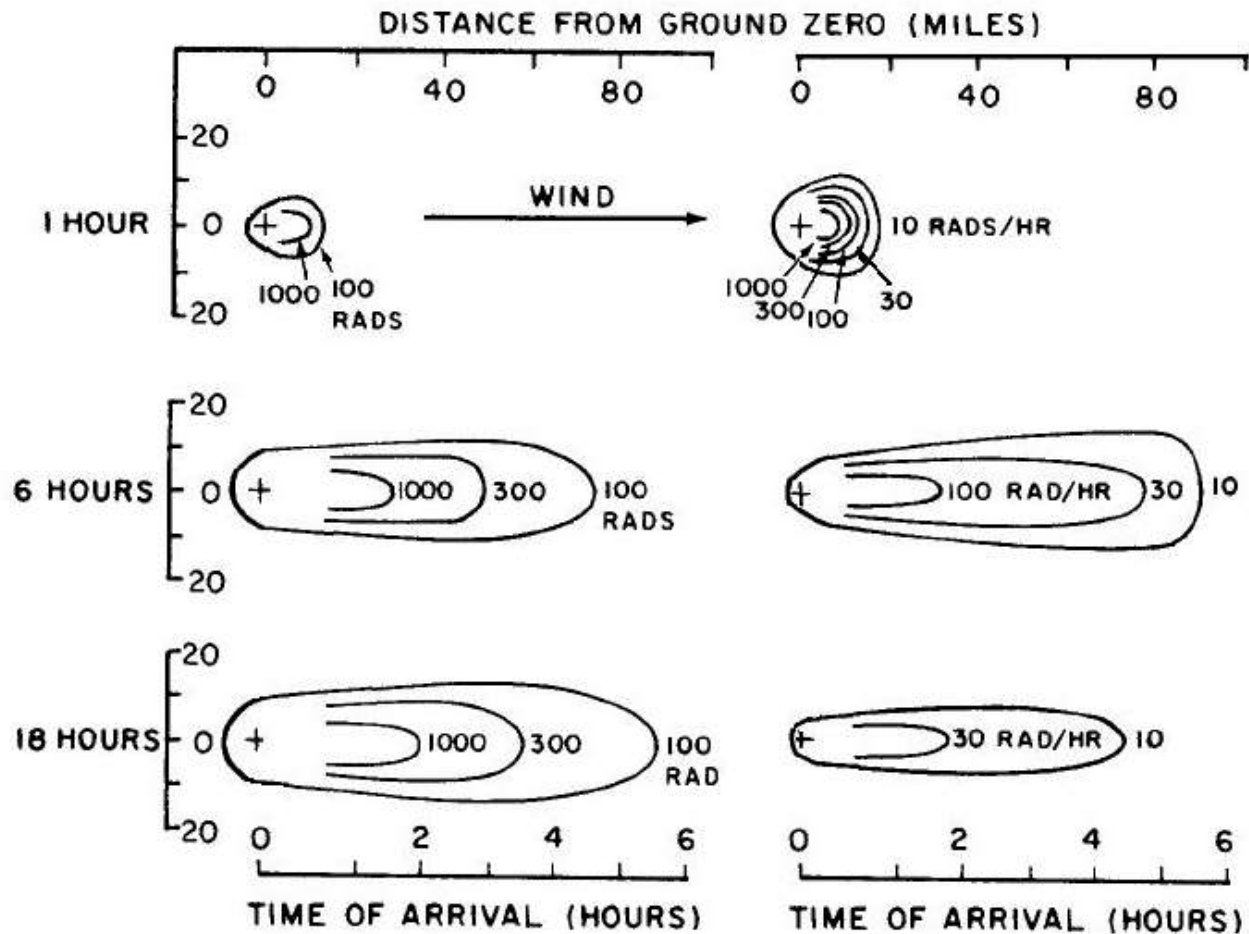
Israeli vs. Iranian Direct Lethality



Fall Out

- **The closer to ground a bomb is detonated, the more dust and debris is thrown into the air, and the more local fallout.**
- **Impact with the ground severely limits the blast and radiation from a bomb. Ground bursts are not usually considered tactically advantageous, with the exception of hardened underground targets such as missile silos or command centers.**
- **Population kills can be different. For a 1 MT explosion, lethal ellipses can reach 40-80 miles against unsheltered populations after 18 hours**
- **For a 1 MT explosion, lethal ellipses will reach 40-80 miles against unsheltered populations after 18 hours. Area of extreme lethality (3000 rads) can easily reach 20+ miles.**
- **A dose of 5.3 Gy (Grays) to 8.3 Gy is considered lethal but not immediately incapacitating. Personnel will have their performance degraded within 2 to 3 hours, and will remain in this disabled state at least 2 days. However, at that point they will experience a recovery period and be effective at performing non-demanding tasks for about 6 days, after which they will relapse for about 4 weeks. At this time they will begin exhibiting symptoms of radiation poisoning of sufficient severity to render them totally ineffective. Death follows at approximately 6 weeks after exposure.**
- **Delayed effects may appear months to years following exposure. Most effects involve tissues or organs. Include life shortening, carcinogenesis, cataract formation, chronic radiodermatitis, decreased fertility, and genetic mutations.**

Fall Out: The Variable Killing Ground from a 1 MT Weapon



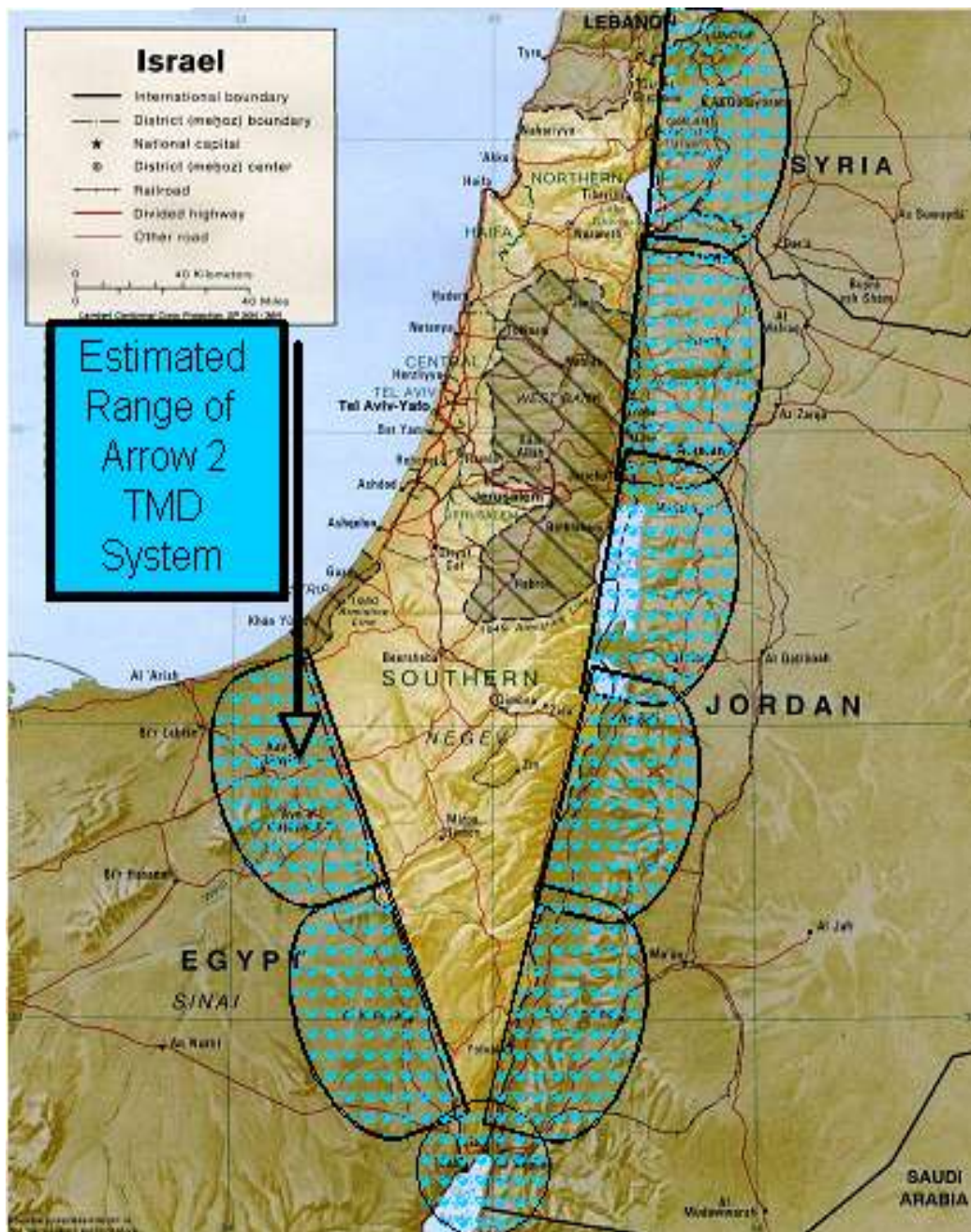
Israel's Key Cities

- **Dispersed in north-south strip along long coastal plain .**
- **Total population: 6.35 million.**
 - **Ethnicity: Jewish 76.4% (of which Israel-born 67.1%, Europe/America-born 22.6%, Africa-born 5.9%, Asia-born 4.2%), non-Jewish 23.6% (mostly Arab) (2004)**
 - **Religions: Jewish 76.4%, Muslim 16%, Arab Christians 1.7%, other Christian 0.4%, Druze 1.6%, unspecified 3.9% (2004)**
- **Jerusalem: (Untargetable because of Arab/Muslim population?)**
 - **724,000 (as of 2006). 65% Jewish, 32% Muslim, and 2% Christian, with a population density of 5,750.4 persons per sq. km**
 - **An area totaling 126 square kilometers (49 sq mi). Located in the Judean Mountains between the Mediterranean Sea and the Dead Sea.**
 - **Offset targeting might produce largely Jewish kills.**
- **Tel Aviv**
 - **Open flat, long north south axis with expanding east.**
 - **50.6 km² or 19.5 sq mi).**
 - **Population density is 7,445 people per km².**
 - **As of June 2006, the city's population stood at 382,500, growing at an annual rate of 0.9%.**
 - **96.1% percent of residents are Jewish, while 3.0% are Arab Muslims and 0.9% are Arab Christians. According to some estimates, about 50,000 unregistered foreign workers live in Tel Aviv.**
- **Haifa.**
 - **Range of hills acts to create basin effect.**
 - **Population of about 267,800 (as of May 2006).**
 - **The city and areas and towns around it are deemed to be in the Haifa District.**
 - **Seaport, located below and on Mount Carmel, and lies on the Mediterranean coast**

Israel: High Value Target Areas



Israel: TMD Coverage with *Existing* Arrow



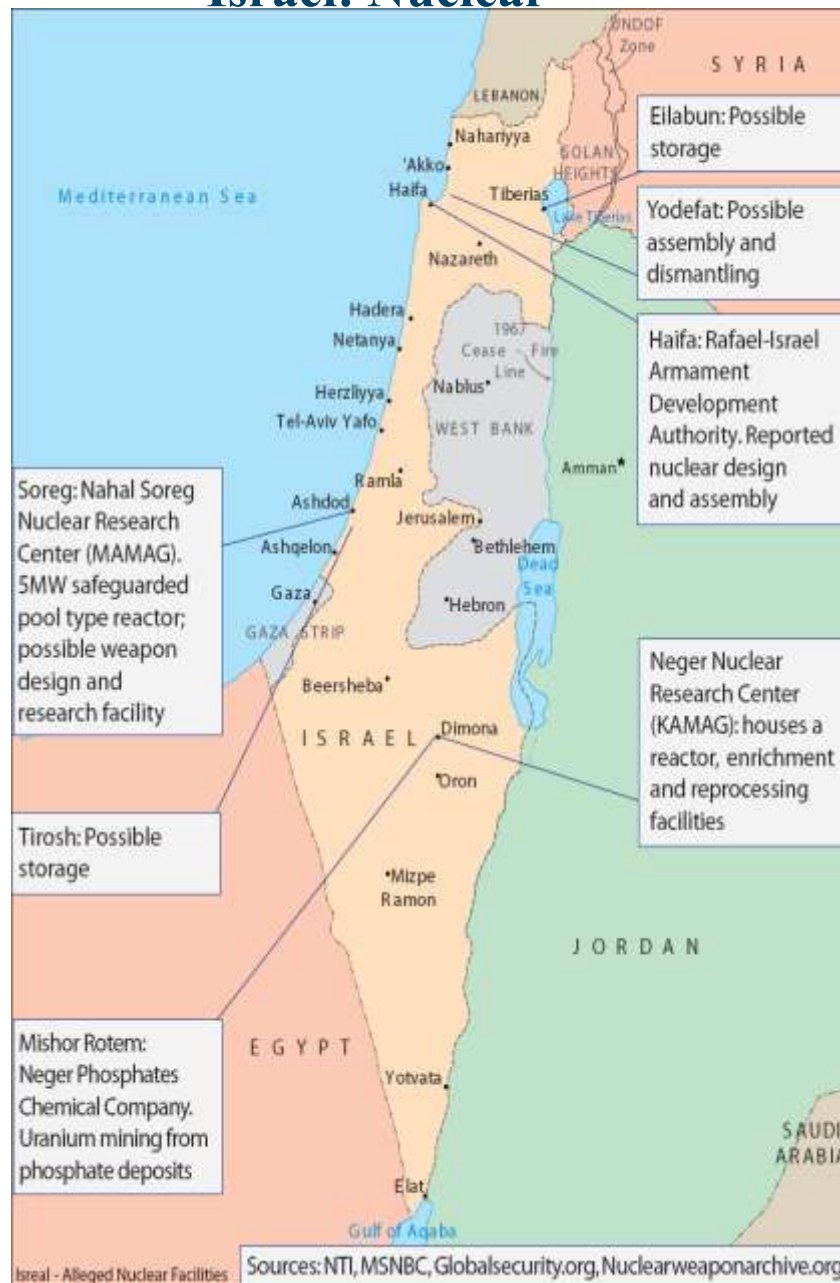
Israel: Missile



Israel: WMD



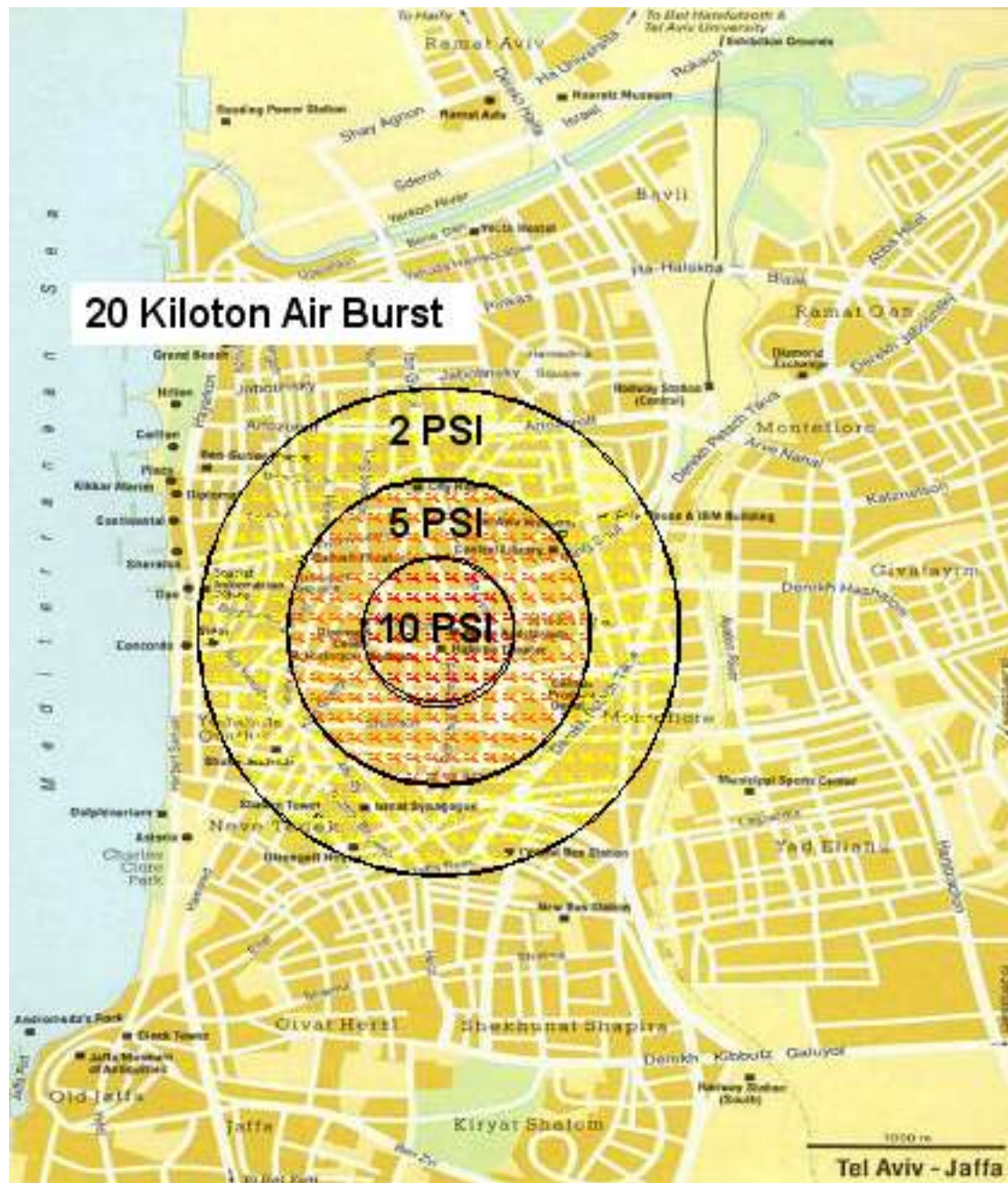
Israel: Nuclear



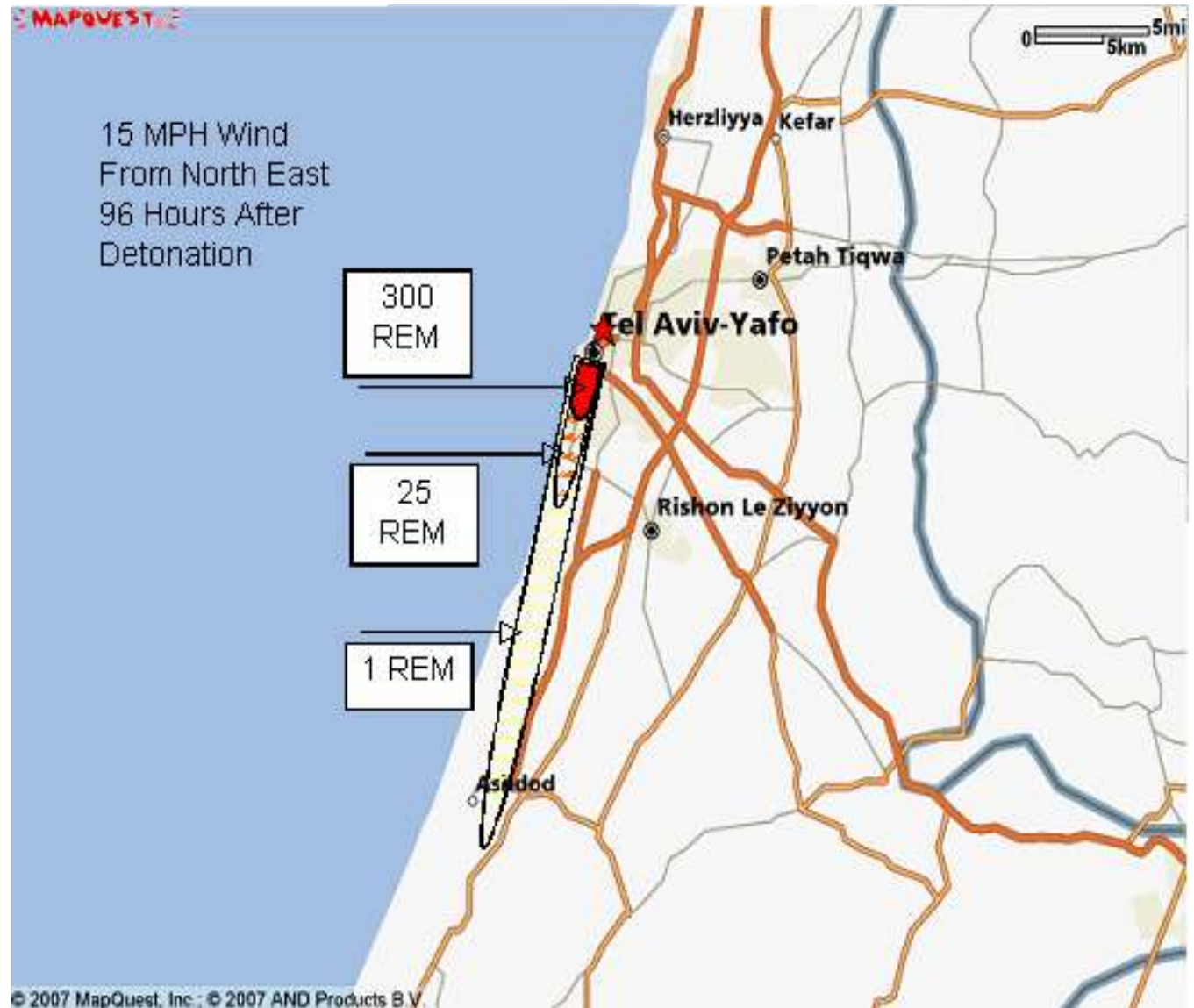
Source: NTI

Sources: NTI, MSNBC, Globalsecurity.org, Nuclearweaponarchive.org

Israel: Blast coverage of 20KT Iranian Nuclear Weapon



**Israel:
Nominal
Worst
Case
20KT
Fall Out
Coverage**



Israeli Missile Capability



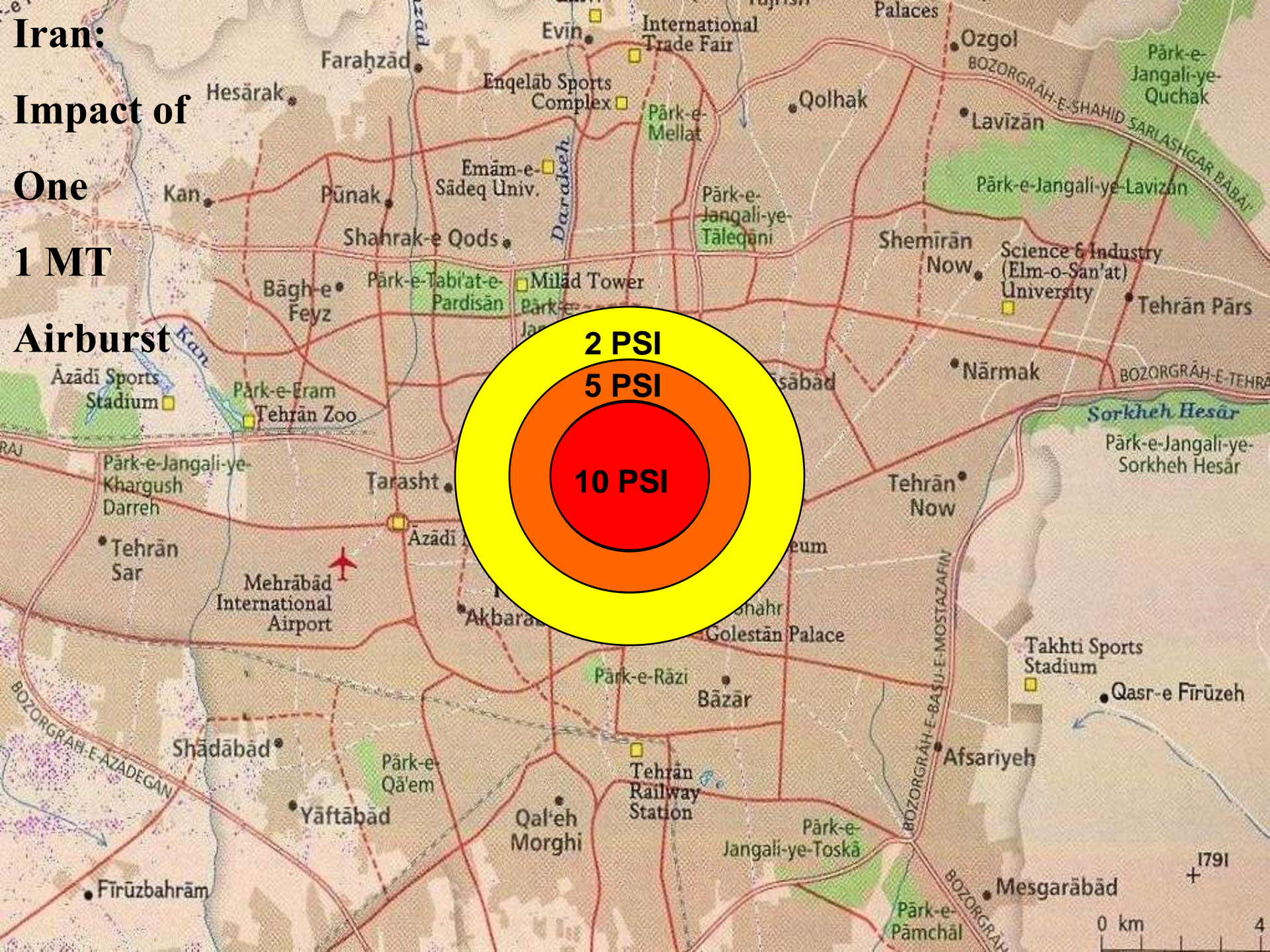
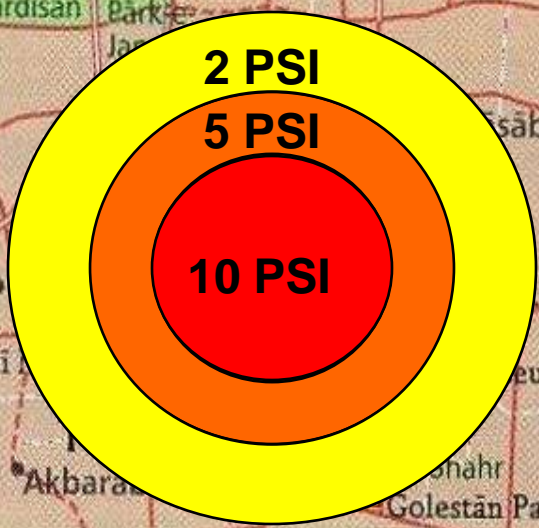
**Iran:
High
Value
Population
Centers**



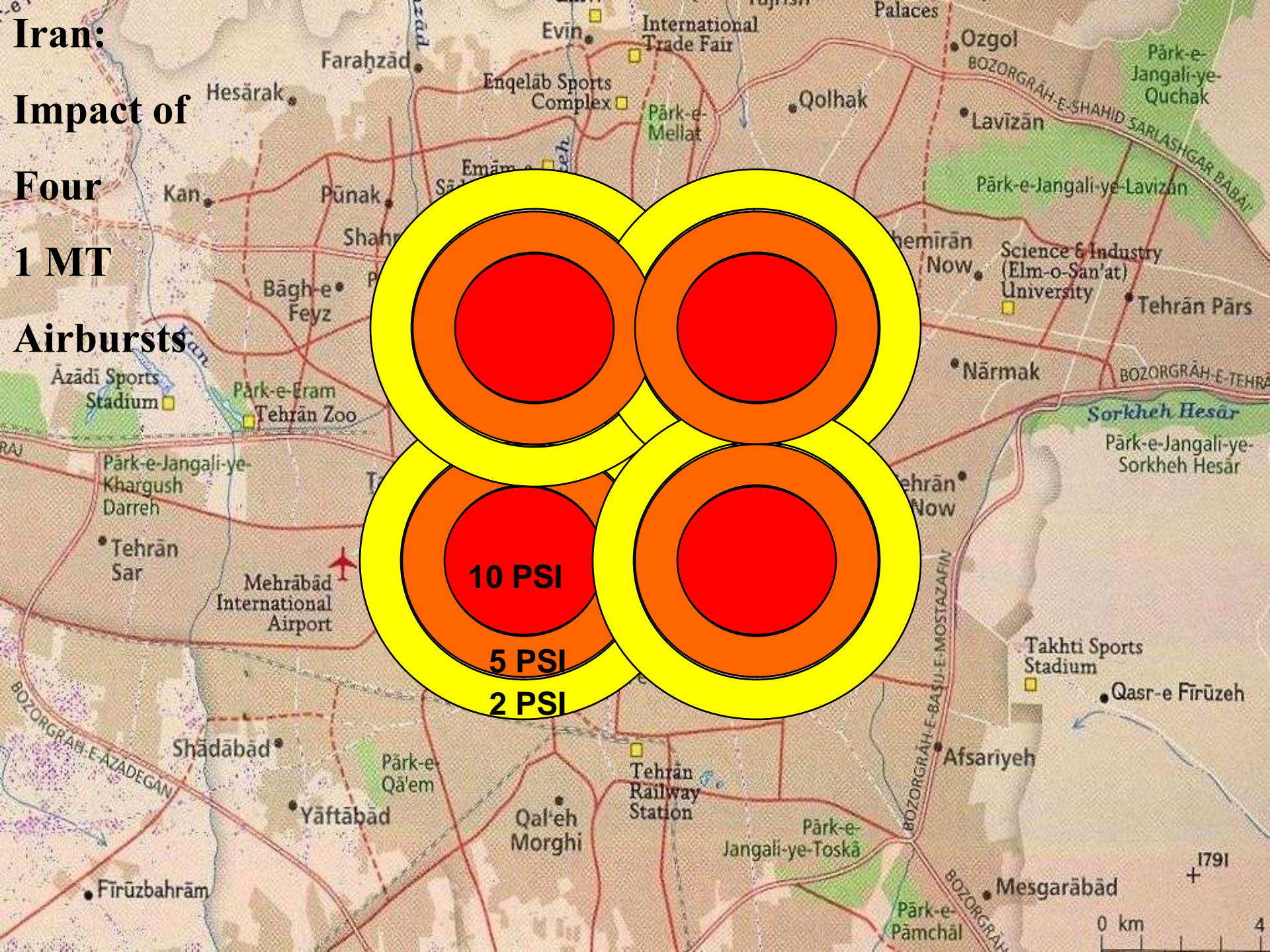
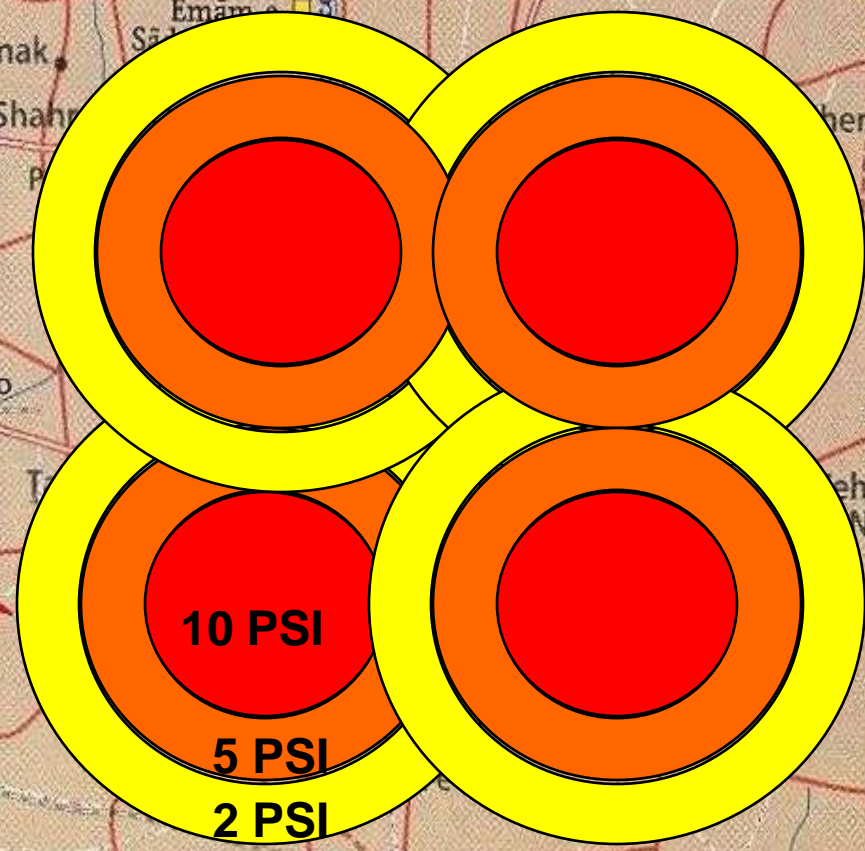
Tehran

- **Iran: Total of 68.7 million.**
 - **Ethnicity: Persian 51%, Azeri 24%, Gilaki and Mazandarani 8%, Kurd 7%, Arab 3%, Lur 2%, Baloch 2%, Turkmen 2%, other 1%**
 - **Religions: Muslim 98% (Shi'a 89%, Sunni 9%), other (includes Zoroastrian, Jewish, Christian, and Baha'i) 2%**
- **Tehran: Topographic basin with mountain reflector. Nearly ideal nuclear killing ground.**
- **Land area of 658 square kilometers (254 sq mi)**
- **Approximately 7.6 million people in city.**
- **12.6 million in municipal area and greater metropolitan area, and 15 million in municipal area. Some 20% of Iran's population.**
- **Tehran is a sprawling city at the foot of the Alborz mountain range with an immense network of highways unparalleled in western Asia.**
- **Hub of the country's railway network. The city has numerous cultural centers**
- **About 30% of Iran's public-sector workforce and 45% of large industrial firms are located in Tehran. More than half of Iran's industry is based in Tehran..**
- **Tehran is the biggest and most important educational center of Iran. Nearly 50 major colleges and universities in Greater Tehran.**
- **Majority of residents are Persians who speak many different dialects of Persian corresponding to their hometown. (including Esfahani, Shirazi, Yazdi, Khuzestani, Semnani, Taleghani, Dari, Judeo-Persian, etc) The second largest linguistic group is that of the Azari.**

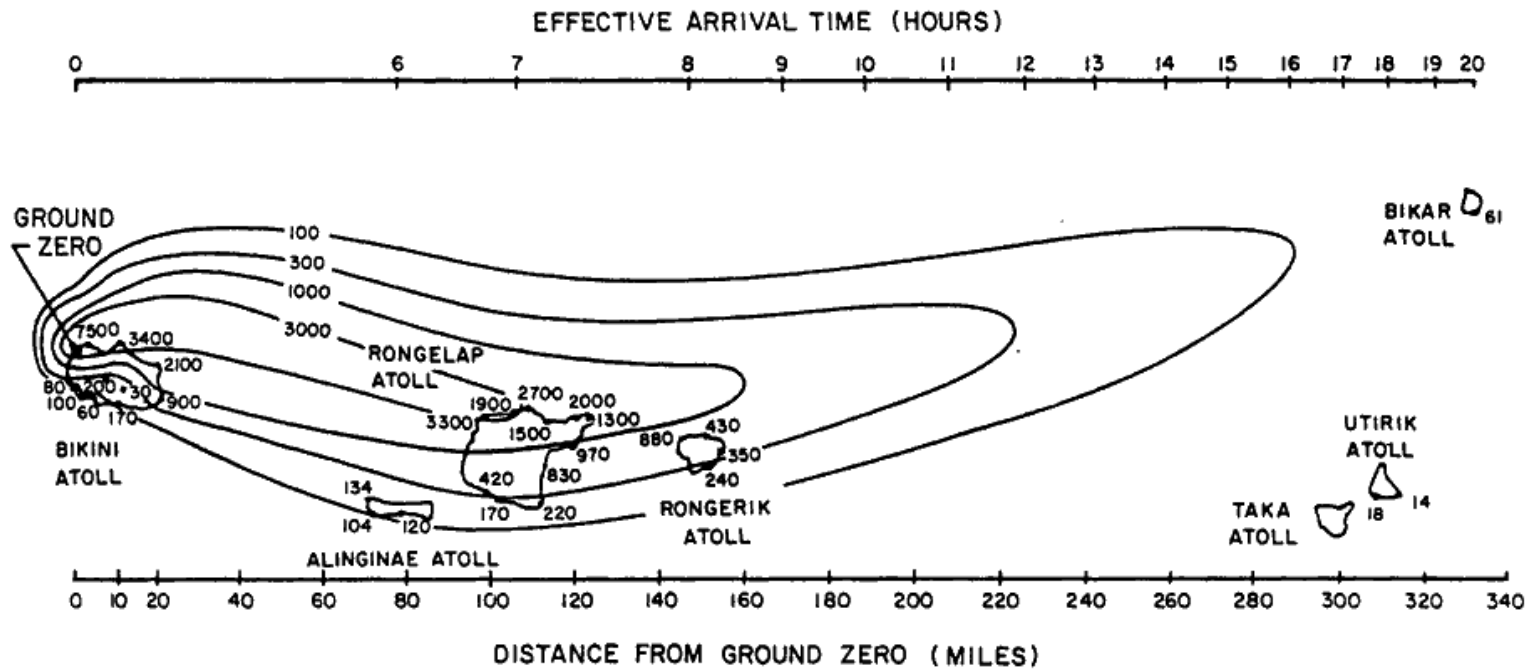
Iran: Impact of One 1 MT Airburst



Iran: Impact of Four 1 MT Airbursts



Tehran: The Fallout Problem



Source: http://en.wikipedia.org/wiki/Nuclear_fallout

Arab and Gulf Cases:

Looking Beyond the US, Israel, and Iran

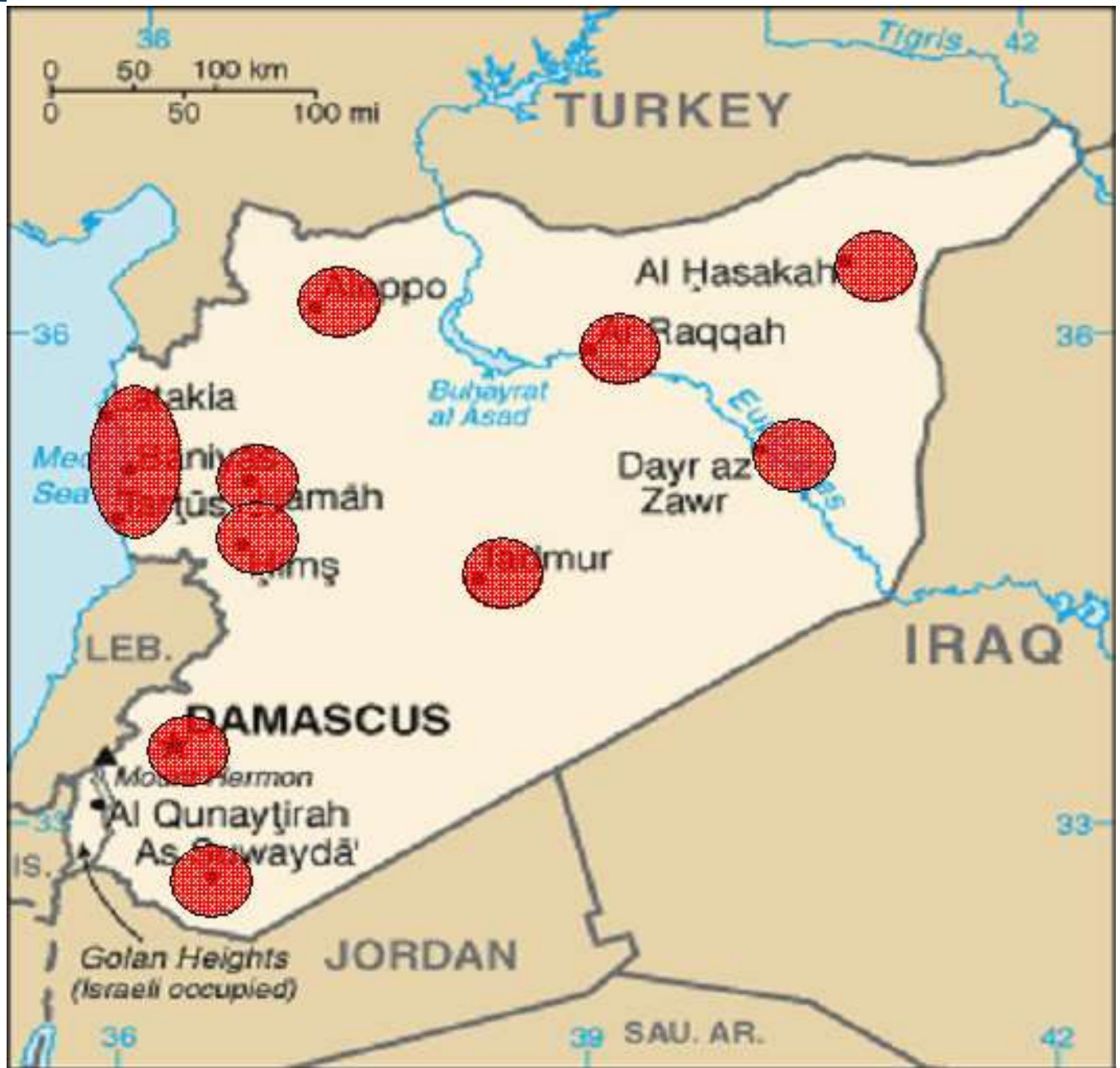
Other Exchange and Deterrence Issues are Critical

- **What regimes can be deterred on the basis of “rational calculations?” Iran is not the only problem.**
- **Expertise in crisis management, level of understanding of key civilian and military decision makers.**
- **Stable structures of warning, attribution, and information to decision makers.**
- **Status of launch of warning, launch under attack, pause, and ride out capabilities.**
- **Level of trans and post attack understanding of escalation, strikes, and impacts.**
- **Threat or execution of nuclear asymmetric response to US guarantees or action in extended deterrence; Israeli strikes: Make the Gulf and oil the target.**
- **Status of Syrian, Israel and Arab/Palestinian tensions some 5-20 years in future.**
- **Who is nuclear/missile armed in the future?**
- **Scale of advances in ballistic/cruise missile/air defense**
- **Nuclear-biological asymmetry?**
- **Countervalue conventional vs. nuclear options?**
- **Are damage limiting preventive or preemptory strikes possible?**

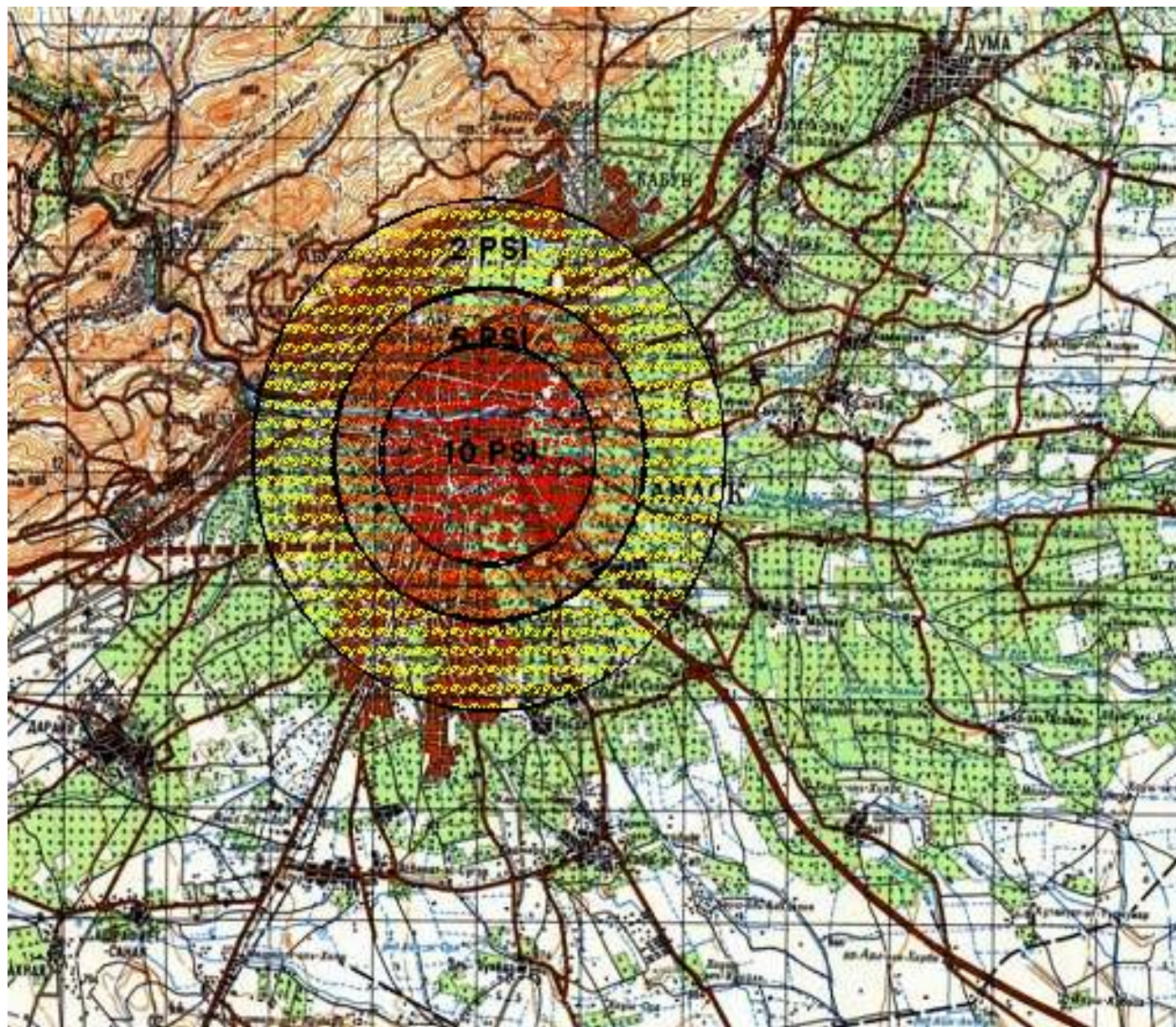
Syrian “Wild Card”-Israeli Exchange

- Assume dispersed force on both sides. But, Israeli preemption may be a limited option
- Assume counterpopulation; counterforce and countervalue not an option.
- CBRN versus Thermonuclear retaliation; first strike of at least marginal benefit.
- Syrian side:
 - Have to assume believe have Biological Weapon of great lethality, or replace “MAD” with “SAD”.
 - Auxiliary or follow-up to Iranian strike?
 - Volley strike with all assets. Must seek to saturate or bypass Arrow and Israeli defenses.
 - Target to maximize casualties, clear attention to fall out, lasting effects.
 - Strike at Haifa and Ashford-Tel Aviv-Yahoo axis.
 - 200,000 to 800,000 prompt to 21-day dead; long term death rate cannot be calculated.
 - Syrian recovery not possible in normal sense of term.
- Israeli side:
 - Higher yields, more accurate force allow to strike all major Syrian cities with 2+1.
 - Launch on confirmed warning from Israeli and US satellites.
 - Reserve strike capability to ensure no other power can capitalize on strikes on Israel; target key Arab neighbors.
 - May combine nuclear counterpopulation with nuclear/conventional counterforce strikes. Syria has a maximum of 11 cities with over 80% of population.
 - Target to maximize casualties, clear attention to fall out, lasting effects.
 - Consider “Alawite” ethnic strike option; send clear message cannot strike at Israel and survive.
 - 6,000,000 to 18,000,000 prompt to 21-day dead; long term death rate cannot be calculated.
 - Israeli recovery *very* possible in population and economic terms.

**Syria:
High
Value
Population
Centers**



**Syria:
1 MT
Strike
On
Damascus**



Egypt: High Value Population Centers



**Egypt:
1 MT
Strike
On
Cairo**



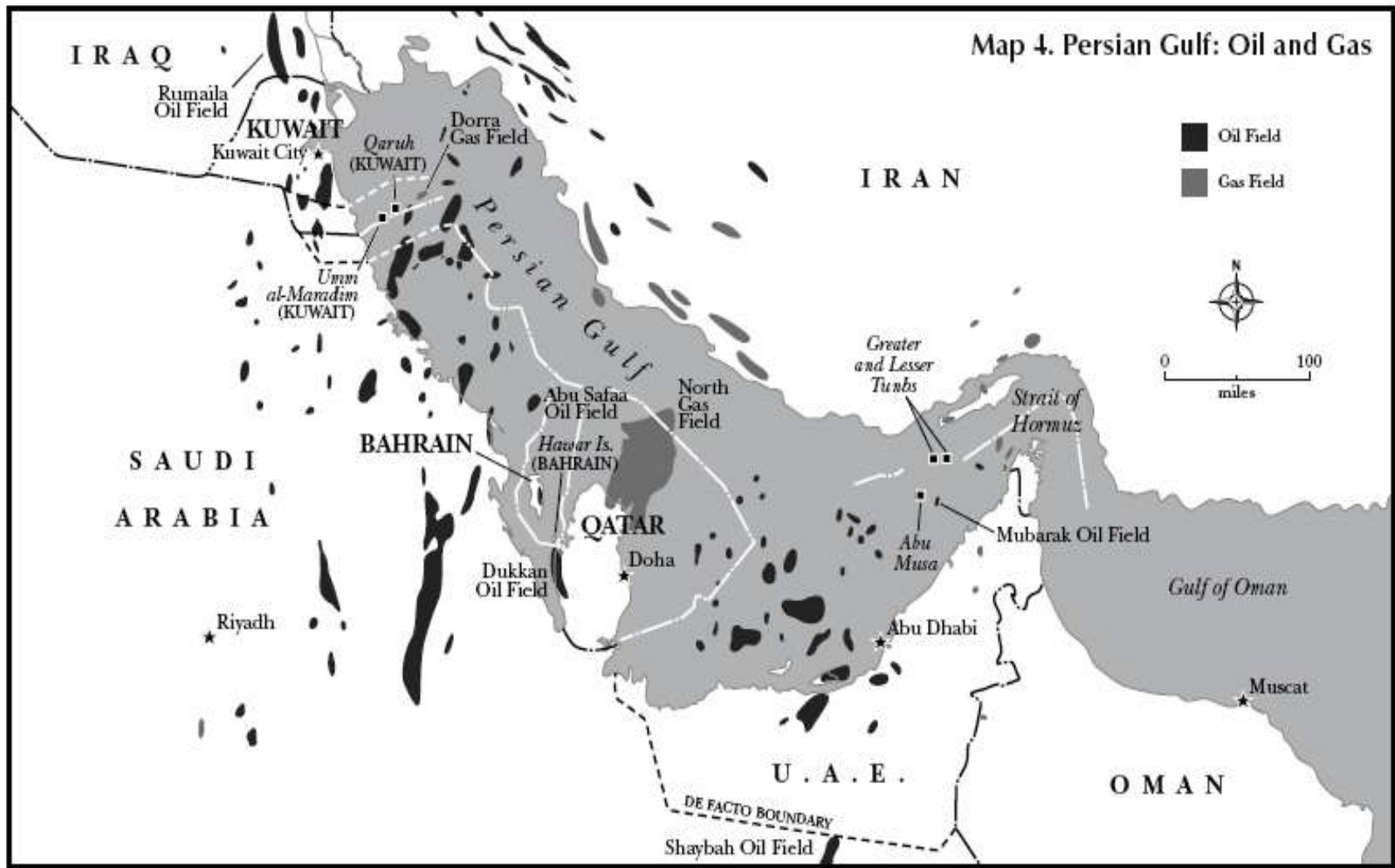
Iran Nuclear, US Conventional

- Assume mature, dispersed Iranian force. Preemption limited option for US, but face launch on warning, launch under attack option.
- Iran cannot threaten US. Can threaten US bases in Gulf, Israel, Europe, GCC allies, Egypt, Jordan, oil export capabilities.
- SAD-like environment relying on proxy targets for maximum damage to US.
- Iranian side:
 - Limited strike designed to intimidate or show resolve, force issue without generating massive nuclear retaliation. Might focus on Arab target, rather than US or Israel, to try to limit retaliation.
 - *Reserve strike capability critical.*
 - *Lower fission yields, less accurate force* limit range of targeting, but can cover all US bases and mix of other targets.
 - Target to maximize casualties, clear attention to fall out, lasting effects.
 - Inflict 2,000,000 to 8,000,000 prompt to 21-day dead; long term death rate cannot be calculated.
 - Iranian recovery very possible.
- US side:
 - Some preemptive damage limitation possible.
 - Launch on confirmed warning from US satellites.
 - Massive reserve conventional and nuclear strike capability.
 - Stealth and precision strike capability give weapons of mass effectiveness (WME) capability.
 - Power, refineries, continuity of government, C4I assets.
 - EMP option would be “semi-nuclear” response.

WME: “Weapons of Mass Effectiveness”

- **Theoretical possibility, give precision long-range strike capability.**
- **Target mix varies with attacker’s motives.**
- **Broad possible target base in MENA area, varying sharply by country.**
 - **Desalination**
 - **Major power plants, nuclear power plants.**
 - **Water purification and distribution.**
 - **Refinery**
 - **High value, long-lead time oil, gas, and petrochemical facilities.**
 - **Ethnic and sectarian high value targets.**
 - **Leadership elite: Royal family, president, etc.**

The Gulf Target Base

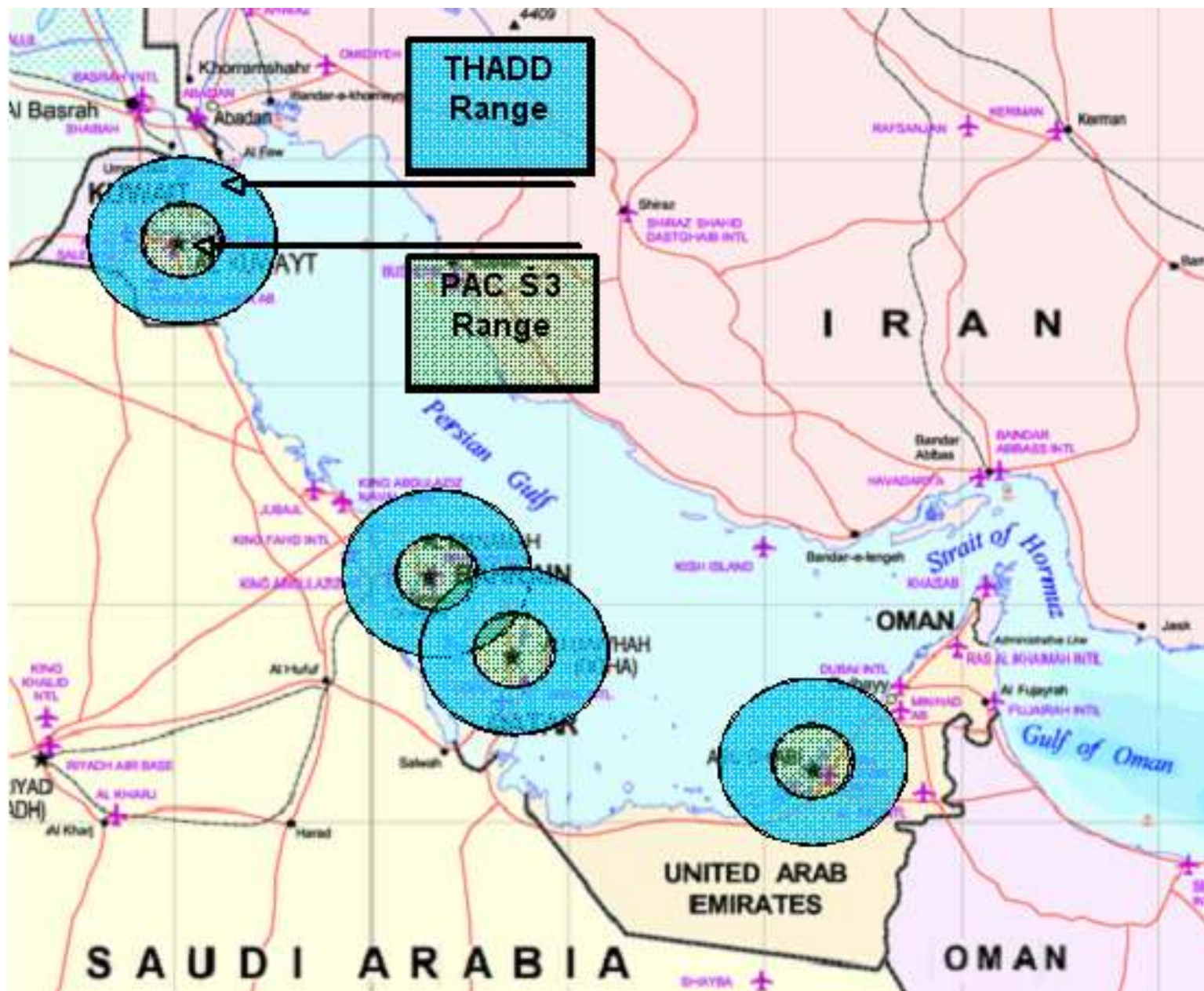


Iran Nuclear, US Nuclear

- Assume mature, dispersed Iranian force. Preemption limited option for US, but face launch on warning, launch under attack option.
- Iran cannot threaten US. Can threaten US bases in Gulf, Israel, Europe, GCC allies, Egypt, Jordan, oil export capabilities.
- SAD-like environment relying on proxy targets for maximum damage to US.
- Iranian side:
 - Either conclude face massive US strike or launch on warning, launch under attack option.
 - *All out volley likely, but limited escalation and reserve option possible.*
 - *Lower fission yields, less accurate force* limit range of targeting, but can cover all US bases and mix of other targets.
 - Target to maximize casualties, clear attention to fall out, lasting effects.
 - Inflict 2,000,000 to 8,000,000 prompt to 21-day dead; long term death rate cannot be calculated.
 - Iranian recovery dependent on scale of US retaliation.
- US side:
 - Preemptive damage limitation unlikely.
 - Launch on confirmed warning from US satellites.
 - May go counterforce, counter leadership.
 - Can easily escalate to destroy much of population.
 - Same basic dilemma as in Cold War: more dead Iranians does not “win” in face of loss of US forces, allied population, but may have to chose assured destruction to maximize deterrence.
 - Law of unintended consequences in terms of global reaction if act or do not act.

GCC Options

- **The Saudi missile and nuclear warhead buy option, with or without GCC support, is key “wild card.”.**
- **Iran can threaten “existential strikes on all Gulf capitals and main population centers.**
- **May avoid US bases in Gulf, Israel, in hopes of avoiding massive retaliation..**
- **Iranian side:**
 - **Either conclude face massive US strike or launch on warning, launch under attack option.**
 - ***All out volley likely, but limited escalation and reserve option possible.***
 - ***Lower fission yields, less accurate force* limit range of targeting, but can cover all capitals, key cities, and US bases.**
 - **Target to either show resolve as last step or maximize casualties, clear attention to fall out, lasting effects.**
 - **Inflict 2,000,000 to 8,000,000 prompt to 21-day dead; long term death rate cannot be calculated.**
 - **Iranian recovery very possible.**
- **Gulf-GCC side:**
 - **Theater missile, cruise missile, air defenses.**
 - **Limited nuclear option of own ? Launch on confirmed warning from US satellites.**
 - **May go counterforce, counter leadership.**
 - **Can easily escalate to destroy much of population.**
 - **Same basic dilemma as in Cold War: more dead Iranians does not “win” in face of loss of US forces, allied population, but may have to chose assured destruction to maximize deterrence.**
 - **Law of unintended consequences in terms of global reaction if act or do not act.**



The “War Game” Paradox:

**The Only Way to Win is
Not to Play**

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The US, Israel, the Arab States and a Nuclear Iran

Part Seven: The Problem of International Response & Arab Attitudes

Anthony H. Cordesman
Arleigh A. Burke Chair in Strategy

CSIS

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INTERNATIONAL STUDIES

Burke Chair
in Strategy

September 23, 2008

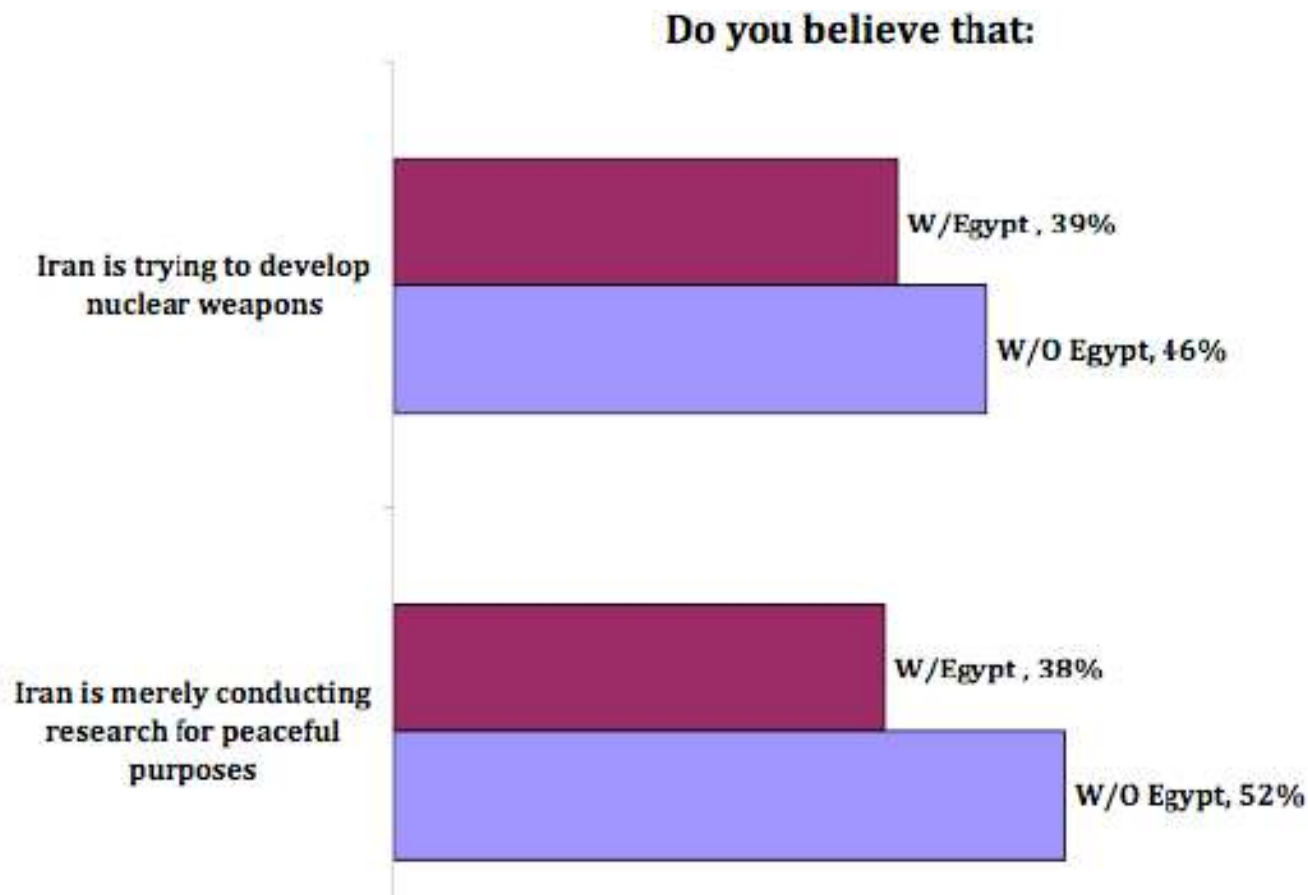
The Problem of International Response & Arab Attitudes:

**Towards the US and Towards Iranian
Nuclear Weapons**

The Broad Problem for the US

- **US faces broad international unpopularity and even by populations of allied states; Not just an Arab problem.**
- **Seeming betrayal of 5+1 negotiations; US seen a rogue state.**
- **Heritage of intelligence failures in Iraq; perception of reckless rhetoric in “axis of evil,” four years of war scares.**
- **Even an unambiguous “red light” to will be seen as “green light” by Israel, Arabs, and international community, and may be treated as such by Israel.**
- **Israeli failure or partial success may provoke Iran to very different effort: Legacy effect.**
- **Impact on Iraq and Afghan Wars; Israel-Palestinian peace process.**
- **“Law of Unpleasant Consequences”**

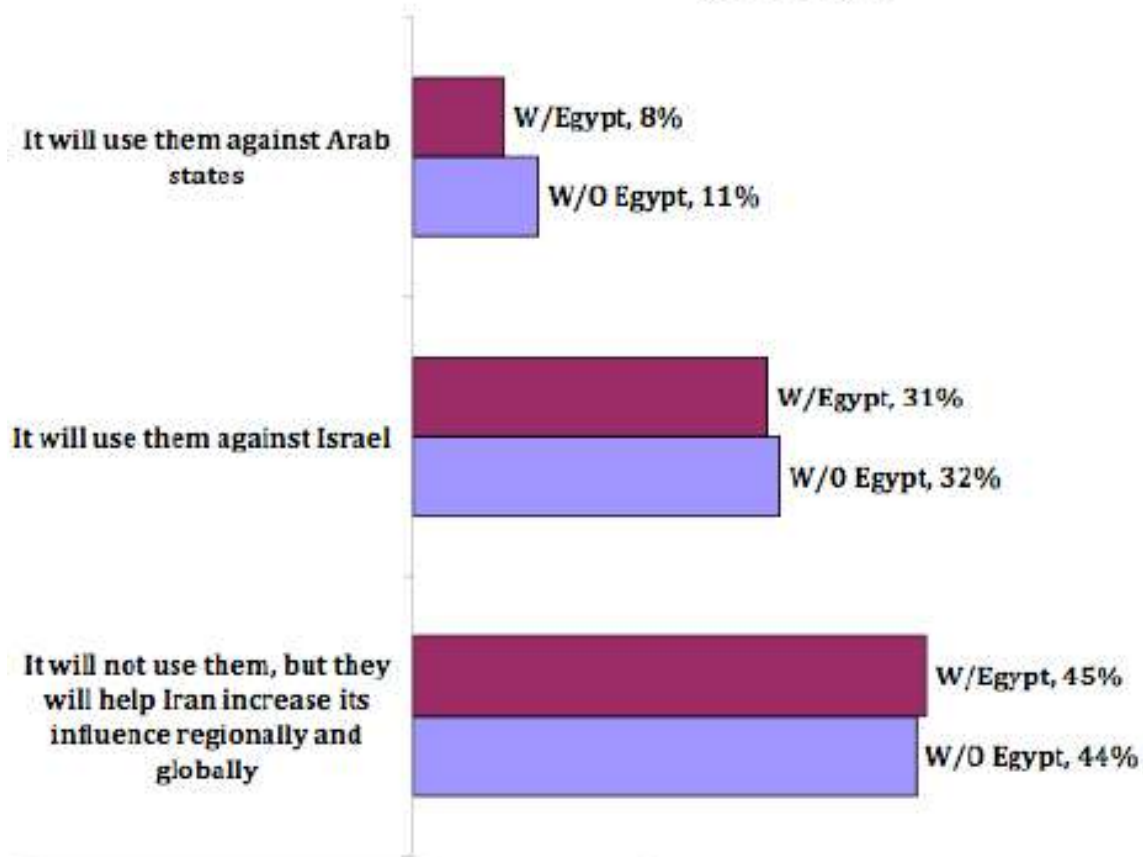
Arab Public Opinion on Whether Iran Has A Nuclear Program



Source: Shibley Telhami, 2008 Annual Arab Public Opinion Poll Survey of the Survey of the Anwar Anwar Sadat Chair for Peace and Sadat Chair for Peace and Development at the University of Maryland Development at the University of Maryland (with Zogby International) International) Conducted March 2008 in Egypt, Jordan, Survey conducted March 2008 in Egypt, Jordan, Lebanon, Morocco, Saudi Arabia (KSA) and the Lebanon, Morocco, Saudi Arabia (KSA) and the UAE UAE

Arab Public Opinion on Impact of Iran's Nuclear Program

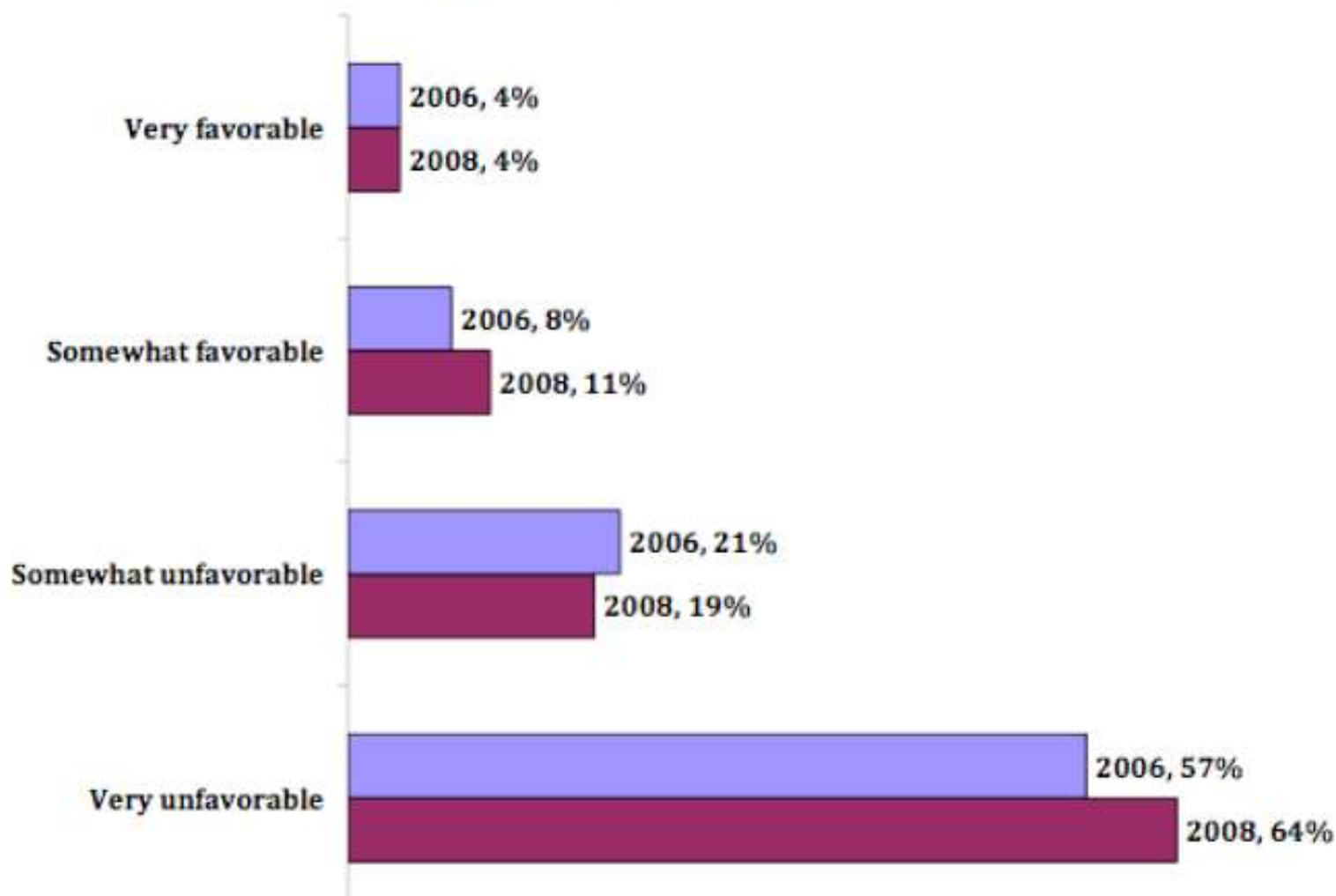
If Iran acquires nuclear weapons, which of the following is closest to your view:



Source: Shibley Telhami, 2008 Annual Arab Public Opinion Poll Survey of the Survey of the Anwar Anwar Sadat Chair for Peace and Sadat Chair for Peace and Development at the University of Maryland Development at the University of Maryland (with Zogby International) International) Conducted March 2008 in Egypt, Jordan, Survey conducted March 2008 in Egypt, Jordan, Lebanon, Morocco, Saudi Arabia (KSA) and the Lebanon, Morocco, Saudi Arabia (KSA) and the UAE UAE

Arab Public Opinion on the US

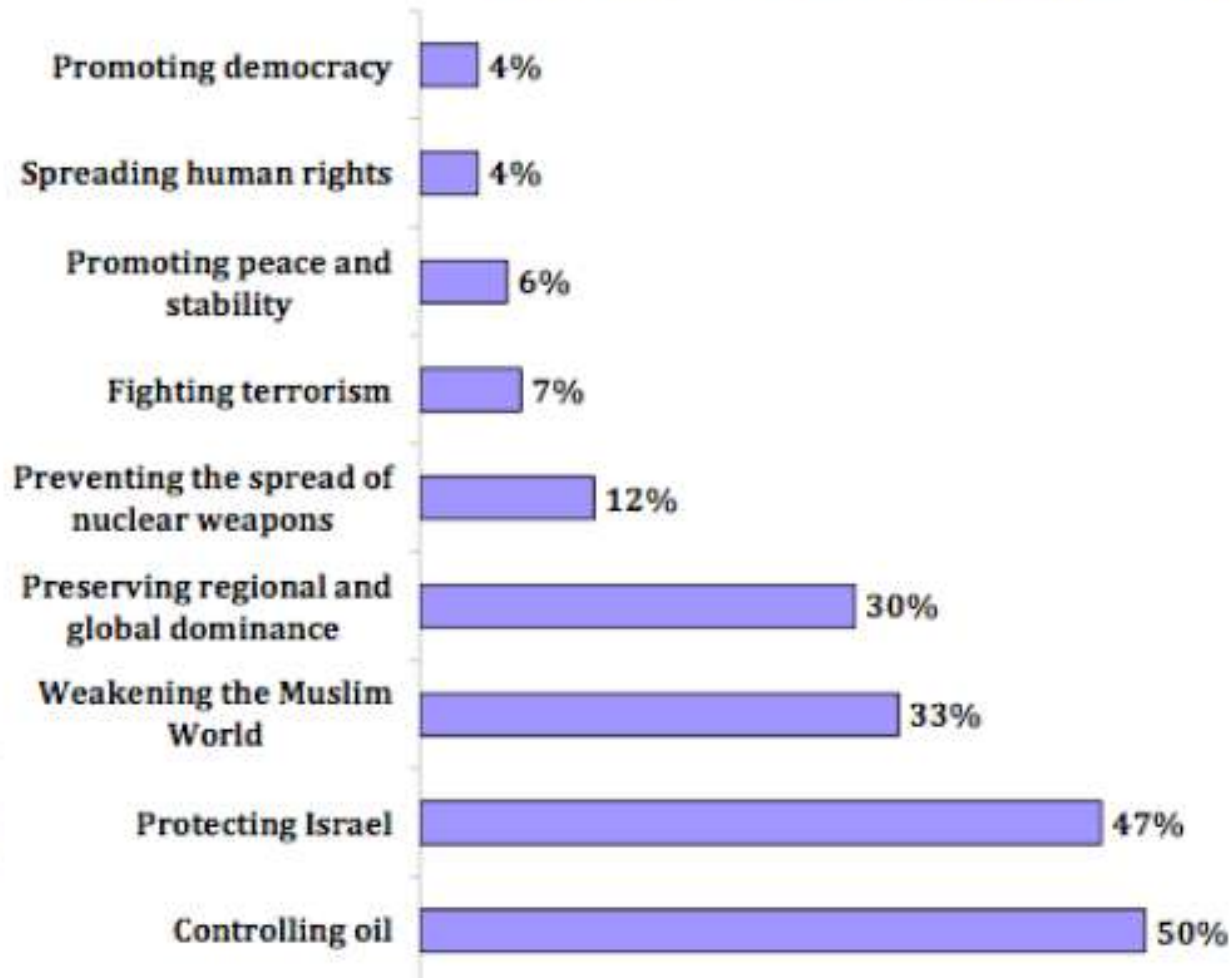
Generally speaking, is your attitude towards the United States:



Source: Shibley Telhami, 2008 Annual Arab Public Opinion Poll Survey of the Survey of the Anwar Anwar Sadat Chair for Peace and Sadat Chair for Peace and Development at the University of Maryland Development at the University of Maryland (with Zogby International) Conducted March 2008 in Egypt, Jordan, Survey conducted March 2008 in Egypt, Jordan, Lebanon, Morocco, Saudi Arabia (KSA) and the Lebanon, Morocco, Saudi Arabia (KSA) and the UAE UAE

US Goals in the MENA Region

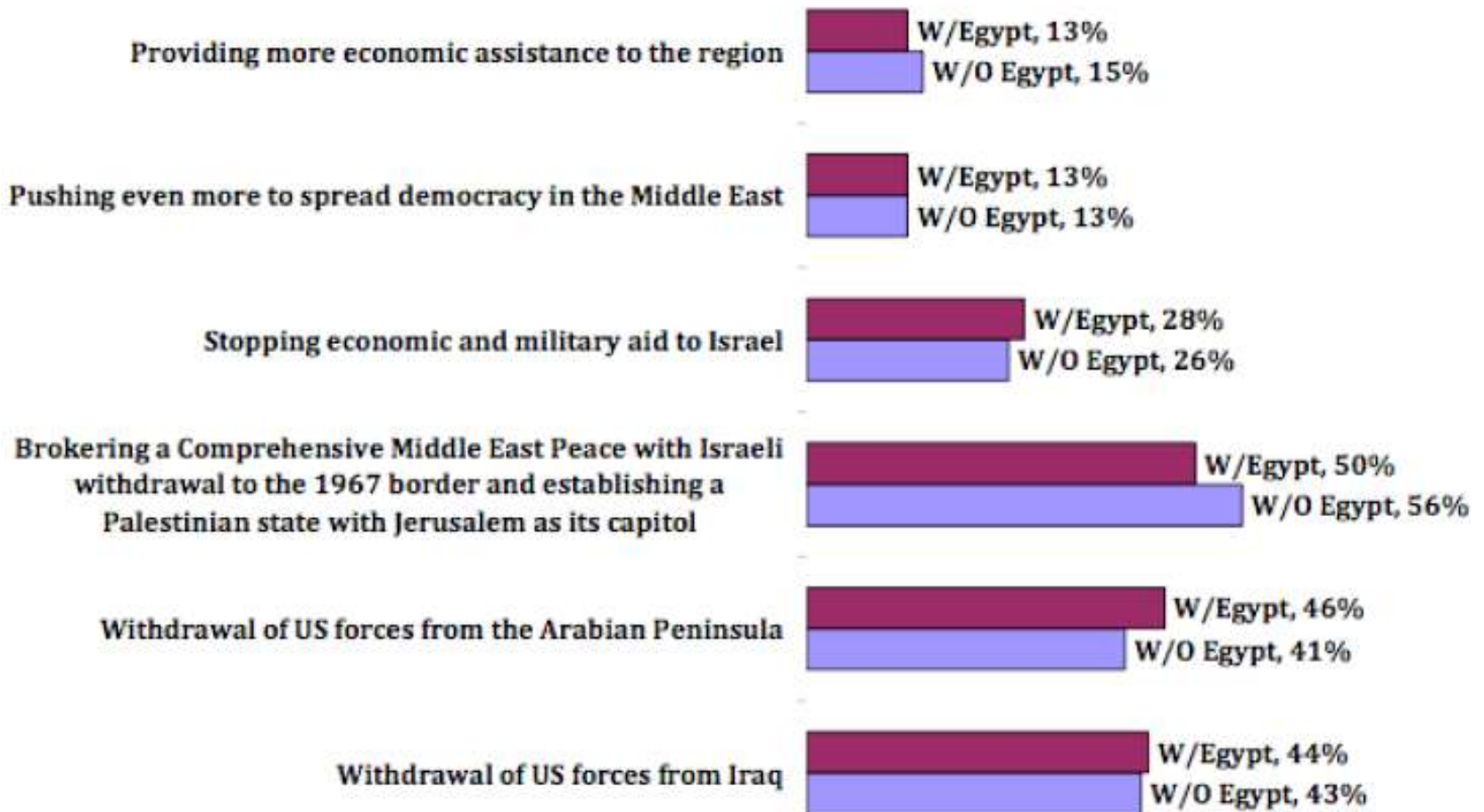
Which TWO of the following factors do you believe are most important in driving American policy in the Middle East?



Source: Shibley Telhami, 2008 Annual Arab Public Opinion Poll Survey of the Survey of the Anwar Anwar Sadat Chair for Peace and Sadat Chair for Peace and Development at the University of Maryland Development at the University of Maryland (with Zogby International) International) Conducted March 2008 in Egypt, Jordan, Survey conducted March 2008 in Egypt, Jordan, Lebanon, Morocco, Saudi Arabia (KSA) and the Lebanon, Morocco, Saudi Arabia (KSA) and the UAE UAE

Steps to Improve View of US

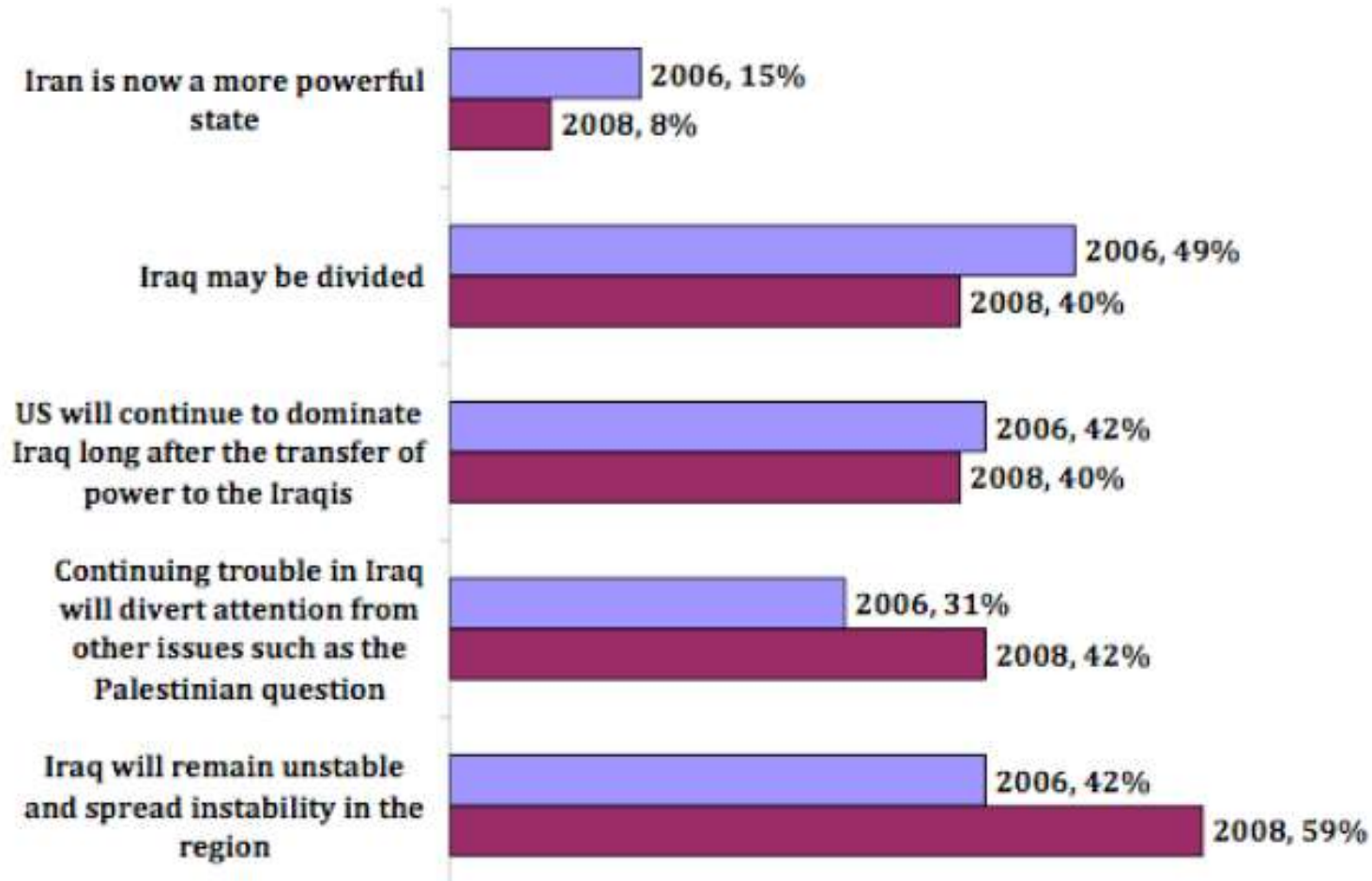
What TWO steps by the US would improve your views of the US most?



Source: Shibley Telhami, 2008 Annual Arab Public Opinion Poll Survey of the Survey of the Anwar Anwar Sadat Chair for Peace and Sadat Chair for Peace and Development at the University of Maryland Development at the University of Maryland (with Zogby International) International) Conducted March 2008 in Egypt, Jordan, Survey conducted March 2008 in Egypt, Jordan, Lebanon, Morocco, Saudi Arabia (KSA) and the Lebanon, Morocco, Saudi Arabia (KSA) and the UAE UAE

Arab Public Opinion on Iraq War

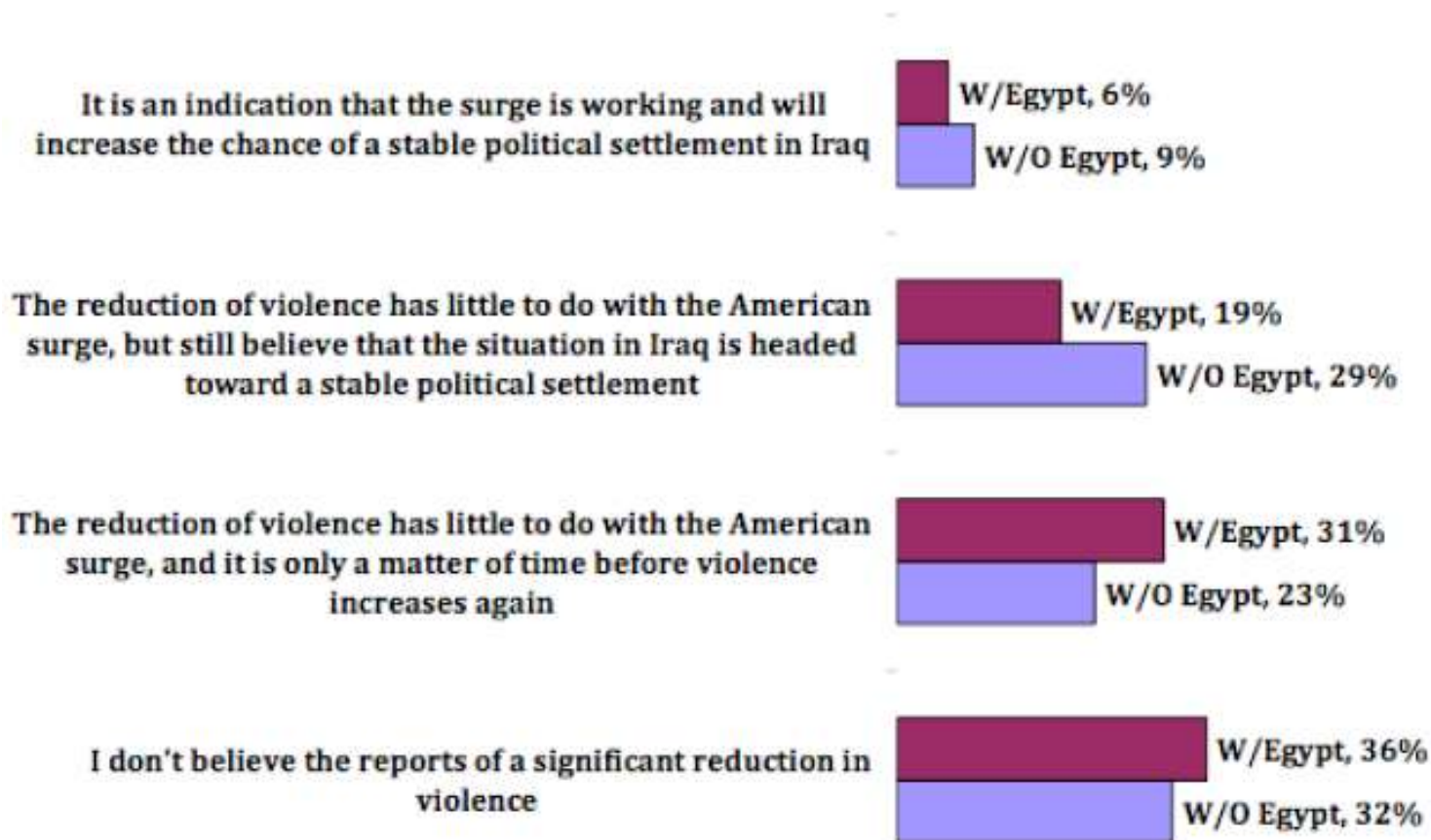
Which of the following is your biggest concern about the consequences of the war in Iraq? (Choose two)



Source: Shibley Telhami, 2008 Annual Arab Public Opinion Poll Survey of the Survey of the Anwar Anwar Sadat Chair for Peace and Sadat Chair for Peace and Development at the University of Maryland Development at the University of Maryland (with Zogby International) International) Conducted March 2008 in Egypt, Jordan, Survey conducted March 2008 in Egypt, Jordan, Lebanon, Morocco, Saudi Arabia (KSA) and the Lebanon, Morocco, Saudi Arabia (KSA) and the UAE UAE

Arab Public Opinion on the “Surge”

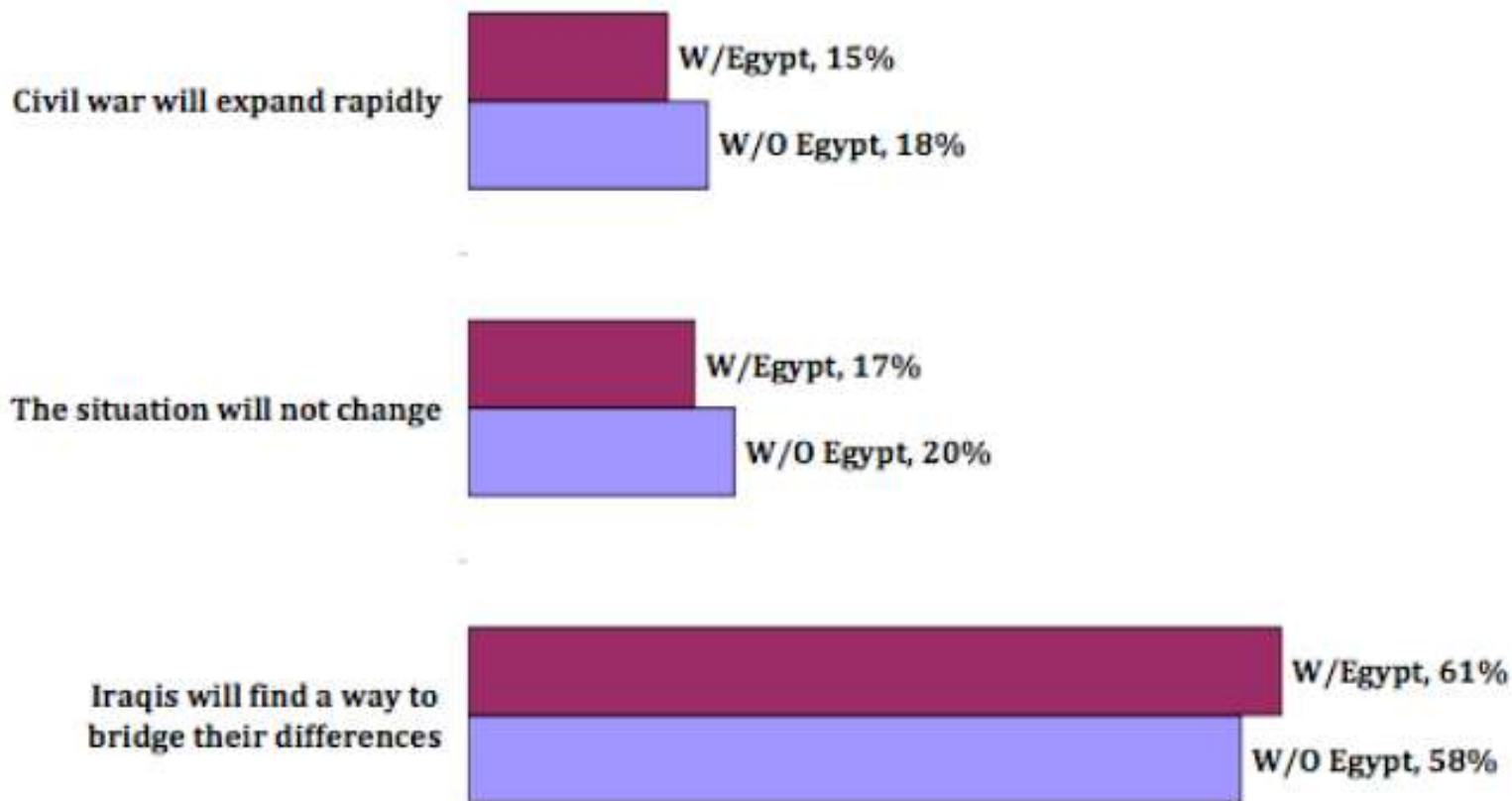
Since the surge of American forces in Iraq, the number of violent incidents has significantly declined in many parts of Iraq. Which of the following is closest to your view?



Source: Shibley Telhami, 2008 Annual Arab Public Opinion Poll Survey of the Survey of the Anwar Anwar Sadat Chair for Peace and Sadat Chair for Peace and Development at the University of Maryland Development at the University of Maryland (with Zogby International) International) Conducted March 2008 in Egypt, Jordan, Survey conducted March 2008 in Egypt, Jordan, Lebanon, Morocco, Saudi Arabia (KSA) and the Lebanon, Morocco, Saudi Arabia (KSA) and the UAE UAE

Arab Public Opinion on US Impact on Iraq

What do you believe would happen in Iraq if the US quickly withdrew its forces?



Source: Shibley Telhami, 2008 Annual Arab Public Opinion Poll Survey of the Survey of the Anwar Anwar Sadat Chair for Peace and Sadat Chair for Peace and Development at the University of Maryland Development at the University of Maryland (with Zogby International) Conducted March 2008 in Egypt, Jordan, Survey conducted March 2008 in Egypt, Jordan, Lebanon, Morocco, Saudi Arabia (KSA) and the Lebanon, Morocco, Saudi Arabia (KSA) and the UAE UAE