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# Analyzing the Impact of Preventive Strikes Against Iran's Nuclear Facilities

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- ***Iran and the Gulf Military Balance - Part One: Conventional and Asymmetric Forces***, available on the CSIS web site at <http://csis.org/publication/reassessing-gulf-military-balance-part-one-conventional-and-asymmetric-forces>.
- ***Iran and the Gulf Military Balance II: The Missile and Nuclear Dimensions***, available on the CSIS web site at <http://csis.org/publication/iran-and-gulf-military-balance-ii-missile-and-nuclear-dimensions>.

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## Executive Summary

## Executive Summary

- Over the past couple of months, speculation about a U.S. or Israeli strike on Iran's nuclear facilities has made headlines around the globe. This report addresses how the U.S. could take the lead in carrying out a preventive Military Strike against Iran. If all peaceful options have been exhausted and Iran has left no other means to convince it to stop or change its course in pursuing nuclear weapons. It also examines how the US could provide a defense umbrella against any Iranian air and missile retaliation that would be aimed at U.S. military targets and allies in the region, in particular the GCC states.
- A key question arises is what should the objectives of a military strike be? To halt the Iranian nuclear program? To set it back five years or for one year? This criteria is the key to defining the force allocation required to achieve a successful mission against Iran's nuclear facilities.
- The study shows that the initial strike should be against key Iranian nuclear enrichment and research facilities, ballistic missile basis located around the country, numerous mobile ballistic missile launchers dispersed around Iran and main ballistic missile production facilities. At the same time, it shows that the payloads required to hit underground enrichment facilities with a high level of damage, to carry out the scale of initial and follow-up attacks, and providing resources such as near real time intelligence required to detect and destroy other potentially lethal Iranian military weapons, for instance ballistic missiles that could be used in a retaliation, can only be carried out by the United States.
- An initial U.S. strike will require a large force allocation consisting of Defensive Counterair and Offensive Counterair Operations, such as the main Bomber Force, the Suppression of Enemy Air Defense System, Escort aircraft for the protection of the Bombers, Electronic Warfare for detection and jamming purposes, Fighter Sweep and Combat Air Patrol to counter any air retaliation by Iran.
- While such first strike will try to be as effective as possible, the U.S. would be the only country that has the air power, support capability, and mix of sea-air forces in the Gulf to continue a sustained campaign over a period of time and restrike after an initial battle damage assessment it is found that further strike sorties are required.

Several other key points are made in the analysis:

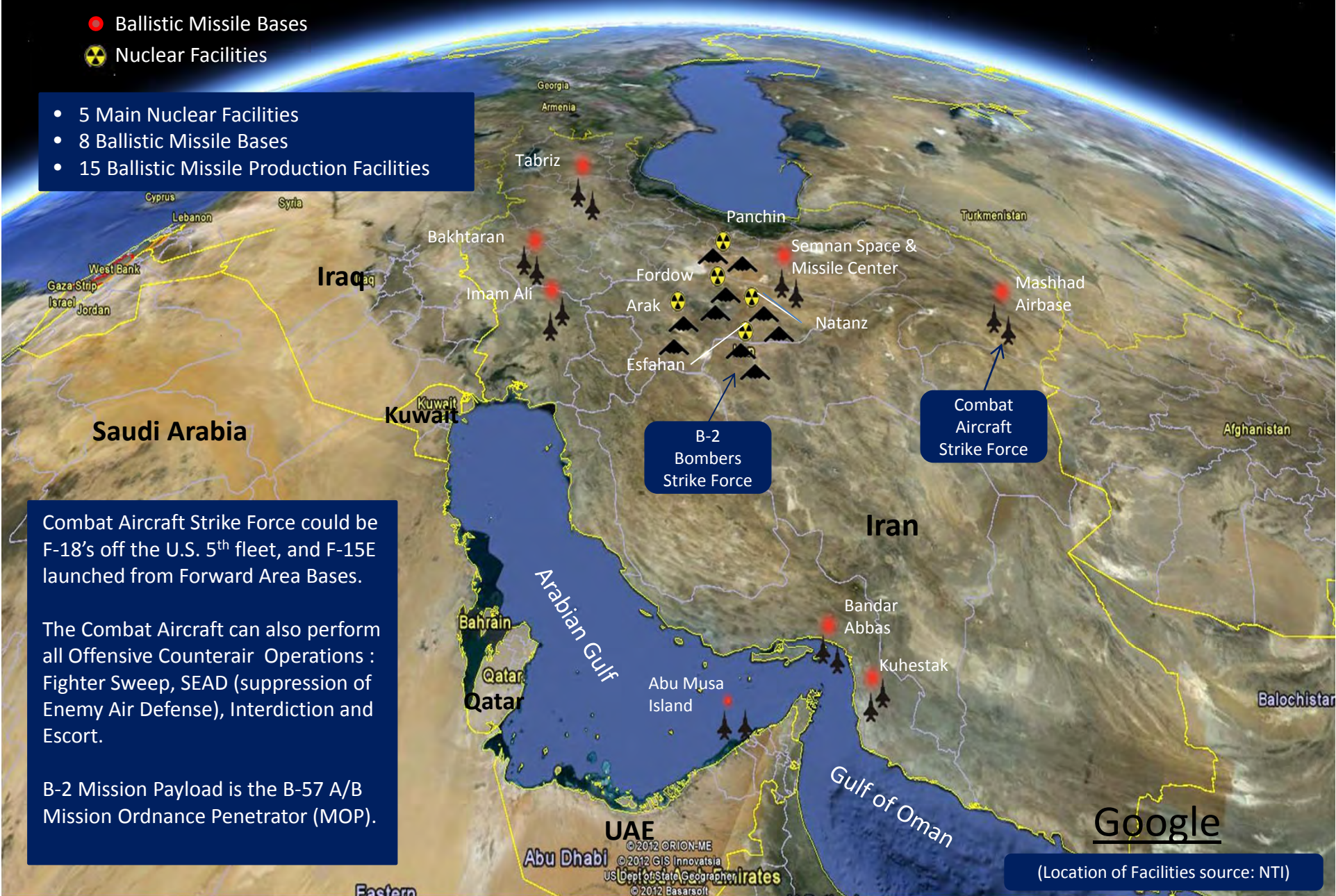
- The aging Iranian airforce will definitely be no match against the U.S. and even the GCC airforces. In addition the Iranian Air Defense systems do not have the Command Control Communications and Intelligence required to detect, track and shoot down the US advanced military combat aircraft. However U.S. planners will definitely take all operational planning precautions necessary to ensure that both the Iranian Airforce and Air Defense system are ineffective and all U.S. combat aircraft have a high probability of survival throughout.
- U.S. officials are working with allies in the Gulf to develop the capability to defeat the threat Iran poses to the Gulf, allied territory, and the flow of trade and energy exports GCC countries worry that during a crisis, Iran could try to prevent their ships from traversing the Strait of Hormuz, cutting off their oil export business.
- The only effective counter-strike capability Iran has other than asymmetric warfare in the Gulf, and the use of proxies like Hezbollah, is their Ballistic Missile Force. A massive retaliation strike with whatever launching sites that have survived the U.S. first strike could still cause quite a considerable damage to the GCC states, in energy, finance and various other critical infrastructure centers.
- The U.S. is currently involved in building a Defensive Shield against a massive Iranian Ballistic Missile attack targeted at the GCC states. The defensive shield consists of a Multi-Tier Ballistic Missile Defense System consisting of Terminal High Altitude Air Defense (THAAD) and Patriot Advanced Capability, PAC-3, missile systems supported with the most advanced Radar and Command and Control facilities.
- Ballistic missile defense (BMD) systems have been provided to Kuwait, the United Arab Emirates, Qatar and Oman, as well as stationing Aegis-equipped warships in the waters of the Arabian Gulf. The U.S. has been developing an integrated early warning radar system across the GCC states that could help U.S. and GCC forces to quickly respond to an Iranian missile attack.

- Israel does not have the capability to carry out preventive strikes that could do more than delay Iran's efforts for a year or two.
- Finally, the fact that US has the capability to carry out preventive strikes does not mean it should not seek to negotiate an end to the threatening aspects of Iran's nuclear programs. The brief shows just how dangerous any war in the Gulf could be to the world's economy – although Iran is more vulnerable than any of its Southern Gulf neighbors.
- The U.S. also needs its Gulf allies as key partners and must consider the “law of unintended consequences.” Preventive military strikes could push the presently volatile middle east region into a war with far reaching global political, military, and economic consequences.

# US Preventive Military Strike against Iranian Nuclear Facilities and Ballistic Missile Bases

- Ballistic Missile Bases
- ☢ Nuclear Facilities

- 5 Main Nuclear Facilities
- 8 Ballistic Missile Bases
- 15 Ballistic Missile Production Facilities



Combat Aircraft Strike Force could be F-18's off the U.S. 5<sup>th</sup> fleet, and F-15E launched from Forward Area Bases.

The Combat Aircraft can also perform all Offensive Counterair Operations : Fighter Sweep, SEAD (suppression of Enemy Air Defense), Interdiction and Escort.

B-2 Mission Payload is the B-57 A/B Mission Ordnance Penetrator (MOP).

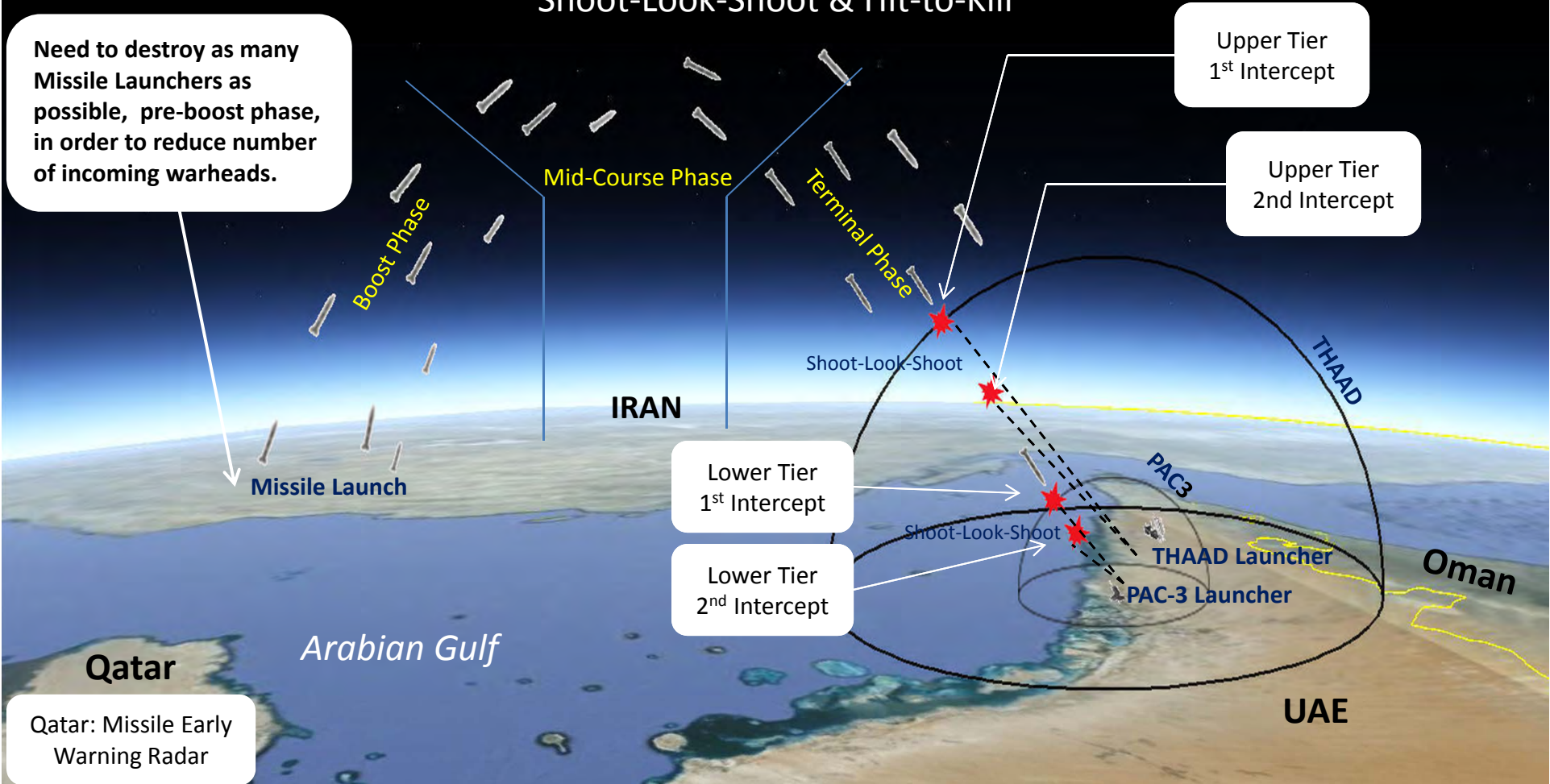
(Location of Facilities source: NTI)



# Two Tier Theater Ballistic Missile Defense (TBMD) – THAAD & PAC 3

## Endo and Exo-Atmospheric Engagements using Shoot-Look-Shoot & Hit-to-Kill

Need to destroy as many Missile Launchers as possible, pre-boost phase, in order to reduce number of incoming warheads.



TBMD System	Defense against
THAAD : UAE	SRBMs (<1000 km) and MRBMs (1000 - 3000 km)
PAC-3 : UAE, Kuwait, Saudi Arabia	SRBMs (300 – 1000 km)

## US Perceptions of the Iranian Threat

## **The Military Power of Iran: The Official US View**

### **Annual Report on Military Power of Iran Report by U.S. Defense Secretary Leon Panetta, June 2012**

#### Iranian Grand Strategy, Security Strategy, and Military Strategy

- There has been no change to Iran's strategies over the past year. Iran's grand strategy remains challenging U.S. influence while developing its domestic capabilities to become the dominant power in the Middle East. Iran's security strategy remains focused on deterring an attack, and it continues to support governments and groups that oppose U.S. interests. Diplomacy, economic leverage, and active sponsorship of terrorist and insurgent groups, such as Lebanese Hizballah, Iraqi Shia groups, and the Taliban, are tools Iran uses to increase its regional power. Iran's principles of military strategy remain deterrence, asymmetrical retaliation, and attrition warfare.
- Iran seeks to increase its stature by countering U.S. influence and expanding ties with regional actors while advocating Islamic solidarity. Iran also desires to expand economic and security agreements with other nations, particularly members of the Nonaligned Movement in Latin America and Africa.
- With the advent of the Arab Spring in 2011, Iran saw opportunities to increase its influence by supporting groups opposed to regimes in power, particularly those perceived to support U.S. interests. Iran publicized its belief that these popular, democratic uprisings were inspired by its own 1979 Islamic Revolution.

Source: Annual Report on Military Power of Iran April 2012, Full Update June 29. Report by U.S. Defense Secretary Leon Panetta for four congressional defense committees to comply with a fiscal 2010 directive to provide an annual classified and unclassified assessment of Iran's military power.]

<http://media.bloomberg.com/bb/avfile/rNnp87SL4Ew8>

[Provided by Bloomberg News :

- Outside the Middle East Iran's efforts to expand political, economic, and security ties with a range of countries demonstrate Tehran's desire to offset sanctions and diplomatic isolation. Iran continues to use a multipronged strategy in Iraq, including engagement with leaders across the political spectrum, outreach to the Iraqi populace, and continued support to Iraqi Shia militants and terrorists, such as Kataib Hizballah, Asaib Ahl al-Haq, and the Promised Day Brigade, in the wake of the U.S. military withdrawal. Iran provides money, weapons, training, and strategic and operational guidance to Shia militias and terrorist groups to protect and preserve Iran's security interests, including threatening the residual U.S. presence. In addition to providing arms and support, the Islamic Revolutionary Guard Corps-Qods Force (IRGC-QF) is responsible for training Iraqi militants and terrorists in Iran, sometimes using Lebanese Hizballah instructors.
- Iran continues to influence events in Afghanistan through a multifaceted approach, including support for the Karzai government while also supporting various insurgent groups. Tehran maintains ties with Afghan leaders across the political spectrum and continues to be involved in a number of humanitarian, economic, and cultural outreach activities among the Afghan populace. Although Tehran's support to the Taliban is inconsistent with their historic enmity, it complements Iran's strategy of backing many groups to maximize its influence while also undermining U.S. and North Atlantic Treaty Organization (NATO) objectives by fomenting violence.
- Iran has been involved in Lebanon since the early days of the Islamic Republic, especially seeking to expand ties with the country's large Shia population. The IRGC-QF continues to provide money, weapons, training, and logistic support to Lebanese Hizballah and views the organization as a key tool in its efforts to pressure Israel.
- Since the beginning of the Syrian unrest, Iran has supported President Bashar al-Asad while downplaying the depth of this support in public. Iran's support to the Asad regime has included military equipment and communications assistance. Iran probably has provided military trainers to advise Syrian security forces.

## Iran's Conventional Forces

- Iran's conventional military capabilities continue to improve, Naval forces are adding new ships and submarines while expanding bases on the Gulf of Oman, the Persian Gulf, and the Caspian Sea. In addition, Iran continues to expand the breadth of its naval operations. Iran deploys naval ships into the Gulf of Aden and Arabian Sea for counter piracy operations and in 2011 and early 2012 deployed two separate surface groups to the Mediterranean.
- In early 2012, the Islamic Revolutionary Guard Corps Ground Resistance Forces (IRGCGRF) conducted a series of exercises in northeastern and central Iran. The exercises, MARTYRS OF UNITY in the northeast and SUPPORTERS OF VELAYAT and VALFAJR in central Iran, were the first significant exercises conducted by the IRGCGRF since its reorganization in 2008. The three exercises consisted of combined-arms maneuvers and were meant to show the IRGCGRF's offensive and defensive capabilities while offering limited training value for the participating units.

## Iran's Unconventional Forces and Related Activities

- Through the IRGC-QF, Iran provides material support to terrorist or militant groups such as HAMAS, Lebanese Hizballah, the Palestinian Islamic Jihad, the Taliban, and Iraqi Shia groups.
- In close cooperation with Syria, Iran has provided Lebanese Hizballah with increasingly sophisticated weapons, including a wide array of missiles and rockets that allow Hizballah to launch weapons from deeper in Lebanon or to strike Israel. We judge that the Iranian military trains Hizballah and Palestinian extremist groups at camps throughout the region.
- Iran provides funding and possibly weapons to HAMAS and other Palestinian terrorists in the Gaza Strip.

## Iranian Capabilities Related to Nuclear and Missile Forces

- Iran is developing a range of technical capabilities that could be applied to the production of nuclear weapons if the decision is made to do so. It continues to progress with its uranium enrichment at Natanz and the newly operational Qom 'Enrichment Facility despite UN Security Council sanctions, The International Atomic Energy Agency's (IAEA's) November 2011 report on Iran provided extensive evidence of past and possibly ongoing Iranian nuclear weapons- related research and development work. Iran has refused to address this evidence and denied repeated IAEA requests for access to documents, personnel, and facilities.
- At the Natanz Underground Fuel Enrichment Plant, as of February 2012, Iran was producing 3.5-percent low-enriched uranium hexafluoride (LEUF6) with about 8,800 of the 9,150 installed IR-1 centrifuges. At the Natanz Aboveground Pilot Fuel Enrichment Plant, Iran was producing 20-percent LEUF6 with one interconnected cascade pair (328 centrifuges). About 6,200 empty IR-1 centrifuge casings were installed in that facility. At the Qom Enrichment Facility (aka the Fordow Fuel Enrichment Plant), Iran was producing 20-percent LEUF6 with two pairs of interconnected cascades (about 700 IR-1 centrifuges). Iran had filled the remainder of the facility's centrifuge capacity with 2,100 empty IR-1 centrifuge casings. Iran declared the entire facility would be used for producing LEUF6, abandoning previous plans to conduct centrifuge research and development there.
- Iran continued construction at the heavy-water Iran Nuclear Research Reactor (IR-40) at Khondab in violation of UN resolutions.

Regular Iranian ballistic missile training continues throughout the country.

- Iran continues to develop ballistic missiles that can range regional adversaries, Israel, and Eastern Europe, including an extended-range variant of the Shahab-3 and a 2,000-km medium-range ballistic missile, the Ashura. Beyond steady growth in its missile and rocket inventories, Iran has boosted the lethality and effectiveness of existing systems with accuracy improvements and new submunition payloads. Iran's missile force consists chiefly of mobile missile launchers that are not tethered to specific physical launch positions. Iran may be technically capable of flight testing an intercontinental ballistic missile by 2015."

The Military Option to Deal with  
Iran's Nuclear Program

## **US Extended Deterrence against the proliferation of WMD and their delivery systems.**

- The U.S. sees Iran with its ballistic missiles and potential of developing a nuclear weapon is a direct threat to the GCC and also poses a threat to all friends and allies in the Middle east region.
- Iran has ignored U.S. warnings and has pressed ahead with its uranium-enrichment program and has recently announced that it is “self-sufficient” in nuclear technology. Iran claims that it can domestically produce its own raw uranium for enrichment.
- The U.S. administration has stated that the full range of U.S. military capability in both conventional and unconventional weapons will be available and ready to be committed to defending its allies and friends against any threat. The U.S. has started implementing a strategy to influence the decision-making bodies in Iran as to the devastating consequences if the GCC, and any other allies are attacked or threatened.
- Citing the Iranian threat, the Obama administration shifted from the Bush administration’s plans to place missile-defense sites in Poland and radar in the Czech Republic to an approach that would in four phases place closer to Iran some Aegis-class Navy missile defense vessels, ground radar and eventually land- based Navy Standard Missile-3 interceptors
- Should deterrence fail, the U.S. will have already provided the GCC countries with Ballistic Missile Defense Systems which have all the Early Warning and Command Control facilities. This will limit the damage should they be attacked, and to enhance the conventional deterrence capability of the GCC. In addition providing modern technology combat aircraft that can be launched within a very short window of time to block any first attack wave and to have the capability to move the war into enemy territory, in the shortest time period, using both Defensive and Offensive Counterair Missions.



- Ballistic missile defense (BMD) systems have been provided to four countries on the Arabian Peninsula. BMD systems were provided to Kuwait, the United Arab Emirates, Qatar and Oman, as well as stationing BMD capable, Aegis-equipped warships in the waters of the Arabian Gulf.
- The U.S. has been developing an integrated early warning radar system across the GCC states that could help U.S. and GCC forces to quickly respond to an Iranian missile attack. The moves are intended to reassure Gulf countries that they would be protected against possible offensive action from Tehran. U.S. officials stressed the defensive nature of the actions being taken throughout the region.
- U.S. officials also are working with allies in the Gulf to ensure freedom of navigation in the region. Arab countries worry that during a crisis, Iran could try to prevent their ships from traversing the Strait of Hormuz, cutting off their oil export business. US officials have repeatedly insisted they are keeping "all options on the table," which includes a military strike option, when it comes to Iran. Secretary of State Clinton made the following remarks with Saudi Arabian Foreign Minister on March 31, 2012 (US State Department).
- “We believe strongly that, in addition to our bilateral military cooperation between the United States and every member nation of the GCC, we can do even more to defend the Gulf through cooperation on ballistic missile defense. We began that conversation in this forum today. Admiral Fox, the commander of the Fifth Fleet, made a presentation outlining some of the challenges that we face when it comes to ballistic missile defense. But we are committed to defending the Gulf nations and we want it to be as effective as possible.
- So we want to begin expert discussions with our friends about what we can do to enhance ballistic missile defense. There are some aspects of a ballistic missile defense system that are already available, some of which have already been deployed in the Gulf. But it’s the cooperation – it’s what they call interoperability that we now need to really roll up our sleeves and get to work on.”

## Illustrative U.S. Preventive Military Strikes

## Military Risks in Strike against Iran's Nuclear Facilities

- The U.S. is the only country that can launch a successful Military Strike, if all peaceful options have been exhausted and Iran has left no other means to convince it to stop or change its course in pursuing Nuclear Weapons. The U.S. should alone determine what the timeline could be if Iran does pursue the path to develop nuclear weapons.
- The question arises is what would the objectives of a military strike be? To pull the Iranian nuclear program back 5 years or delay it for 1 year? This criteria will define the force allocation required to achieve a successful mission against Iran's nuclear facilities. We point out that it is not a simple mission of bombers flying in and out of Iran, this is a complicated Offensive Air Strike that will involve many aircraft, each with its own role, such as Combat Aircraft whose role is to suppress enemy air defenses along the way, aircraft that fly fighter escort with the bombers, aircraft that carry specialized electronic warfare equipment to jam enemy radars and communications., plus probably air-to-air refueling along the way in and out of Iran.
- Depending on the forces allocated and duration of air strikes, it is unlikely that an air campaign alone could alone terminate Iran's program. The possibility of dispersed facilities complicates any assessment of a potential mission success, making it unclear what the ultimate effect of a strike would be on Iran's nuclear facilities.
- The U.S. is aware that the action of a military strike could be destabilizing for the entire Middle East region and potentially generate a nuclear weapons race in that part of the world," Admiral Michael Mullen, the chairman of the Joint Chiefs of Staff, told CNN. "I think an attack would also be, by us or by anybody else, be very destabilizing.

## Illustrative US Strike Mission

- B-2 bombers out of Diego Garcia, each carrying 2 GBU-57 MOP bombs.
- Mission can be achieved with a high success rate also maintaining a sustained strike over a couple of days.
- B-2 bombers escorted by F-18s from the 5<sup>th</sup> fleet stationed in the Gulf area, or F-15Es and F-16Cs from forward area air bases.
- United States and Western allies considered to be the only countries involved, no GCC or any Arab country involvement and especially no-Israeli direct involvement.
- Still though, Iran most probably will accuse Israel to be part of the Strike and will try to retaliate, either by launching a Ballistic Missile on Israel carrying conventional or WMD (chemical, biological, radiological) and activating Hezbollah to launch cross border attacks against Israel.
- Iran would also try to attack any U.S. military airbases that are active in the Gulf even if they are stationed in GCC countries.
- If Iran attacks any of the GCC countries, then they will have the right to self-defense. In addition the whole Arab Middle East will not accept an Iranian attack on any of the GCC countries.

## The B-2 Bomber



Primary Function	Multi role heavy bomber
Engines:	Four GE F-118-GE-100 engines, each with a thrust of 17,300 pounds (7,847 kg)
Speed, Cruise:	High subsonic
Ceiling:	50,000 ft (15,000 meters)
Weight Takeoff, (typical):	335,500 – 350,000 pounds (152,600 – 159,000 kg)
Weight, Empty (typical):	125,000 – 160,000 pounds
Range:	6,000 nmi (9,600 km), unrefueled range for a Hi-Lo-Hi mission with 16 B61 nuclear free-fall bombs 10,000 miles with one aerial refueling.
Payload:	40,000 pounds (18,000 kg)
Crew:	Two pilots
Current Armament:	<p><b>Nuclear:</b> 16 B61, 16 B83</p> <p><b>Conventional:</b> 80 MK82 (500lb), 16 MK84 (2000lb), 34-36 CBU-87, 34-36 CBU-89, 34-36 CBU-97</p> <p><b>Precision:</b> 216 GBU-39 SDB (250 lb), 80 GBU-30 JDAM (500 lb), 16 GBU-32 JDAM (2000 lb), GBU-27, GBU-28, GBU-36, GBU-37, AGM-154 HSOW, 8-16 AGM-137 TSSAM, 2 MOP / DSHTW/ Big BLU</p>

(Source: [http://www.GlobalSecurity.org/wmd/systems/b-2-s\[ecs.html](http://www.GlobalSecurity.org/wmd/systems/b-2-s[ecs.html))

- In July 2009, verification of equipment required to integrate the MOP on the B-2 was complete - the hardware that holds the MOP inside the weapons bay. The MOP is a GPS-guided weapon containing more than 5,300 pounds of conventional explosives inside a 20.5 ft long bomb body of hardened steel. It is designed to penetrate dirt, rock and reinforced concrete to reach enemy bunker or tunnel installations. The B-2 will be capable of carrying two MOPs, one in each weapons bay.
- The B-2 currently carries up to 40,000 pounds of conventional ordnance. For example, it can deliver 80 independently targeted 500-lb class bombs from its smart bomb rack assembly; or up to 16 2,000-lb class weapons from its rotary launcher. Integration of the MOP on the B-2 is the latest in a series of modernization programs that Northrop Grumman and its subcontractors have undertaken with the Air Force to ensure that the aircraft remains fully capable against evolving threats.

<b>GBU-57A/B Massive Ordnance Penetrator (MOP)</b>	<b>Specifications</b>
Weight, total	13,600 kg (slightly less than 30,000 pounds)
Weight, explosive	2,700 kg (6,000 lb)
Length	6m / 20.5 feet
Diameter	31.5 in diameter
Control	Short-span wings and trellis-type tail
Penetration	60 meters (200ft) through 5,000 psi reinforced concrete 40 meters (125 ft) through moderately hard rock 8 meters (25 feet) through 10,000 psi reinforced concrete
Contractors	Boeing, Northrop Grumman
Platforms	B-52, B2
Guidance	GPS aided Inertial Navigation System

**Priority Targets in addition to Iran's Main Nuclear Facilities**  
**Ballistic Missiles Facilities**

<b>Missile Base</b>	<b>Missile Production Facility</b>
Bakhtaran Missile Base	Fajr Industrial group
Abu Musa Island	Gostaresh Scientific Research Center
Bandar Abbas	Iran Aircraft Manufacturing Industries
Imam Ali Missile Base	Isfahan Missile Complex
Kuhestak Missile battery	Karaj Missile Development Complex
Mashad Airbase	Lavizan Technical and Engineering Complex
Semnan Space and Missile Center	Parchin Chemical Industries
Tabriz Missile Base	Qods Aeronautics Industries
	Semnan Missile Complex
	Shahid Bakeri Industrial Group
	Shiraz Missile Plant
	Sirjan Missile Plant

(Source: <http://www.nti.org/country-profiles/iran/delivery-systems/>)

## U.S. Military Strike Force Allocation against Iran’s Nuclear and Ballistic Facilities Offensive Counterair (OCA) Mission

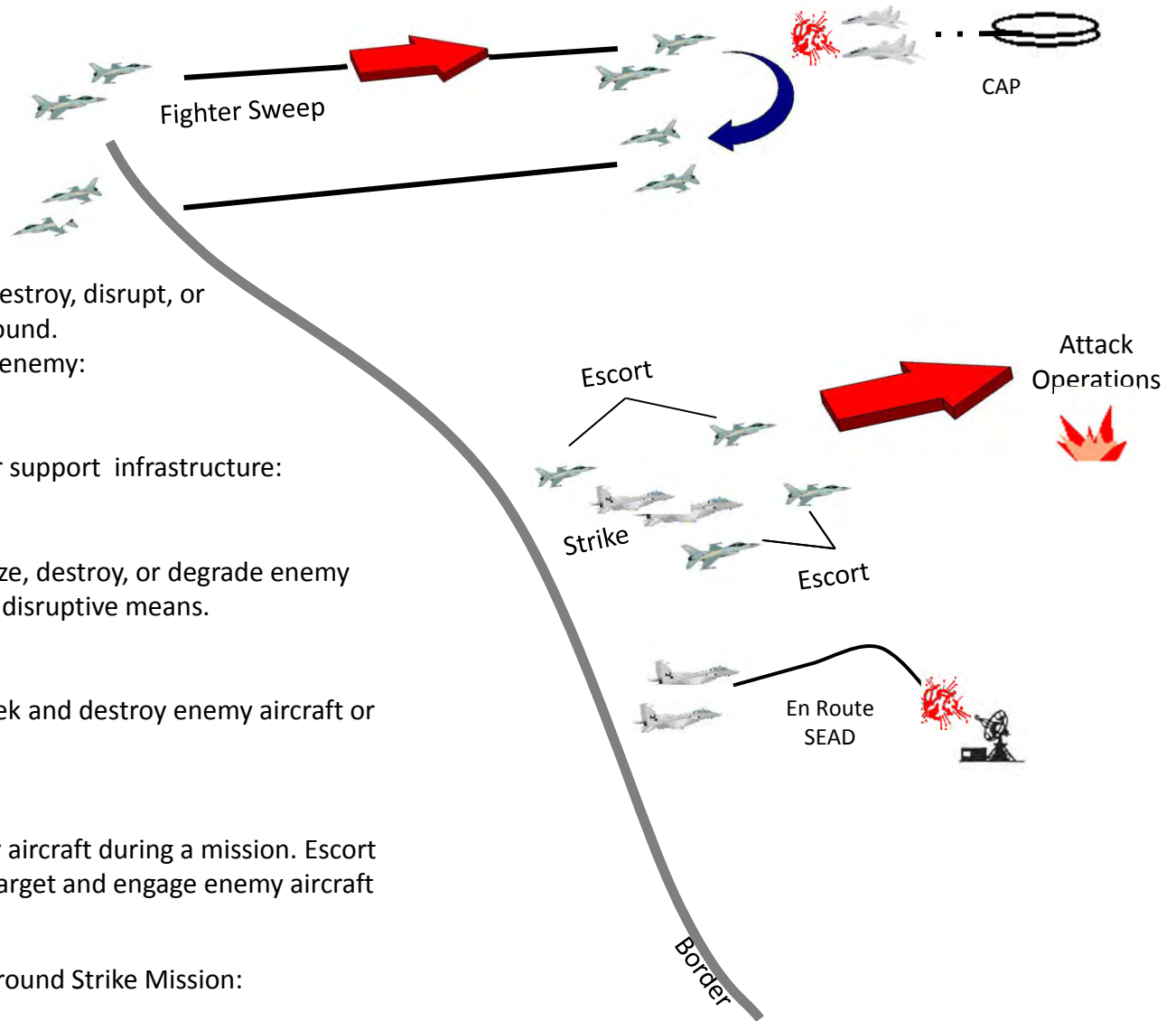
### Performance Criteria and Mission Parameters:

- A damage performance criteria above 75% for each target, nuclear and missile, resulting in a delay of at least 5 to 10 years in Iran’s Nuclear Program, and substantially weakening Iran’s ballistic missile retaliatory capability.
- Two aircraft are allocated to each target to maximize the damage on First Strike.
- Destroying the maximum number of Missile Bases, Mobile Launchers and Production Facilities during (boost Phase) or before Launch, thereby reducing the number of incoming missiles (warheads) and also reducing the number of shots defense needs to take at each Incoming warhead.

Iran Target	Number of Targets	Aircraft Allocated
Main Nuclear	5 Facilities	2 A/C per target resulting in 10 B-2 Bombers
Missiles Bases	8 Bases	2 A/C per base resulting in 16 Strike A/C
Missile Production	15 Facilities	2 A/C per target resulting in 30 Strike A/C
Mobile Missile Launchers	Assuming 22 Launchers in various locations	2 A/C per mobile launcher resulting in 44 A/C
<b>TOTAL</b>	<b>50</b>	<b>10 B-2 Bombers 90 Strike Aircraft = 100</b>



# Offensive Counterair Missions (OCA)



## Attack Operations

- Attack operations are intended to destroy, disrupt, or degrade counterair targets on the ground.
- These missions are directed against enemy:
  - Ballistic Missile Sites
  - Airfields
  - Command Control and their support infrastructure:

## Suppression of Enemy Air Defenses (SEAD)

SEAD is an OCA mission designed to neutralize, destroy, or degrade enemy surface-based air defenses by destructive or disruptive means.

## Fighter Sweep:

An offensive mission by fighter aircraft to seek and destroy enemy aircraft or targets of opportunity in a designated area.

## Escorts:

Escorts are aircraft assigned to protect other aircraft during a mission. Escort missions are flown over enemy territory to target and engage enemy aircraft and air defense systems.

## Decrease in Aircraft Required in an Air-to-Ground Strike Mission:

- Improved Weapons Accuracy
- Increased Survivability
- Larger Payload

(Source: Counterair Operations USAF AFDD 2-1.1 October 1, 2008)

## **Additional requirements to increase Mission Effectiveness**

The effectiveness of OCA operations depends on the availability of certain resources. System capabilities are influenced by the situation, threats, weather, and available intelligence. The following are some of the resources used to conduct OCA:

### **Aircraft:**

Fighter and bomber aircraft provide the bulk of the weapon systems for OCA operations. Other types of aircraft and weapon systems are often critical enablers of counterair operations (e.g., electronic attack, electronic protection, and air refueling aircraft).

### **Missiles:**

These weapons include surface-to-surface, air-to-surface, and air-to-air missiles, as well as air-, land-, and sea-launched cruise missiles. Many of these weapons have long ranges and some have very quick reaction times. These weapon systems can eliminate or reduce the risk of harm to friendly forces by destroying enemy systems in the air and on the ground.

### **ISR Systems:**

ISR systems and resources may be used in counterair operations to provide intelligence, surveillance, reconnaissance, deception, and other effects against enemy forces and air defense systems. These activities include the use of airborne, space-borne, and ground (e.g., human intelligence) assets.

**Unmanned Aircraft Systems (UAS):**

UAS may be used in counterair operations to provide ISR, deception, jamming, harassment, or destruction of enemy forces and air defense systems. These systems may be preprogrammed or remotely piloted. They provide valuable intelligence to friendly forces and may now be used to attack some targets either too dangerous or risky for manned aircraft or where manned aircraft are not present or available to respond. They may also be used to help provide persistent air presence over enemy forces in situations where this may have important psychological effects upon an adversary (as part of OCA or other operations) if synergistically tasked to help provide persistent presence over adversary forces.

**Special Operations Forces (SOF):**

SOF can conduct direct action missions, special reconnaissance, and provide terminal guidance for attacks against valuable enemy targets. Planners in the AOC coordinate with the special operations liaison element to coordinate the use of special operations assets in support of the counterair mission.

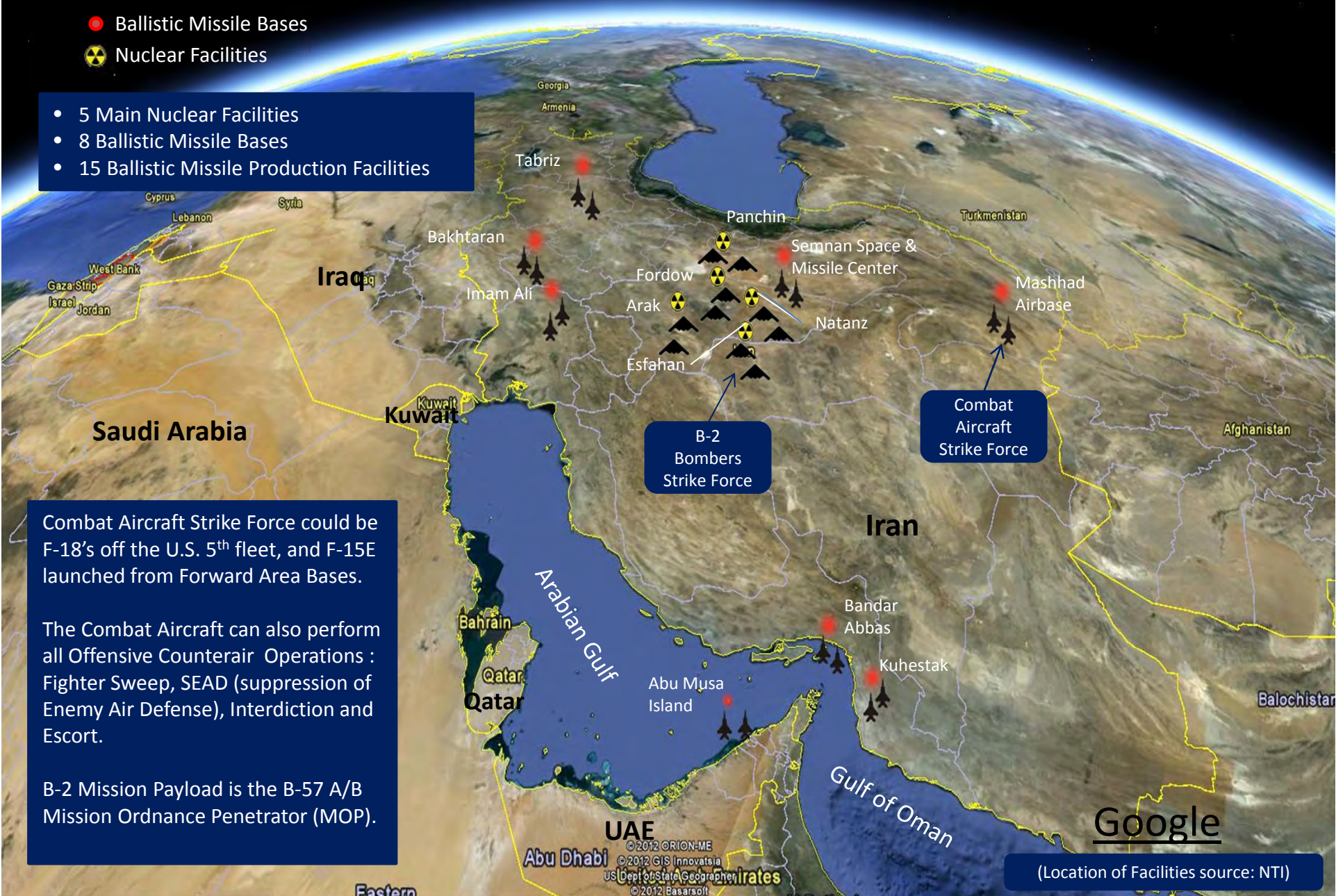
**C2 Systems:**

These systems enhance OCA operations by providing early warning, intelligence, identification, and targeting data, as well as C2 of friendly forces.

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(Location of Facilities source: NTI)

## Countering Iran's Air Defense

## Iran's Current Land Based Air Defense Systems

- Iran has extensive surface-to-air missile assets, but most are obsolete or obsolescent. Iran's systems are poorly netted, have significant gaps and problems in their radar and sensor coverage and modernization, and a number of its systems are vulnerable to electronic warfare
- U.S. never delivered integrated system before fall of Shah so Iran never had a fully functioning air defense system.
- Iran has made many statements that it has upgraded and modernized many of the components of such its Air Defense systems using Russian, Chinese, US, European, and Iranian-designed and made equipment. But Iran does not have the design and manufacturing capability to create truly modern system, one that is immune to electronic warfare, and one that can function without become tactically vulnerable to anti-radiation weapons and other forms of active "suppression of enemy air defense" (SEAD) systems.
- Only modern short-range point defense system is TOR-M. Other short-range systems mix of older Russian system, SHORADs (Short Range Air Defense), and aging – possible inactive British and French systems.
- Medium to long-range systems are low capability or obsolescent. Iran has some 150 HAWKS and IHAWKS do not have capable ECM. Date back to 1960s and 1970s. It claims to be able to produce its own IHAWK missiles. Has various versions of SA-2 obsolete.
- Radar sensor and battle management/C4I systems have major limitations.
- Regardless of how much Iran states that it has made progress, it will still be vulnerable to the advanced technology U.S. combat aircraft as well as the electronic warfare and defense suppression weapon systems. This will give the U.S. Strike Force the freedom, if required after the first strike, to conduct a sustained campaign of strikes over a few days.

## Gulf Land-Based Air Defense Systems in 2008

Country	Major SAM	Light SAM	AA Gun
Bahrain	(8) IHAWK	(60) RBS-70 (18) FIM 92A Stinger (7) Crotale	(26) Guns (15) Orlikon 35mm (12) L/70 40mm
Iran	(16/150) IHAWK (3/10) SA-5 (45) SA-2 Guideline	SA-7/14/16 HQ-7 (29) SA-15; Some QW-1 Misaq (29) TOR-M1; Some HN-5 (30) Rapier; Some FM-80 (Ch Crotale) 15 Tigercat; Some FIM-92A Stinger	(1,700) Guns ZSU-23-4 23mm ZPU-2/4 23mm ZU-23 23mm M-1939 37mm S-60 57mm
Kuwait	(4/24) IHAWK Phase III (5) Patriot PAC-2	(6/12) Aspide (48) Starbust	12 Oerlikon 35mm
Oman	None	Blowpipe; (2) Mistral SP (34) SA-7; (6) Blindfire (20) Javelin; (40) Rapier S713 Martello	(26) Guns (4) ZU-23-2 23mm (10) GDF-(x)5 Skyguard 35mm (12) L-60 40mm
Qatar	None	(10) Blowpipe (12) FIM-92A Stinger (9) Roland II (24) Mistral (20) SA-7	
Saudi Arabia	(16/128) IHAWK (4-6/16-24) Patriot (17/141) Shahine Mobile (2-4/160) PAC-2 Launchers (17) ANA/FPS-117 Radar (73/68) Crotale Shahine	(40) Crotale (500) Stinger (ARMY) (500) Mistral (ADF) (500) FIM-43 Redeye (ARMY) (500) Redeye (ADF) (73-141) Shahine Static (500) FIM-92A Stinger (ARMY) (400) FIM-92A Avenger (ADF)	(1,220) Guns (92) M-163 Vulcan 20mm (30) N-167 Vulcan 20mm (NG) (850) AMX-30SA 30mm (128) GDF Orlikon 35mm (150) L-70 40mm (store) (130) M-2 90mm (NG)
UAE	(2/31) IHAWK	20+ Blowpipe (20) Mistral Some Rapier/Crotale/ RB-70/Javelin/SA-18	(62) Guns (42) M-3VDA 20mm SP (20) GCF-BM2 30mm

(Source: Iranian Weapons of Mass Destruction. Anthony Cordesman CSIS)

## Medium to Long Range Surface To Air Missile Systems

Air Defense System	Associated Early Warning/Acquisition Radars	Associated Tracking & Guidance Radars	Missile Ranges (km) Altitude (ft)	In Service Date
SA-2	Spoon Rest D (P-18) Flat Face A (P-15)	Fansong A/B	Max (km): 40 Min (km) : 8 Altitude (ft): 3,000 to 90,000	1971 Upgraded
SA-3	Flat Face B (P-19) Squat Eye	Low Blow	Max (km) : 30 Min (km) : 6 Altitude (ft): 150 to 160,000	1971
SA-6	Long Track (P-40) Height Finder: Thin Skin B (PRV-9)	Straight Flush	Max (km): 24 Min (km) : 4 Altitude (ft): 50 to 45,000	1973
SA-8	Flat Face B (P-19) Long Track (P-40) Height Finder: Thin Skin B (PRV-9)	Land Roll	Max (km) : 15 Min (km) : 0.2 Altitude (ft): 40 to 40,000	1982
SA-5	Back Trap (P-80) Tall King C (P-14) Spoon Rest D (P-18) Height Finder: Odd pair (PRV-13) Odd Group (PRV-16)	Square Pair	Max (km) : 250 Min (km) : 20 Altitude (ft): 1,500 to 130,000	1983
IHAWK	AN/MPQ-50 AN/MPQ-55(PIP II)/62 (PIP III) Range only Radar	AN/MPQ-57 (PIP II)/61 (PIP III)	Max (km): 35 Min (km): 3 Altitude (ft): 0 to 55,000 ft	1971
Patriot PAC-2	AN/MPQ-53 Phased-Array Radar Carries out Search, target detection, track and identification, missile tracking and ECCM functions	AN/MSQ-104 Engagement Control Station (ECS)	Max (km): 70 Min (km): 3 Altitude (ft): 80,000	1990

(Source: Iranian Weapons of Mass Destruction. Anthony Cordesman CSIS)



## GCC vs Iranian Airforce Comparison

- Iran's most advanced fighters consist of a small number of export versions of the Su-24 and MiG-29, whose avionics lag far behind their Russian counterparts. It is reported that Iran has less than 30 export versions of MiG-29, some not operational. These limits to Iran's air force are particularly important as Iran has air bases that are only a few minutes flight time from critical targets in the Gulf and in the coastal areas of the southern Gulf states. They are also important because Iran's weaknesses in air-to-air combat, and its weaknesses in surface-to-air missile defense which are described shortly, leave it highly vulnerable to any US attack.
- Iran claims to have modernized the avionics on some of these aircraft, and to have adapted its F-14s to carry the Hawk air-to-surface missile as a long-range air-to-air missile to compensate for the fact its F-14s were sabotaged during the fall of the Shah and cannot make effective use of Phoenix missiles – which in any case are long beyond their useful life. It also claims to have created electronic warfare aircraft and to have modernized the avionics on its 3 PF-3 Orion maritime patrol aircraft – which are as close to an AWACs/airborne warning and control aircraft as Iran has. It also has claimed to have a mix of unmanned combat aerial vehicles (UCAVs and UAVs) it can use to make up for some of the limitation in its aircraft.
- The GCC have been planning their defenses so as to provide a military deterrent sufficient to make any direct confrontation as costly as possible to Iran or any other adversary. It is in this deterrent role that lies the ultimate rationale for any GCC Joint Defense Pact and Cooperation.
- Two main considerations underlying the choice of a Military Doctrine by the GCC states have been: Balance of Forces and Strategic Depth. In particular for the Arabian Gulf “front line states” Kuwait, Bahrain, Qatar, UAE and Oman, the main concern would be strategic depth to an Iranian attack.

(Source: Anthony Cordesman CSIS)

- Defense Performance Criteria should be a 85% Probability that the defense shoots down all the incoming threat aircraft; this also means an 85% of zero leakage. Furthermore a 90% Probability that incoming are incoming threat aircraft are successfully detected early and tracked by the GCC Air Defense.
- Lack of Strategic Depth results in limitations on the area of operational maneuverability during conflict, time to respond, and an increase in the vulnerability of vital strategic critical infrastructure economic centers due to the proximity to the borders. Saudi Arabia is be the only state that has strategic depth, and is looked upon to play a pivotal role in the Security Arrangements of the Gulf and the Arab Israeli conflict. Saudi Arabia's oil resources, population and strategic depth make it a major and essential participant in any regional security arrangements or conflict in the Gulf region.
- When transformed into an operational doctrine, the GCC states would base their Force Structure Planning on: Defensible Borders. Borders which can be defended without a pre-emptive initiative, and the parallel capability to take the war to the enemy and to fight on enemy territory.
- The requirement would be to enhance the conventional military ability for the GCC states consisting of four major components: Force Structure; Modernization; Readiness; Sustainability. In addition it would include developing an asymmetric warfare capability. The total GCC Air Power is 428 combat aircraft, in assuming only 75% are operationally ready (full-mission capable), the total available force will then be 320 and with a sortie rate of 3 per aircraft per day the total number of sorties generated would be 960. Whereas for Iran, a total of 158 aircraft with an operational readiness rate of 60%, the available combat force will be 95, and with 2 sorties per aircraft per day the total sorties generated will come to 190. The 6:1 ratio of sorties generated projects the weakness of the Iranian Airforce vs the those of the GCC countries.
- By following the guidelines of the USAF Doctrine manuals in the missions needed for Offensive Counterair, Defensive Counterair as well as Counterland Operations, the 6:1 ratio clearly implies that there is a substantial advantage in favor of the GCC Airforces achieving the specified wartime objective of winning an air war or destroying a target set.

## Air Bases and Air Force Order of Battle



### Three Main Iranian Nuclear Facilities

- Natanz: Uranium Enrichment Facility
- Arak: Heavy Water Nuclear Reactor and Possible Future Plutonium Production Reactor
- Esfahan: Nuclear Research Center. Uranium Conversion Facility (UCF)

	Combat A/C	Attack Helo's
Iran	319	95
Iraq	-	37
Kuwait	50	45
Bahrain	33	16
Qatar	18	25
UAE	184	67
Oman	64	41
Saudi Arabia	278	67
Yemen	79	18

### Iran Airbases

Tabriz	F-5E/F, MiG-29
Hamadan	F-4E/D Su-24
Dezful	F-5E/F
Bushehr	F-4E/D F-14
Bandar Abbas	2 Helicopter Wings
Shiraz	Su-25 Su-24
Esfahan	F-5E Su-24
Tehran	MiG-29 Su-24
Zahedan	F-7M
Kermanshah	F-5E/F

## Iran Airforce Tactical Fighter Capabilities - 2012

Type	No	Operational Readiness (%)	Force Available	Total Sortie Per Day	Postulated Employment
MiG-29A	25	60	15	30	Air Defense/Escort/FS/BAS
Su-25	13	60	8	16	CAS/BI/Deep Strike
SU-24	30	60	18	36	CAS/BI/Deep Strike
F-14	25	60	15	30	Air Defense/FS CAS/BI/Deep
F-4E/D	65	69	39	78	Strike/SEAD
<b>Total</b>	<b>158</b>		<b>95</b>	<b>190</b>	

BAS: Battlefield Air Superiority

CAS: Close Air Support

BI: Battlefield Interdiction

DS: Defense Suppression

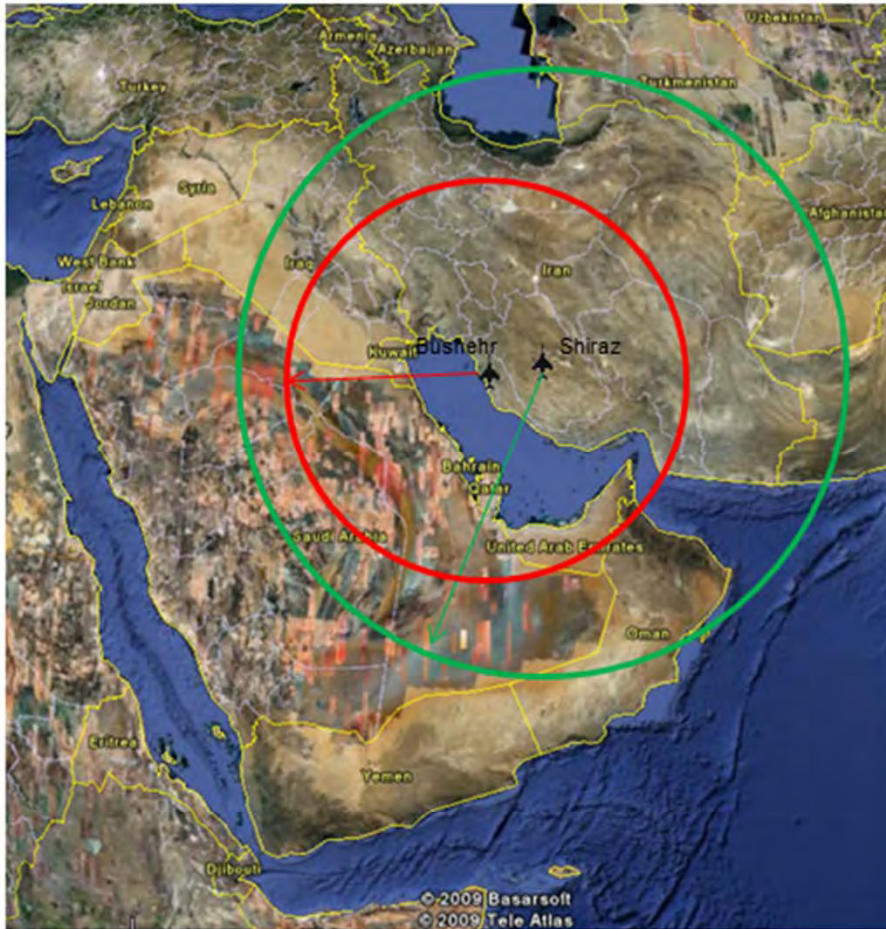
FS: Fighter Sweep

Sustained Conditions : 12 hr Operational Day

18 hr Maintenance Day

2 Sorties per Aircraft per day

## Air to Ground Ranges of Iranian Air Force



### Mission Profile: Hi-Lo-Hi

F-4E (Bushehr):  
(4) MK83 1000lb Bombs  
(1) 600 Gallon Fuel Tank  
10 Minutes loiter time  
Range = 400 nmi

SU-24 (Shiraz):  
(4) 500 kg/1000 lb Bombs  
(1) 400 gallon tank  
10 minutes loiter time  
Range = 590 nmi

SU-25 (Shiraz):  
(4) 500kg/1000lb Bombs  
(1) 400 gallon tank  
(2) 10 minutes loiter time  
Range = 600 nmi

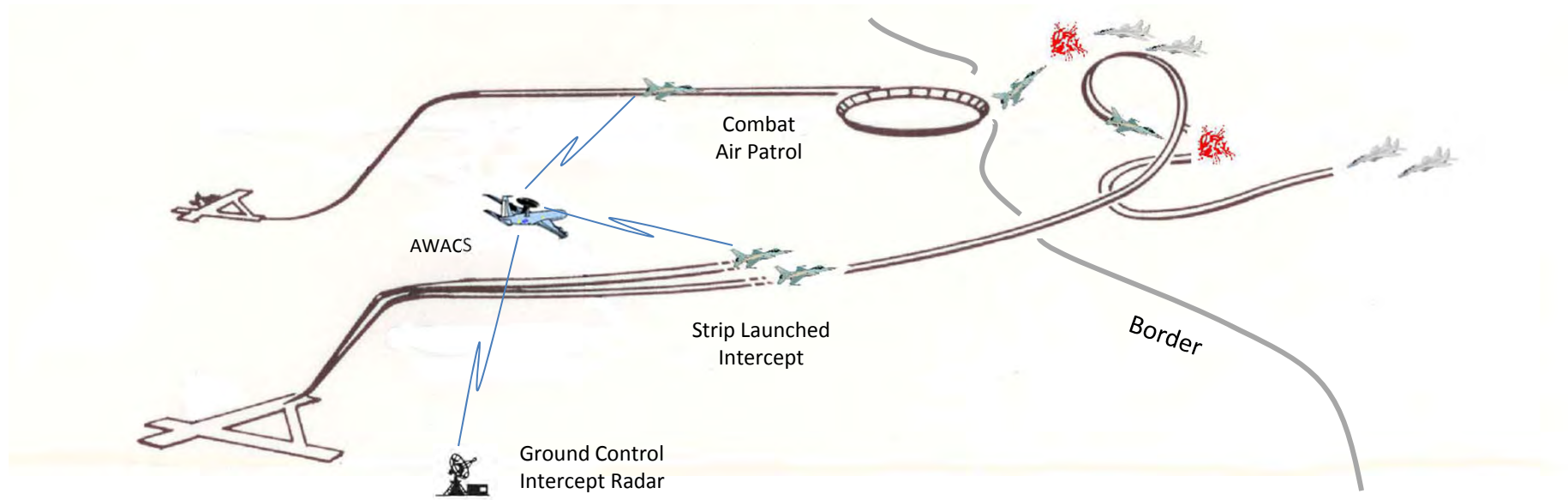
## GCC Airforce Tactical Fighter Capabilities - 2012

Type	Order of Battle	Operational Ready %	Force Available	Force Total Sorties per Day	Postulated Employment
Tornado IDS	Saudi Arabia: 25	75	19	57	Deep Strike
Typhoon	Saudi Arabia: 22	75	16	48	FS, BAS, AD, Escort
Mirage 2000	UAE: 62 Qatar: 12 (Total: 74)	75	UAE: 46 Qatar: 9 (Total: 55)	UAE: 138 Qatar: 27 (Total: 165)	FS, BAS, AD, Escort
F-18	Kuwait: 39	75	29	87	FS, BAS, AD, Escort, CAS, BI, SEAD
F-16C/D	Bahrain: 21 Oman: 12 UAE: 80 (Total: 113)	75	Bahrain: 16 Oman: 9 UAE: 60 (Total: 85)	Bahrain: 48 Oman: 27 UAE: 180 (Total: 255)	FS, BAS, AD, Escort, CAS, BI
F-15C/D	Saudi Arabia: 84	75	63	189	FS, BAS, AD, Escort, CAS, BI
F-15S	Saudi Arabia: 71	75	53	160	Deep Strike, FS, AD, Escort, CAS, BI
<b>Total</b>	<b>428</b>		<b>320</b>	<b>960</b>	

FS: Fighter Sweep, BAS: Battlefield Air Superiority, AD: Air Defense,  
CAS: Close Air Support (Air to Ground Role), BI: Battle Field Interdiction (Air to Ground Role)  
SEAD: Suppression of Enemy Air Defense

Sustained Conditions : 12 hr Operational Day  
18 hr Maintenance Day  
3 Sorties per aircraft per day

## Defensive Counterair Operations



**Mission** : Defense of Border from Enemy Intrusion.

**Objective** : Provide Airspace Surveillance over selected corridor and Intercept.

**Assumptions & Conditions:**

- Corridor Width & Distance from Base
- Threat Operations
- Duration of Coverage

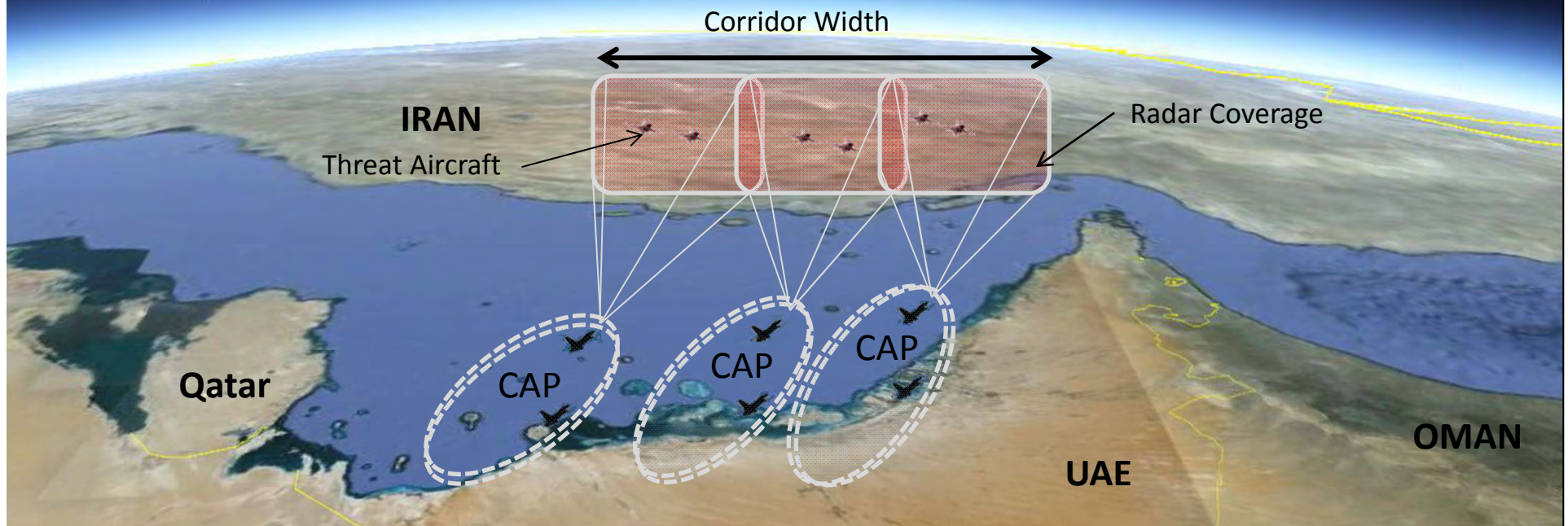
**Central Factors in Threat Engagement Analysis:**

- C4I (Command Control Communications Computing and Intelligence) and the maximum Air Defense engagement force
- The Operational Readiness of the forces resulting in the combat forces available as Full Mission Capable.
- The maximum usable Ground/Strip Launched Interceptor force and Combat Air Patrol operations. The Maximum Strip Launched Interceptors is highly sensitive to the C4I time delay and the response time.
- In the Alert Phase of air operations, the combat ready assets are assigned to the Ground Launched Intercept and Combat Air Operations (CAP).



# Typical GCC Combat Air Patrol Mission

Aircraft Required on CAP Stations	x	Number of Aircraft to Support Each CAP Station	=	Total Aircraft Required
(Number of CAP Stations) x 2	x	$\frac{\text{Operational Day } 12 \text{ hrs}}{(\text{Sortie Rate}) \times (\text{Loiter Time})}$	=	(Aircraft Required on CAP) x (Aircraft Required to Support CAP)
$3 \times 2 = 6$	x	$12 / (3 \times 2) = 2$	=	$6 \times 2 = 14$



Saudi Arabia

Decreasing the Number of Aircraft Required Entails:

- Increasing Aircraft Sortie Rate & Time on Station (Loiter Time)
- Increasing Aircraft Radar Range & Time on Station (Loiter Time)

## **What Iran lacks in Air Power:**

The following are some general criteria that would be required for Iran to try and maintain a technological and qualitative edge over the GCC Airforces:

- **Aircraft:**

- Multi-mission capability.
- High Operational Readiness/Full Mission Capable state and high sortie rates.
- All weather day / night operational capability
- Quick response / ground launched interceptors against incoming intruders.
- High Endurance.
- Airborne Electronic Warfare (ESM/ECM/ECCM) survivability
- Detect track and engage multiple mobile ground targets as well as Hard and Deeply Buried Targets (HDBTs).
- Rapidly destroy advanced air defense systems.
- Capable of carrying out deep strike missions.
- Short C4I Early Warning delay time due to having antiquated System, semi-automated man in the loop, giving rise to long Response / Scramble Time by Combat Aircraft

- **Air to Air Missiles:**

- Aircraft to be capable of multiple target engagement. Fire and Forget/Launch and leave with high single shot kill capability.
- Good target discrimination and enhanced resistance to countermeasures.
- Increase in range of firing missile at the same time shortening the flight time to the target.
- low Loss Exchange Ratio in a Closing / BVR Environment and Visual Engagement Environment.

-

•**Air to Ground:**

Weapons that serve as an effective force multiplier.

Stand-off capability, operating from ranges outside enemy point defenses.

Low and high altitude launches.

Preserve crew and aircraft survivability

Effective against a wide array of land and sea targets with high single shot kill probability.

Weapons that employ launch and leave with high accuracy (small CEP).

Capable of day/night and adverse weather conditions

## Iran's Missile Forces

## Deterrence and Active Defense Risks Iran's Missile Program

- There is little disagreement that Iran's actions pose a potential threat, but there is far less agreement over the nature, scale and timing of this threat. US, European, Gulf, and Israeli policymakers and experts agree that Iran possesses a large and growing missile force, with some missiles capable of hitting Israel, and Europe. They agree that Iran has begun developing longer range and solid-fuel missiles. At the same time, the Iranian program is in flux and many of Iran's missile systems are still in a development phase where their range, accuracy, warhead, and reliability are impossible to predict.
- Iran has been developing ballistic missile capabilities based on Russian, North Korean, and Chinese technology or weapons systems since the early 1980s. Iran currently possesses the largest ballistic missile inventory in the Middle East, and the country's military and scientific establishments are working to increase the sophistication, scale, and reach of its missiles.
- Iran sees its missile capabilities as a way to compensate for its shortcomings in conventional forces, as well as a means to strike at high-value targets with little warning, such as population centers, and Western and Western-backed forces in the region, including US bases in the Gulf. As such, ballistic missiles play an integral role in Iran's asymmetric warfare doctrine. Given the emphasis Iran places on its missile program, it is clear that Iran considers its ballistic missile arsenal among its most important assets as both a deterrent to attack and leverage over other regional players.
- There is no agreement as to when Iran may acquire missiles with homing warheads and the kind of terminal guidance that can hit point targets effectively with conventional warheads. There is no agreement on the reliability and accuracy of Iran's missiles under operational conditions, there is no agreement on Iran's ability to deploy systems with countermeasures to missile defenses. There is no agreement on when Iran might deploy a fully function nuclear warhead. And, there is no agreement on the future size, character, and basing mode of Iran's missile forces once its long-range systems are deployed in strength.

## **Iran Military Doctrine:**

- Since Iran presently does not have access to high technology military weapon systems, it will need to develop all ranges of Ballistic Missiles to compensate for its deficiencies in conventional forces.
- Iran has no problem in Strategic Depth, can be an advantage fighting in and over familiar territory. Force Structure Planning based on:
  - High attrition rate inflicted on adversary civilians
  - In depth defenses, as Iran has the strategic depth

## **Tactical Ballistic Missiles Threat:**

- Iran's ballistic missiles cover the complete spectrum range from 150 km up to 5,500 km, the Short, Medium, and Intermediate Ranges of Ballistic Missiles. Iran believes that these will compensate for any deficiencies in its Air Power.
- Ballistic Missiles can be used with success against Soft Targets, in open areas and cities to inflict maximum human casualties and create terror. In essence what is considered as a major component in Asymmetric Warfare in the form of high civilian casualties.
- This arsenal of Ballistic Missiles possessed by Iran has been declared to be for defensive purposes against any foreign invasion, in particular against the U.S.
- However, it has become very clear that it is an arsenal that is intended to inflict maximum casualties and damage, in essence a major component for Asymmetric Warfare in the form of high attrition and defenses in depth and to compensate for any deficiencies in its Air Power.

Iran	SRBM < 1000 km	MRBM 1,000 – 3,000 km	IRBM 3,000 – 5,500 km	ICBM > 5,500 km
	Shahab-1	Shahab-3	Shahab-5	Shahab-6
	Shahab-2	Shahab-4	-	-
	Mushak-120	Ghadr-101	-	-
	Mushak-160	Ghadr-110	-	-
	Mushak-200	IRIS	-	-
	-	Sajil	-	-

Syria	SRBM < 1000 km	MRBM 1,000 – 3,000 km	IRBM 3,000 – 5,500 km	ICBM > 5,500 km
	SCUD-B	-	-	-
	SCUD-C	-	-	-
	SCUD-D	-	-	-
	SS-21b	-	-	-

Israel	SRBM < 1000 km	MRBM 1,000 – 3,000 km	IRBM 3,000 – 5,500 km	ICBM > 5,500 km
	-	Jericho II	-	Jericho III

Pakistan	SRBM < 1000 km	MRBM 1,000 – 3,000 km	IRBM 3,000 – 5,500 km	ICBM > 5,500 km
	Shaheen I	Shaheen II	-	-
	Hatf I	Ghauri I	-	-
	Hatf II	Ghauri II	-	-
	Hatf III	Ghauri II	-	-
M-11	-	-	-	

India	SRBM < 1000 km	MRBM 1,000 – 3,000 km	IRBM 3,000 – 5,500 km	ICBM > 5,500 km
	Agni I	Agni II	Agni III	Surya
	Prithvi I			
	Prithvi II			



Iran is the only state between the four that has signed and ratified the NPT Treaty.

Iran has been heavily investing in:

- Precision Strike Munitions
- Naval-anti-ship weapons such as the Chinese C802 that hit the Israeli Navy ship during the 2006 war in Lebanon and the Ra'ad 350 km anti-ship missile.
- Ballistic Missiles
- Cruise Missiles such as the Kh55 Russian land attack cruise missile, effective against Oil Platforms.

SRBM : Short Range Ballistic Missile

MRBM : Medium Range Ballistic Missile

IRBM : Intermediate Range Ballistic Missile

ICBM : Intercontinental Ballistic Missile

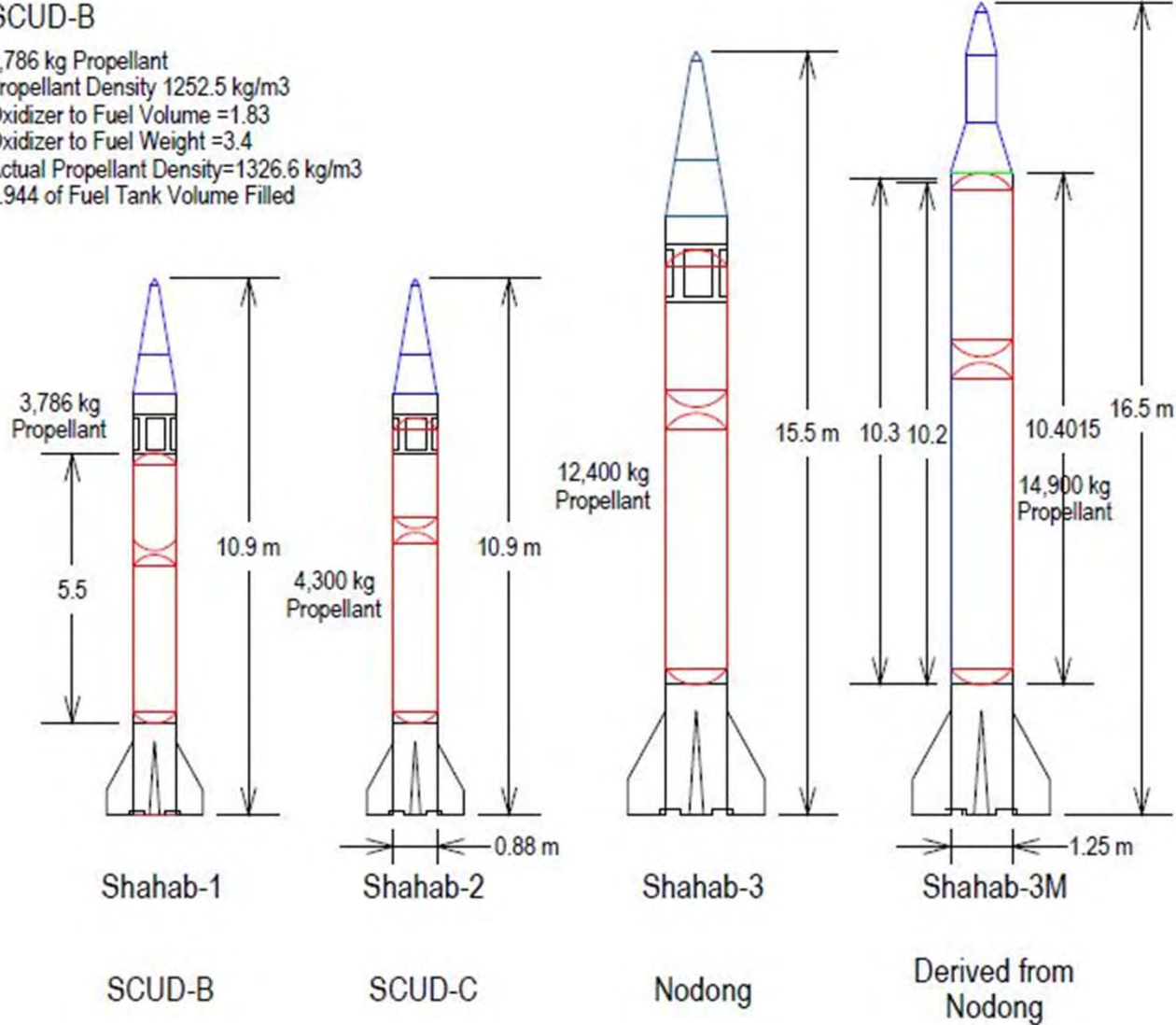
<b>Missile</b>	<b>Translation</b>	<b>Fuel Type</b>	<b>Estimated Range</b>	<b>Payload</b>
Fajr-3	<i>Dawn-3</i>	Solid	45 km	45 kg
Fajr-5	<i>Dawn-5</i>	Solid	75 km	90 kg
Fateh-110	<i>Victorious</i>	Solid	20 km	500 kg
Ghadr-1	<i>Powerful-1</i>	Liquid	1600 km	750 kg
Iran-130/Nazeat	<i>Removal</i>	Solid	90-120 km	150 kg
Kh-55		Liquid	2500-3000 km	400-450 kg
Nazeat-6	<i>Removal-6</i>	Solid	100 km	150 kg
Nazeat-10	<i>Removal-10</i>	Solid	140-150 km	250 kg
Oghab	<i>Eagle</i>	Solid	40 km	70 kg
Sajjil-2	<i>Baked Clay-2</i>	Solid	2200-2400 km	750 kg
Shahab-1	<i>Meteor-1</i>	Liquid	300 km	1000 kg
Shahab-2	<i>Meteor-2</i>	Liquid	500 km	730 kg
Shahab-3	<i>Meteor-3</i>	Liquid	800-1000 km	760-1100 kg
Shahin-1	<i>Hawk-1</i>	Solid	13 km	
Shahin-2	<i>Hawk-2</i>	Solid	20 km	
Zelzal-1	<i>Earthquake-1</i>	Solid	125 km	600 kg
Zelzal-2	<i>Earthquake-2</i>	Solid	200 km	600 kg

Source: 2010 IISS Iran's Ballistic Missile Capabilities: A Net Assessment



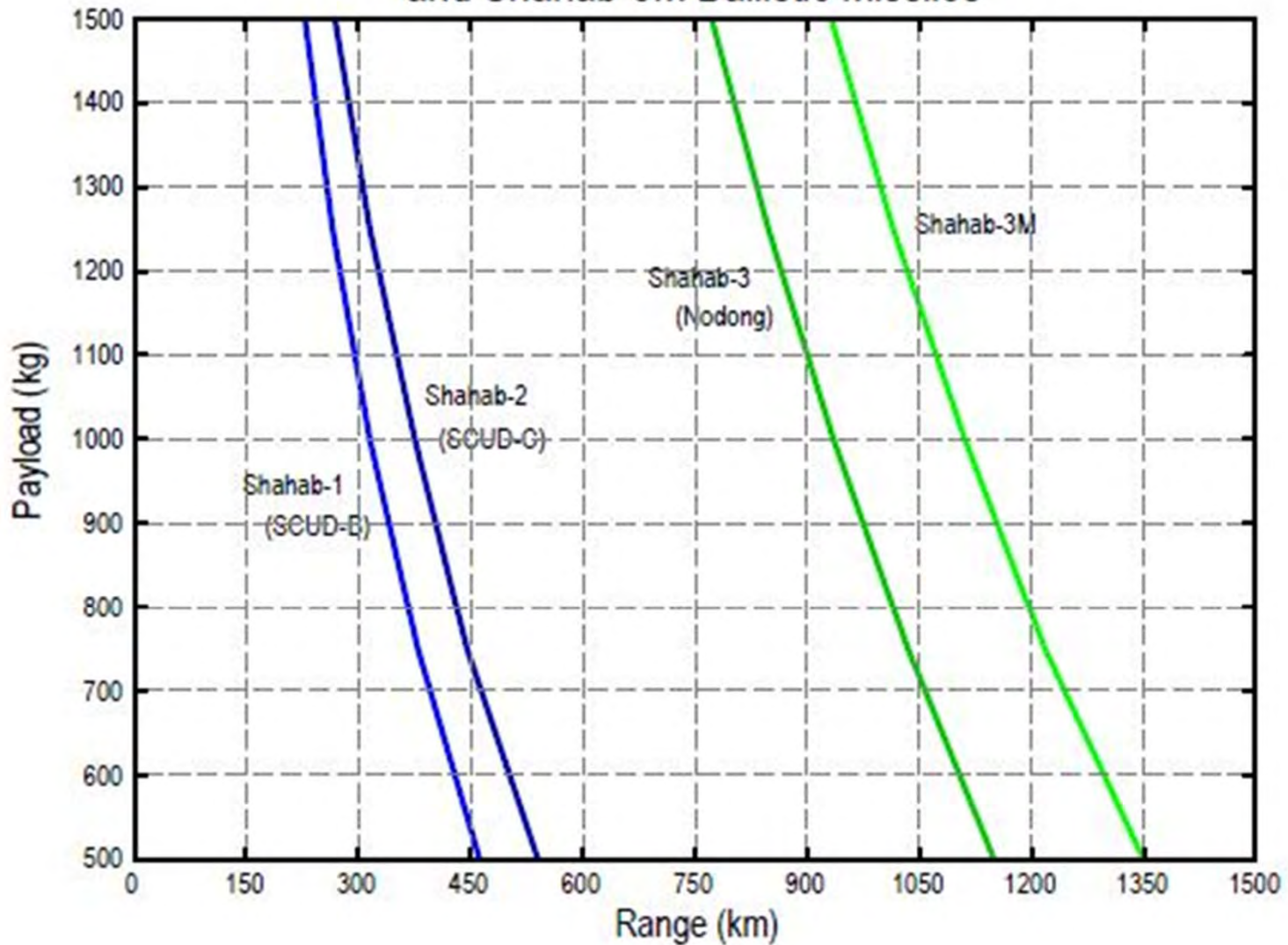
## SCUD-B

3,786 kg Propellant  
 Propellant Density 1252.5 kg/m<sup>3</sup>  
 Oxidizer to Fuel Volume =1.83  
 Oxidizer to Fuel Weight =3.4  
 Actual Propellant Density=1326.6 kg/m<sup>3</sup>  
 0.944 of Fuel Tank Volume Filled

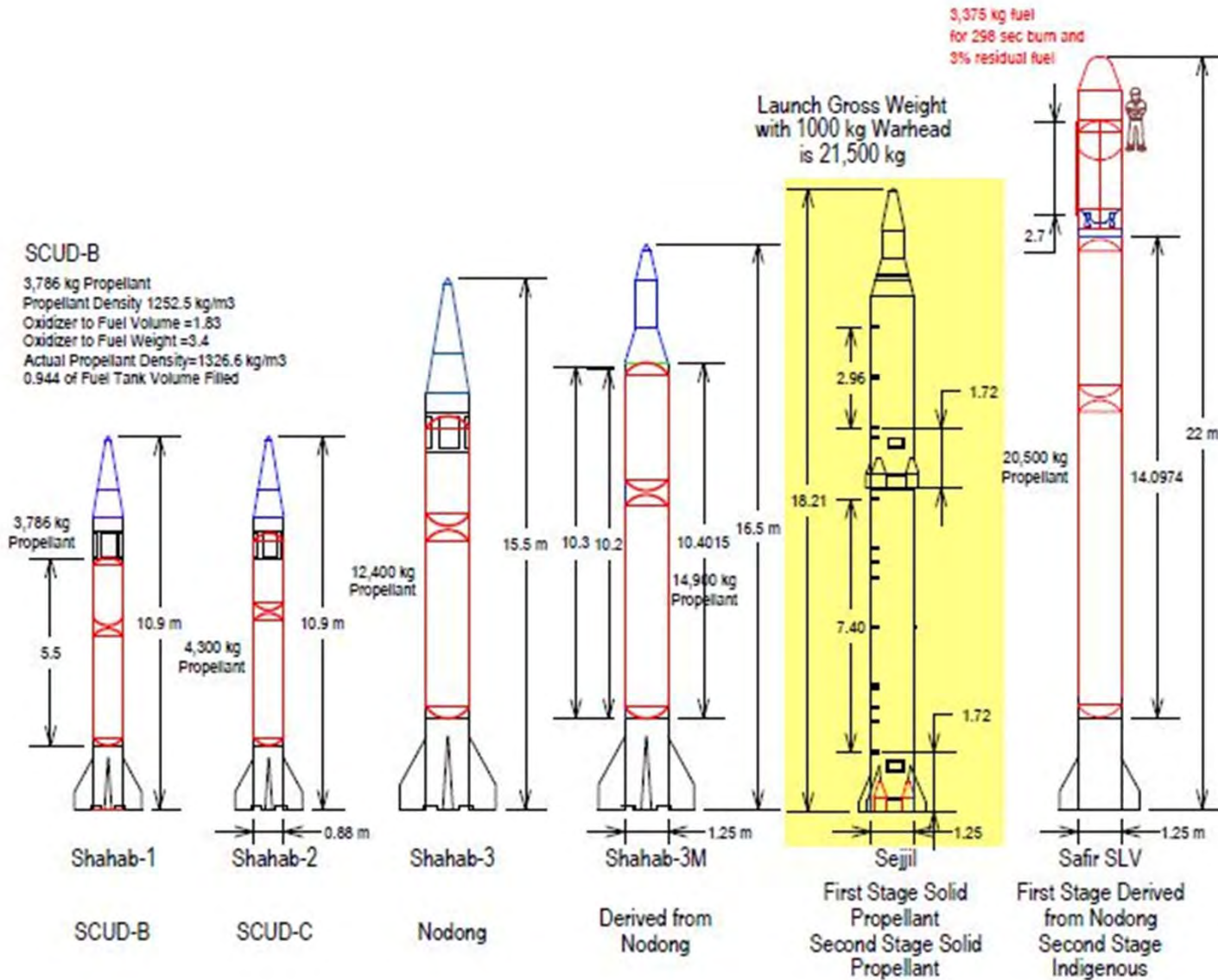


( Reference: Theodore Postol, "A Technical Assessment of Iran's Ballistic Missile Program" May 6, 2009. Technical Addendum to the Joint Threat Assessment on Iran's Nuclear And Missile Potential.)

## Range Versus Payload of SCUD-B, SCUD-C, Nodong and Shahab-3M Ballistic Missiles

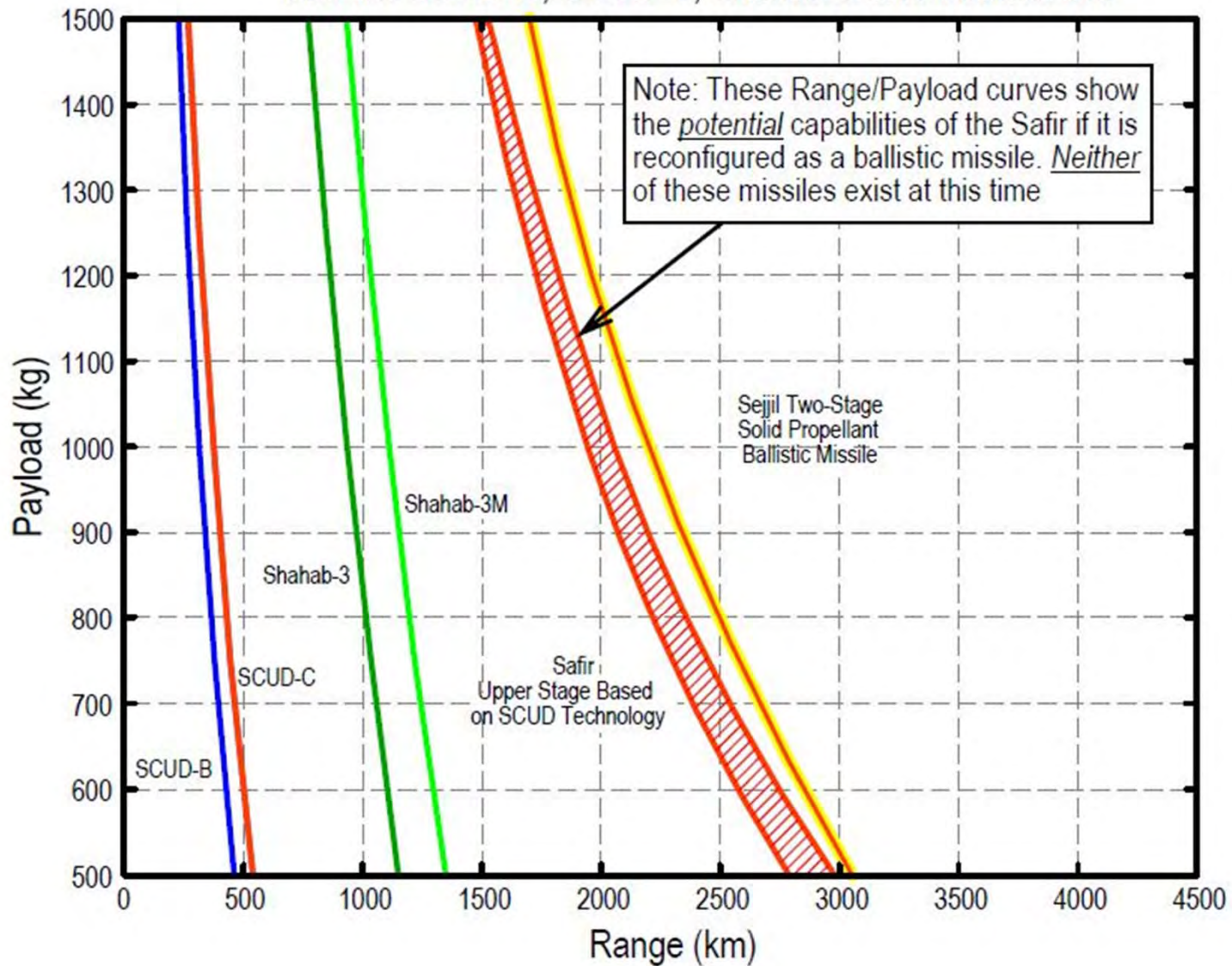


( Reference: Theodore Postol, "A Technical Assessment of Iran's Ballistic Missile Program" May 6, 2009. Technical Addendum to the Joint Threat Assessment on Iran's Nuclear And Missile Potential.)



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## Range Versus Payload of the Iranian Sejjil and Safir Two-Stage Ballistic Missiles and the SCUD-B, SCUD-C, Shahab-3 and Shahab-3M

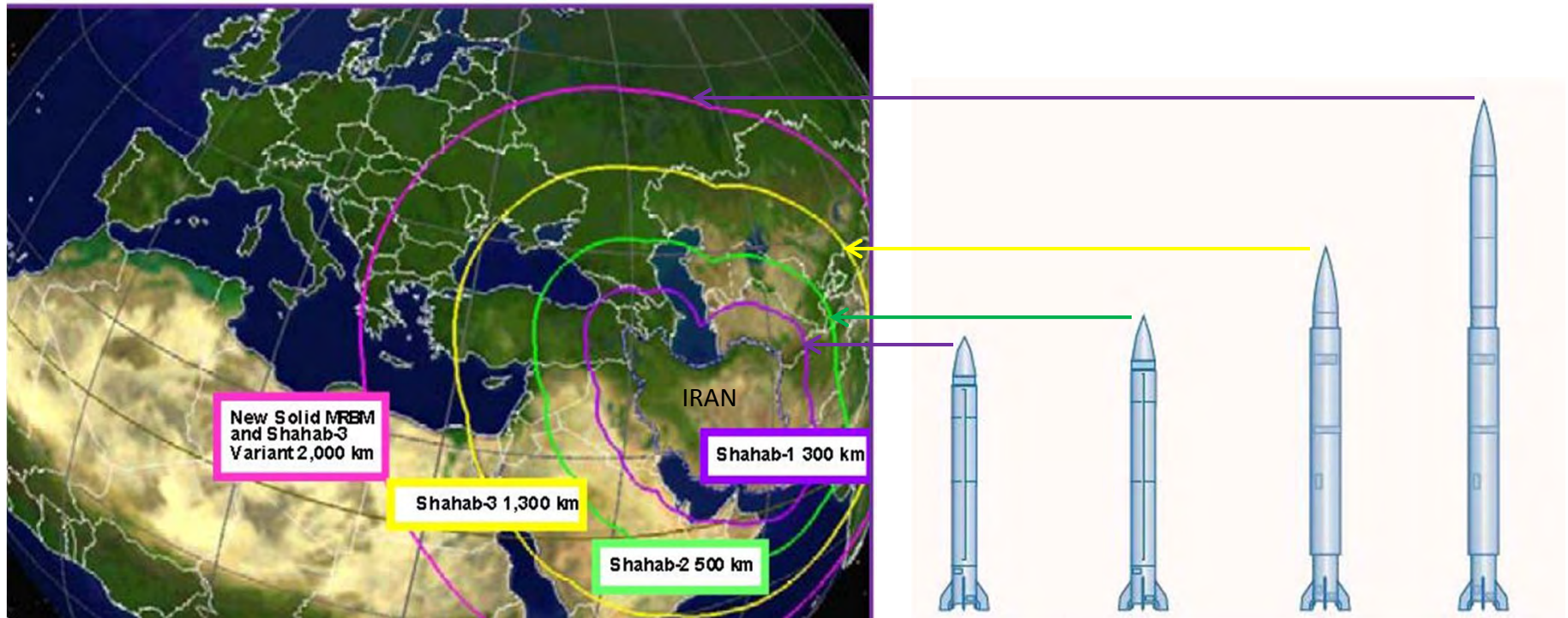


( Reference: Theodore Postol, "A Technical Assessment of Iran's Ballistic Missile Program" May 6, 2009. Technical Addendum to the Joint Threat Assessment on Iran's Nuclear And Missile Potential.)

# Iran

## Shahab Ballistic Missiles

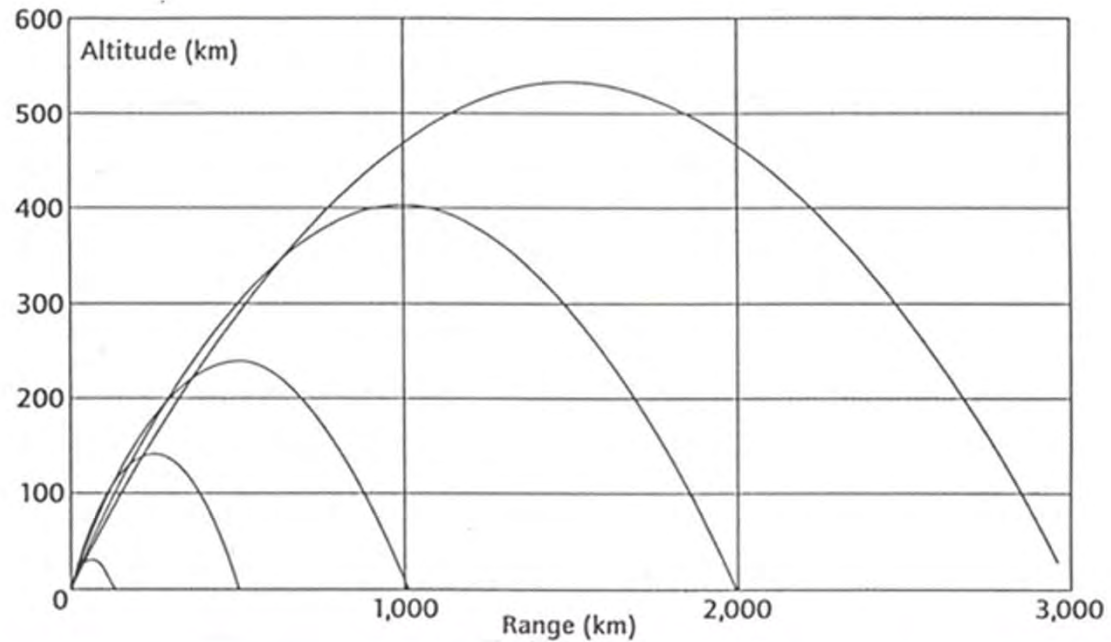
### Range vs Payload



(Reference: Ballistic Missile Defense Review Report.  
BMDR DoD February 2010)

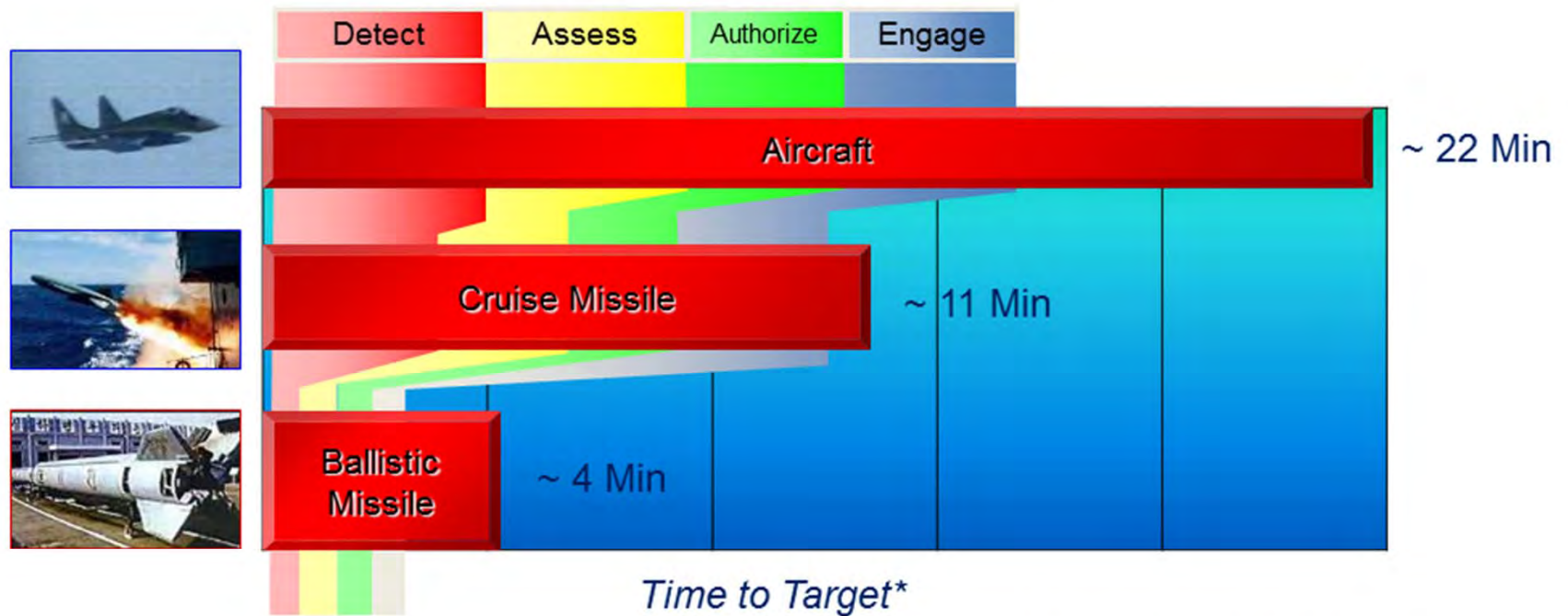
	Shahab-1	Shahab-2	Shahab-3	Shahab-4
Class:	SRBM	SRBM	MRBM	MRBM
Range (km):	300	500	1,300	2,000
Payload (kg):	1,100	600	650	1,000

## Typical Trajectories of Theatre Ballistic Missiles (TBMs)



Range (Km)	Class	Burn-out velocity (km/sec)	Boost Phase (sec)	Flight Time (min)
120	SRBM	1.0	16	2.7
500	SRBM	2.0	36	6.1
1,000	SRBM	2.9	55	8.4
2,000	MRBM	3.9	85	11.8
3,000	MRBM	4.7	122	14.8

# Missile Defense Challenge



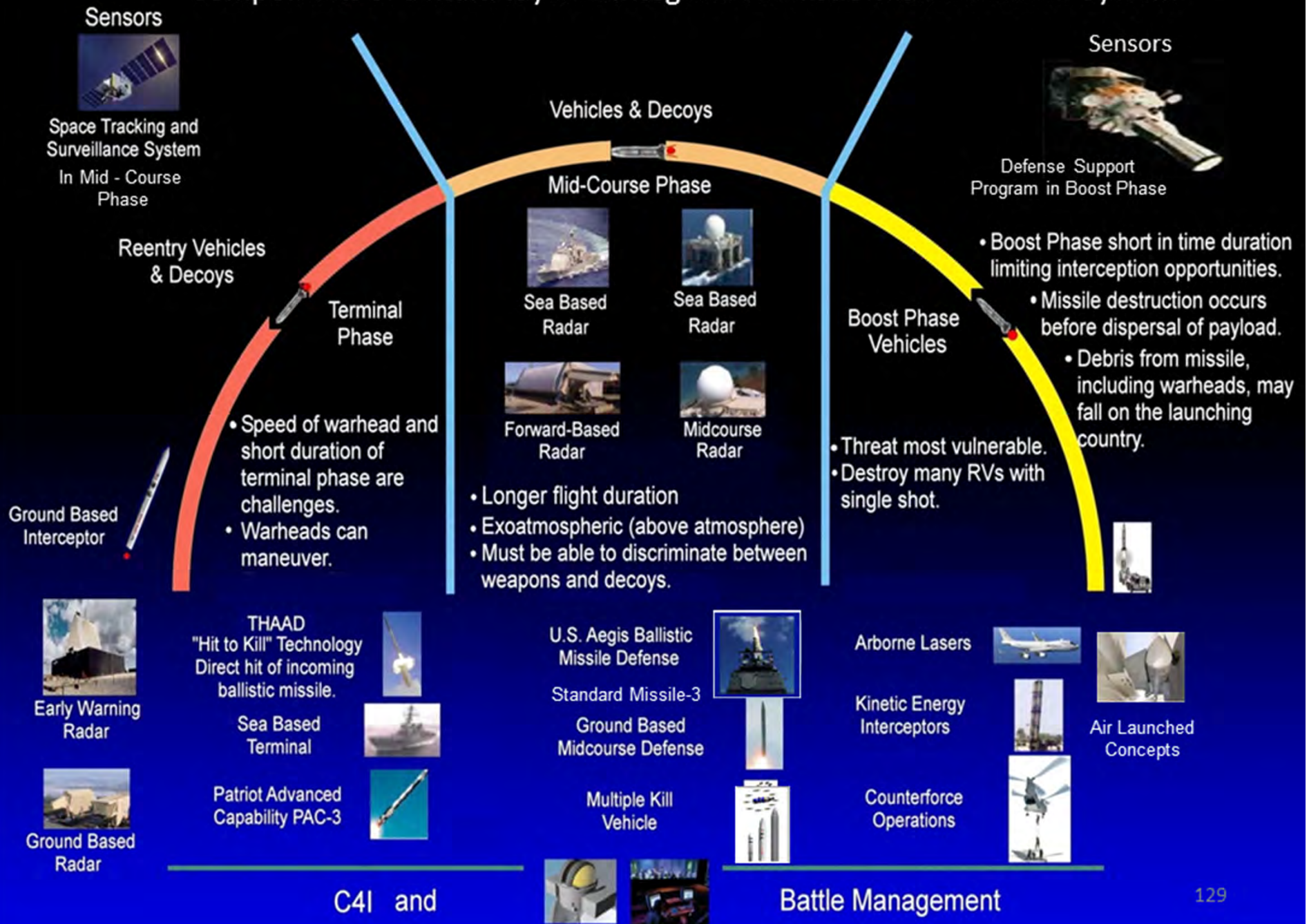
\* Based on Approximate Range of 320 Km

**Responsive Missile Defense System is Crucial**

U.S. & GCC  
Defense against Iranian Ballistic Missiles



# Components of a multi-layered integrated Ballistic Missile Defense System



## Sea Based Air Defenses

### The U.S. Navy's Role in Missile Defense Network

#### Role of the U.S. Navy Aegis System:

- Will provide an efficient and highly mobile sea-based defense against Short and Medium – Range Ballistic Missiles in their midcourse phase.
- The system will allow the BMD Command to move its defense capabilities close to the enemy sites.
- The system will have the Engagement & Long Range Tracking Capability
- Intercepting Short to Medium Range Ballistic Missiles in the midcourse phase of the flight with Standard Missile – 3.
- Serves as a forward deployed sensor, providing early warning and long range search & track capabilities for ICBMs and IRBMs.

#### Contributions:

- Will extend the battle space of the BMDs and contribute to an integrated layered defense. The Naval Aegis system extends the range of the Ground Missile defense (GMD) element by providing reliable track data used to calculate firing solutions.
- Aegis BMD will coordinate engagements of short and medium range ballistic missiles with terminal missile defense systems.
- As tracking information is shared among these systems, the BMDS will have the opportunity to follow the engagement of a target during the midcourse segment with coordinated terminal engagements.



Sea Based Radar



Sea Based Radar



Aegis Ballistic Missile

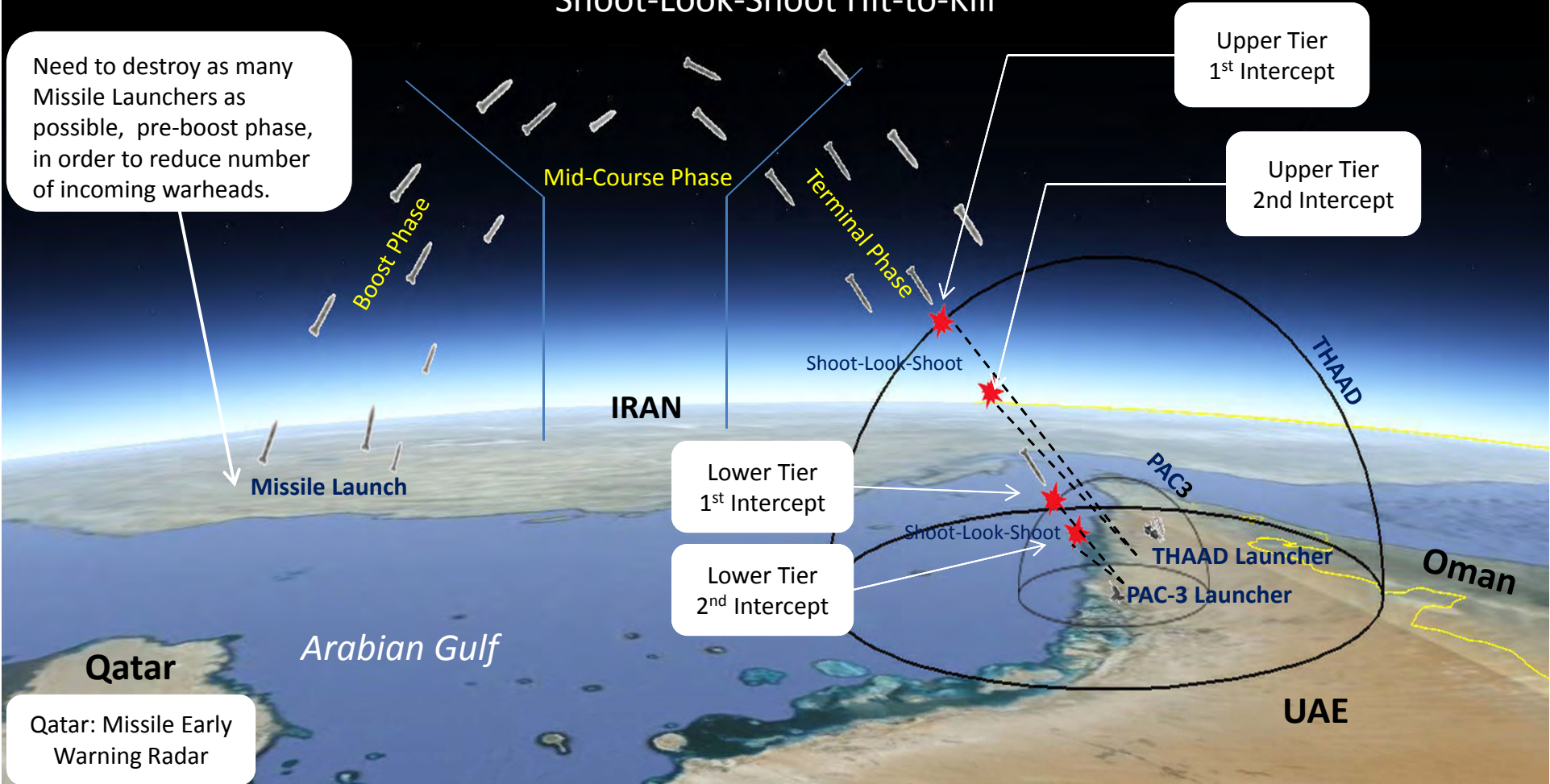
(Source: Missile Defense Agency. (MDA) Department of Defense. "Testing Building Confidence", 2009 )

Country	TBMD System
UAE	<ul style="list-style-type: none"> <li>• The UAE is so far the first GCC country to buy the Terminal High Altitude Air Defense (THAAD) missile system.</li> <li>• On Dec 31, 2011 Pentagon announced that the UAE will be buying 2 full THAAD batteries, 96 missiles, 2 Raytheon AN/TPY-2 radars, and 30 years of spare parts. Total Value \$3.34 billion.</li> <li>• In 2008 the UAE ordered Patriot PAC-3: 10 fire units, 172 missiles, First delivery 2009.</li> </ul>
Kuwait	<p>July 2012, Pentagon informed Congress of a plan to sell Kuwait \$4.2 billion in weapon systems, including 60 PAC-3 missiles, 20 launching platforms and 4 radars. This will be in addition to the 350 Patriot missiles bought between 2007 and 2010. In 1992, Kuwait bought 210 of the earlier generation Patriots and 25 launchers. Kuwait bought a further 140 more in 2007.</p>
Saudi Arabia	<p>In 2011 Saudi Arabia signed a \$1.7 billion US contract to upgrade it's Patriot anti-missile system.</p>
Qatar	<p>The U.S. is building a Missile Warning Facility in Qatar that would utilize an AN/TPY-2-X Band Radar.</p>

(Source: Anthony Cordesman and Alexander Wilner, "Iran and the Gulf Military Balance -1" July 11, 2012)

# Two Tier Theater Ballistic Missile Defense (TBMD) – THAAD & PAC 3

## Endo and Exo-Atmospheric Engagements using Shoot-Look-Shoot Hit-to-Kill

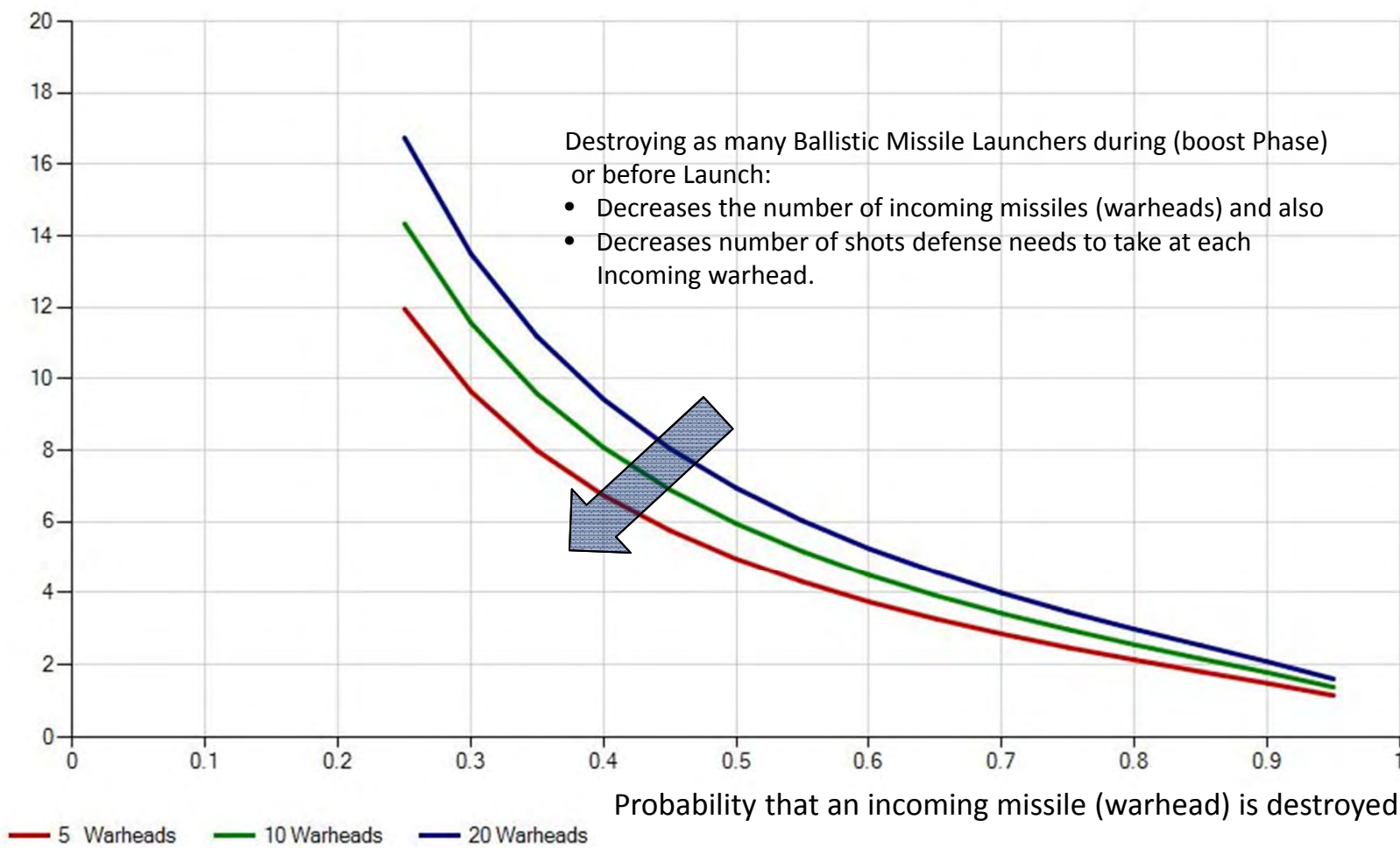


TBMD System	Defense against
THAAD : UAE	SRBMs (<1000 km) and MRBMs (1000 - 3000 km)
PAC-3 : UAE, Kuwait, Saudi Arabia	SRBMs (300 – 1000 km)

## Defense Required to meet Performance Criteria

- Defense Performance Criteria: 85% Probability that the defense shoots down all the incoming missiles (warheads); 85% of zero leakage.
- 99% Probability that incoming missiles (warheads) are successfully tracked by the defense.

Number of shots that must be taken at each incoming missile (warhead) to achieve the defense performance criteria.



## **THEATER BALLISTIC MISSILE DEFENSE SYSTEM, C4ISR & BATTLEFIELD MANAGEMENT.**

- The Challenge for the GCC States is to design an effective multi-layered Theater Ballistic Missile Defense System (TBMDs) to counter the Short, Medium and Intermediate Ballistic Missiles.
- Due to the very short time window in the defense against Ballistic Missiles, they will have to be engaged automatically, which requires intercept authorization and rules of engagement to be agreed upon in advance. All part of an effective C4ISR / BM system in both peace time and war. This will also act as a Force Multiplier.
- Evident that the key to an effective TBMD lies in regional cooperation, which can take a range of forms from coordination and cooperation between command centers and defense systems for TBMD purposes - while enabling each state to control its own defenses.
- Cooperation to be comprehensive in nature, leading to a near-real time situation awareness of the military developments in the area, hostile and friendly military capabilities and their operational levels. This would also be in the form of cooperation into TBMDs and NBC threat assessment. This requires an C4ISR capability in all its Components, such as, Unmanned Air Systems (UAS's) / Unmanned Air Vehicles (UAV's).
- As the Front Lines of a Missile War will be over the Arabian Gulf region, the a Multi-Tier TBMD systems will play the leading role in Air Defenses and in a Theater Ballistic Missile Defense Network. Sea based systems will provide an efficient and highly mobile defense against Theater Ballistic Missiles.
- The Naval System, such as the U.S. Navy Aegis system, will allow the TBMD command to move its defense capabilities close to the enemy sites and serve as a forward deployed sensor and will have the Long Range Engagement and Tracking Capability. This will extend the battle space of the BMDs and contribute to an integrated layered defense.

# Ballistic Missile War Between Iran the U.S. and the Gulf States

Space  
Sensor



Defense Support  
Program in Boost Phase

Iranian Shahab 3  
Launched against Israel

Early Warning & Long Range  
Search & Track Capabilities  
against Iranian MRBMs



© 2009 Basarsoft  
© 2009 Europa Technologies  
© 2009 TeleAtlas  
© 2009 Geacentre Consulting

Google

26°02'47.46" N 52°35'43.14" E

Eye alt: 437.79 mi

Countering Iranian attacks on the  
Straits of Hormuz



The IMF in a report “World Economic Outlook (update) January 24, 2012,” summarized the global financial situation as follows:

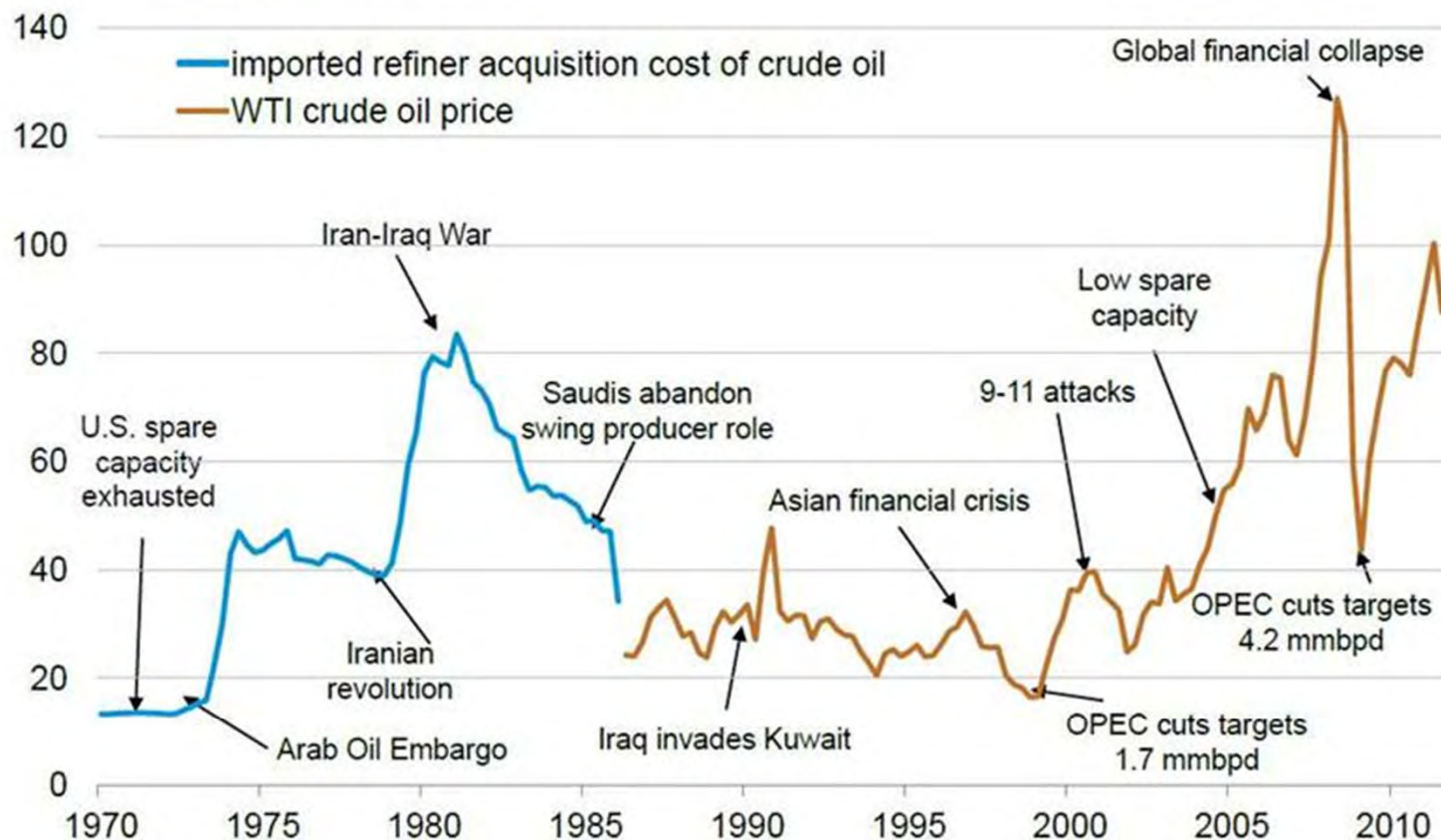
- Concerns about geopolitical oil supply risks are increasing again. The oil market impact of intensified concerns about an Iran-related oil supply shock (or an actual disruption) would be large, given limited inventory and spare capacity buffers, as well as the still-tight physical market conditions expected throughout 2012.”
- On January 25, 2012, In a regular note to the Group of 20 leading industrialized countries, the IMF said that “if Iran goes ahead with a threat to blockade oil exports via the Straits of Hormuz in the Gulf, the shock could be even greater. A blockade of the Strait of Hormuz would constitute, and be perceived by markets to presage, sharply heightened global geopolitical tension involving a much larger and unprecedented disruption.”

#### Effects of Oil Price Spikes:

- Sharp and/or sustained oil price increases place further pressures on highly oil-dependent industries and consumers, as well as raising geopolitical tensions. According to the International Energy Agency (IEA), a sustained US\$ 10/barrel increase in the price of oil could lower growth of global GDP by 0.5 percentage points (pct pts) in the subsequent year.
- In addition to adverse impacts for growth effects, substantially higher oil prices generate current account surpluses in producing countries, which may exacerbate global macroeconomic imbalances and fuel financial market turbulence.

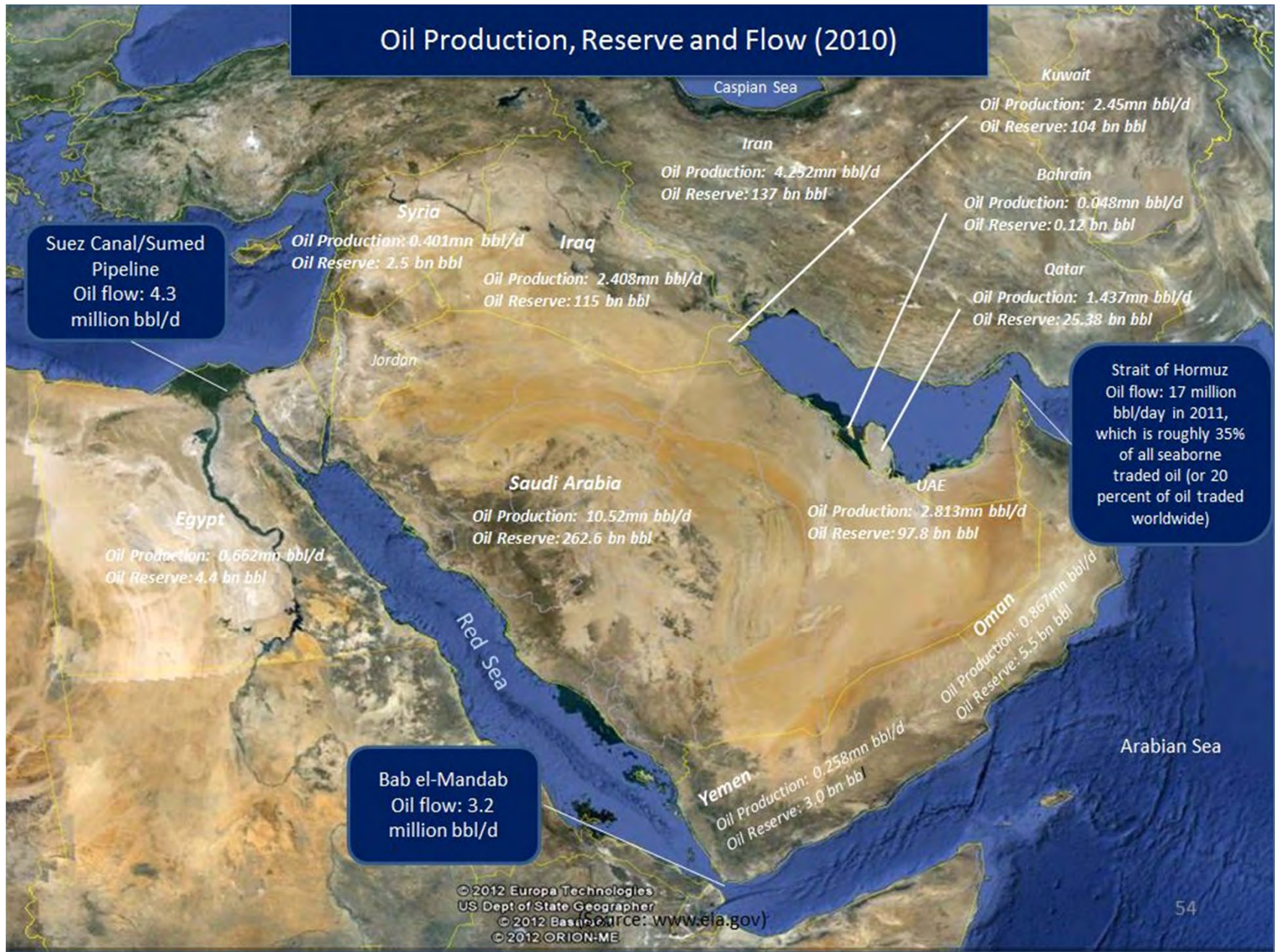
## Crude oil prices react to a variety of geopolitical and economic events

price per barrel  
(real 2010 dollars, quarterly average)



Sources: U.S. Energy Information Administration, Thomson Reuters

# Oil Production, Reserve and Flow (2010)



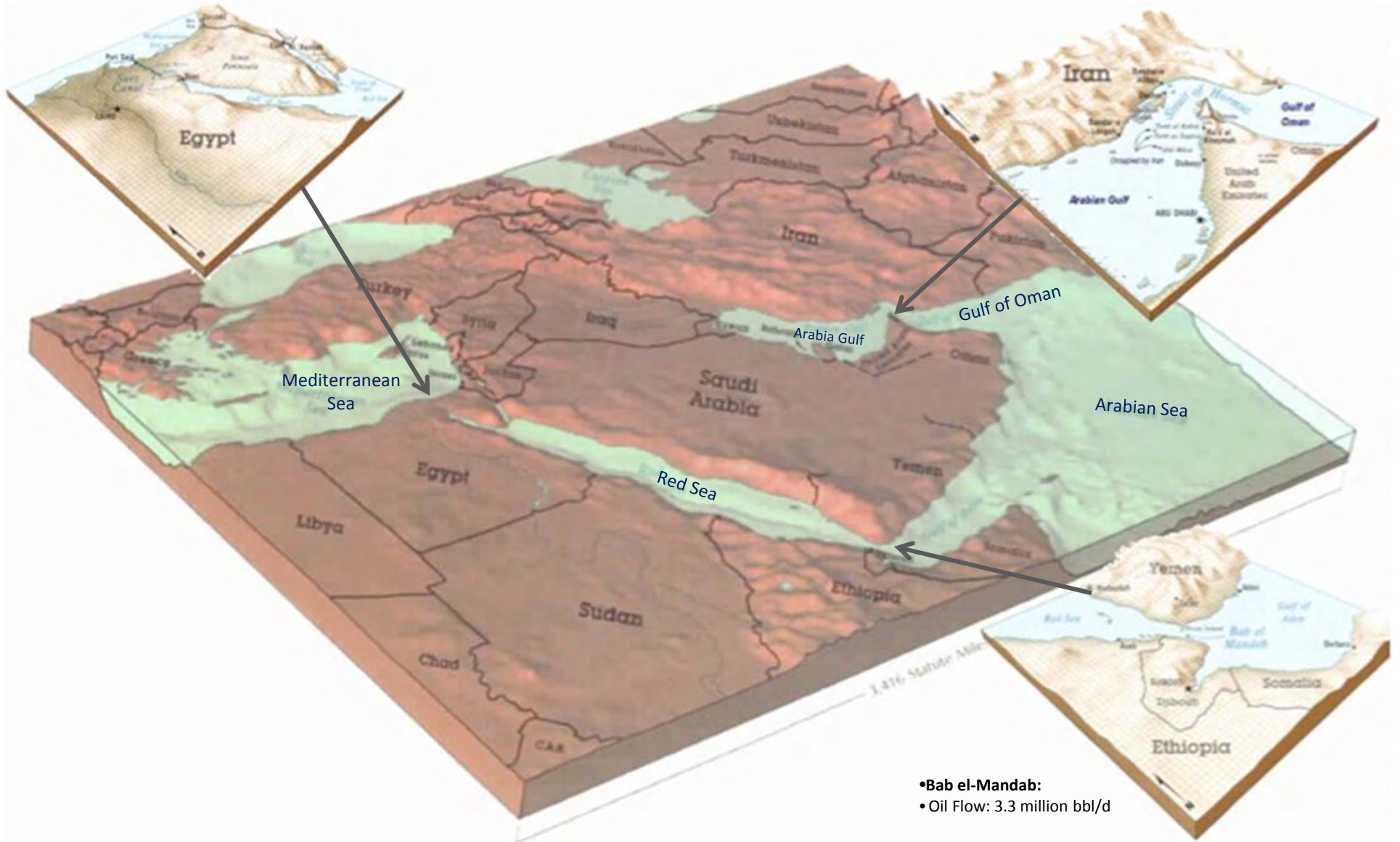
# Oil Transit Chokepoints

•The Suez Canal/Sumed Pipeline:

•Oil Flow: 4.5 million bbl/d

•The Strait of Hormuz:

•Oil Flow: 16.5 million bbl/d



•Bab el-Mandab:

•Oil Flow: 3.3 million bbl/d

## Global Importance of Gulf Energy Exports

- The volume of Gulf oil exports amounts to some 20% of all the world's oil production of 87 million barrels a day. Any major disruption affects the entire economy of Asia and all world oil prices – regardless of where oil is produced. It can lead to panic and hoarding on a global basis and the US economy will be no more exempt to the resulting rise in energy prices and the global impact on limited exports to the US and other major industrial and trading states on than any other major economic power. US and other energy importer energy independence may happen someday, but today it is foolish, dangerous myth.
- Virtually all of the Gulf's oil must pass through the Gulf, the Strait of Hormuz, the Gulf of Oman, and the Arabian Sea – and then through the Indian Ocean. Gulf oil production and loading facilities, and tanker traffic can be attacked anywhere in the Gulf. Iran can use a mix of mines, submarines, submersibles, drones, anti-ship missiles, small craft, and assault forces anywhere in the Gulf region to threaten the flow of oil exports.
- Iran can cherry pick its targets in an effort to pressure and intimidate the US and Southern Gulf states. It can use long-range conventionally armed missiles or drones against large military or urban targets as terror weapons. It can attack sporadically and unpredictably in a war of attrition or attempt to “swarm” US and Gulf naval forces.).

(Source: EIA/DOE, *World Oil Transit Chokepoints*, August 2012, <http://www.eia.gov/countries/regionsttopics2.cfm?fips=WOTC&trk=c> .

## **Strait of Hormuz**

- At its narrowest point, the Strait is 21 miles wide, but the width of the shipping lane in either direction is only two miles, separated by a two-mile buffer zone. The Strait is deep and wide enough to handle the world's largest crude oil tankers, with about two-thirds of oil shipments carried by tankers in excess of 150,000 deadweight tons.
- Flows through the Strait in 2011 were roughly 35 percent of all seaborne traded oil, or almost 20 percent of oil traded worldwide. More than 85 percent of these crude oil exports went to Asian markets, with Japan, India, South Korea, and China representing the largest destinations.
- In addition, Qatar exports about 2 trillion cubic feet per year of liquefied natural gas (LNG) through the Strait of Hormuz, accounting for almost 20 percent of global LNG trade. Furthermore, Kuwait imports LNG volumes that travel northward through the Strait of Hormuz. These flows totaled about 100 billion cubic feet per year in 2010.

(Source: EIA/DOE, *World Oil Transit Chokepoints*, August 2012, <http://www.eia.gov/countries/regionstoptics2.cfm?fips=WOTC&trk=c> .

**Volume of Crude Oil and Petroleum Products Transported Through World Chokepoints, 2007-2011 in Millions of Barrels Per Day**

<b>Location</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
<b>Bab el_Mandab</b>	<b>4.6</b>	<b>4.5</b>	<b>2.9</b>	<b>2.7</b>	<b>3.4</b>
<b>Turkish Straits</b>	<b>2.7</b>	<b>2.7</b>	<b>2.8</b>	<b>2.9</b>	<b>N/A</b>
<b>Danish Straits</b>	<b>3.2</b>	<b>2.8</b>	<b>3.0</b>	<b>3.0</b>	<b>N/A</b>
<b>Strait of Hormuz</b>	<b>16.7</b>	<b>17.5</b>	<b>15.7</b>	<b>15.9</b>	<b>17.0</b>
<b>Panama Canal</b>	<b>0.7</b>	<b>0.7</b>	<b>0.8</b>	<b>0.7</b>	<b>0.8</b>
Crude Oil	0.1	0.2	0.2	0.1	0.1
Petroleum Products	0.6	0.6	0.6	0.6	0.6
<b>Suez Canal and SUMED Pipeline</b>	<b>4.7</b>	<b>4.6</b>	<b>3.0</b>	<b>3.1</b>	<b>3.8</b>
Suez Crude Oil	1.3	1.2	0.6	0.7	0.8
Suez Petroleum Products	1.1	1.3	1.3	1.3	1.4
SUMED Crude Oil	2.4	2.1	1.2	1.1	1.7

Source: EIA/DOE, *World Oil Transit Chokepoints*, August 2012, <http://www.eia.gov/countries/regions-topics2.cfm?fips=WOTC&trk=c>.

## Alternative Routes to the Strait of Hormuz

Most potential options to bypass Hormuz are currently not operational. Only Iraq, Saudi Arabia, and the United Arab Emirates (UAE) presently have pipelines able to ship crude oil outside of the Gulf, and only the latter two countries currently have additional pipeline capacity to circumvent Hormuz. At the start of 2012, the total available pipeline capacity from the two countries combined, which is not utilized, was approximately 1 million bbl/d. The amount could potentially increase to 4.3 million bbl/d by the end of this year, as both countries have recently completed steps to increase standby pipeline capacity to bypass the Strait.

Iraq has one major crude oil pipeline, the Kirkuk-Ceyhan (Iraq-Turkey) Pipeline that transports oil from the north of Iraq to the Turkish Mediterranean port of Ceyhan. This pipeline pumped about 0.4 million bbl/d in 2011, far below its nameplate capacity of 1.6 million bbl/d and it has been the target of sabotage attacks. Moreover, this pipeline cannot send additional volumes to bypass the Strait of Hormuz unless it receives oil from southern Iraq via the Strategic Pipeline, which links northern and southern Iraq. Currently, portions of the Strategic Pipeline are closed, and renovations to the Strategic Pipeline could take several years to complete.

Saudi Arabia has the 745-mile-long Petroline, also known as the East-West Pipeline, which runs from across Saudi Arabia from its Abqaiq complex to the Red Sea. The Petroline system consists of two pipelines with a total nameplate capacity of about 4.8 million bbl/d. The 56-inch pipeline has a nameplate capacity of 3 million bbl/d and its current throughput is about 2 million bbl/d.

The 48-inch pipeline had been operating in recent years as a natural gas pipeline, but Saudi Arabia recently converted it back to an oil pipeline. The switch could increase Saudi Arabia's spare oil pipeline capacity to bypass the Strait of Hormuz from 1 million bbl/d to 2.8 million bbl/d, which is only attainable if the system is able to operate at its full nameplate capacity.

Source: EIA/DOE, *World Oil Transit Chokepoints*, August 2012, <http://www.eia.gov/countries/regions-topics2.cfm?fips=WOTC&trk=c>.



## **Alternative Routes to the Strait of Hormuz - 2**

The UAE constructed a 1.5 million bbl/d Abu Dhabi Crude Oil Pipeline that runs from Habshan, a collection point for Abu Dhabi's onshore oil fields, to the port of Fujairah on the Gulf of Oman, allowing crude oil shipments to circumvent Hormuz. The pipeline was recently opened and the first shipment of 500,000 barrels of oil was sent through the pipeline to the Fujairah oil terminal where it was loaded on a tanker and sent to the Pak-Arab Refinery in Pakistan.

The pipeline will be able to export up to 1.5 million bb/d, or more than half of UAE's total net oil exports, once it reaches full operational capacity in the near future. However, the UAE does not currently have the ability to utilize this pipeline completely, until it ramps to full capacity. In late May, Fujairah ruler Sheikh Hamad bin Mohammed Al-Sharqi noted that this pipeline capacity could rise further to a maximum 1.8 million bbl/d.

Saudi Arabia also has two additional pipelines that run parallel to the Petroline system and bypass the Strait of Hormuz, but neither of them have the ability to transport additional volumes of oil should the Strait of Hormuz be closed. The Abqaiq-Yanbu natural gas liquids pipeline has a capacity of 290,000 bbl/d and is running at capacity. The IPSA (Iraqi Pipeline through Saudi Arabia) is used to transport natural gas to Saudi Arabia's western coast. It was originally built to carry 1.65 million bbl/d of crude oil from Iraq to the Red Sea, but Saudi Arabia later converted it to carry natural gas, and has not announced plans to convert it back to transport crude oil.

Other pipelines, such as the Trans-Arabian Pipeline (TAPLINE) running from Qaisumah in Saudi Arabia to Sidon in Lebanon, have been out of service for years due to war damage, disuse, or political disagreements, and would require a complete renovation before being usable. Relatively small quantities, several hundred thousand barrels per day at most, could be trucked to mitigate closure of the Strait of Hormuz.

## Currently Operable Crude Oil Pipelines that Bypass the Strait of Hormuz:

If war should come while surplus pipeline capacity is still limited to the high EIA estimate of 4.3 million barrels a day – and all pipeline loading and other facilities remained secure from attack -- this would only provide 25% percent of the 17 million barrels a day flowing through the Gulf.

Pipeline	Kirkuk-Ceyhan (Iraq-Turkey) Pipeline <sup>1</sup>	Petroline (East-West Pipeline)	Abu Dhabi Crude Oil Pipeline United Arab Emirates	Total
Owner	Iraq	Saudi Arabia		
<b>2011 (average)</b>				
Capacity	0.4	3.0	0.0	3.4
Throughput	0.4	2.0	0.0	2.4
Unused Capacity <sup>2</sup>	0.0	1.0	0.0	1.0
<b>2012 (mid-year) <sup>3</sup></b>				
Capacity	0.4	4.8	1.5	6.7
Throughput <sup>4</sup>	0.4	2.0	0.0	2.4
Unused Capacity	0.0	2.8	1.5	4.3

Notes: All estimates are EIA estimates as of August 17, 2012 and expressed in million barrels per day (bbl/d).

1 Although the Kirkuk-Ceyhan Pipeline has a nominal nameplate capacity of 1.6 million bbl/d, its effective capacity is 0.4 million bbl/d because it cannot transport additional volumes of oil until the Strategic Pipeline to which it links can be repaired to bring in additional volumes of oil from the south of Iraq.

2 "Unused Capacity" is defined as pipeline capacity that is not currently utilized and can be readily available.

3 All estimates for 2012 are rates around the mid-year point; not the forecast average for 2012.

4 The 2012 throughput rates are based off of 2011 estimates.

Source: EIA/DOE, *World Oil Transit Chokepoints*, August 2012, <http://www.eia.gov/countries/regionstopics2.cfm?fips=WOTC&trk=c>.

## Overland Oil Supply Pipelines

Selected Oil and Gas Pipeline Infrastructure in the Middle East

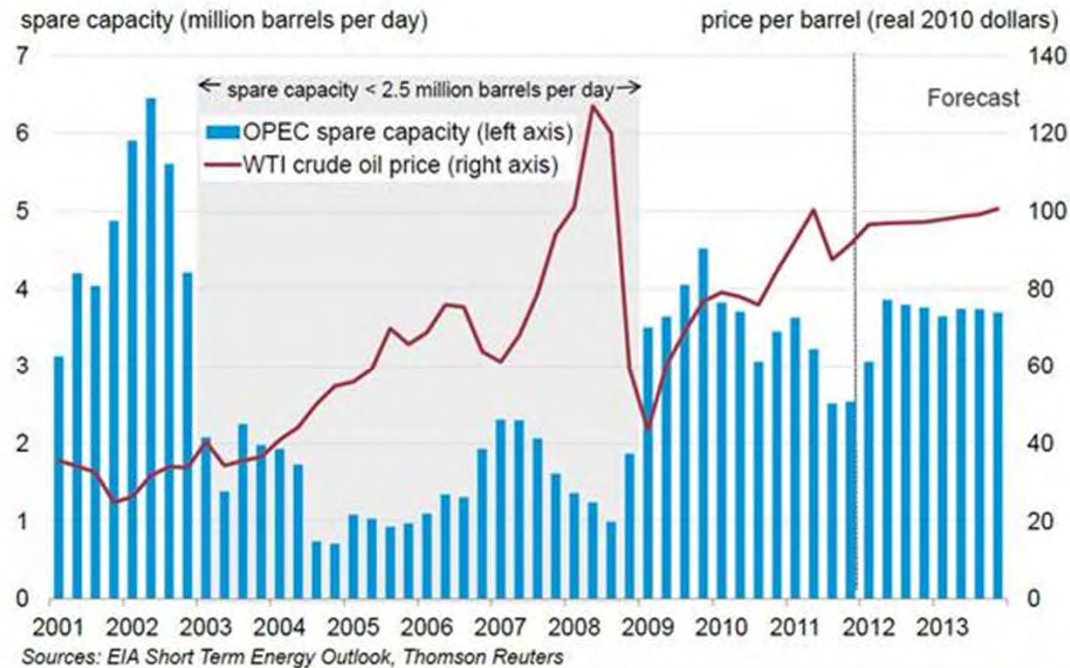


(Source: [http://www.eia.doe.gov/emeu/cabs/Persian\\_Gulf/images/pg\\_map.pdf](http://www.eia.doe.gov/emeu/cabs/Persian_Gulf/images/pg_map.pdf))

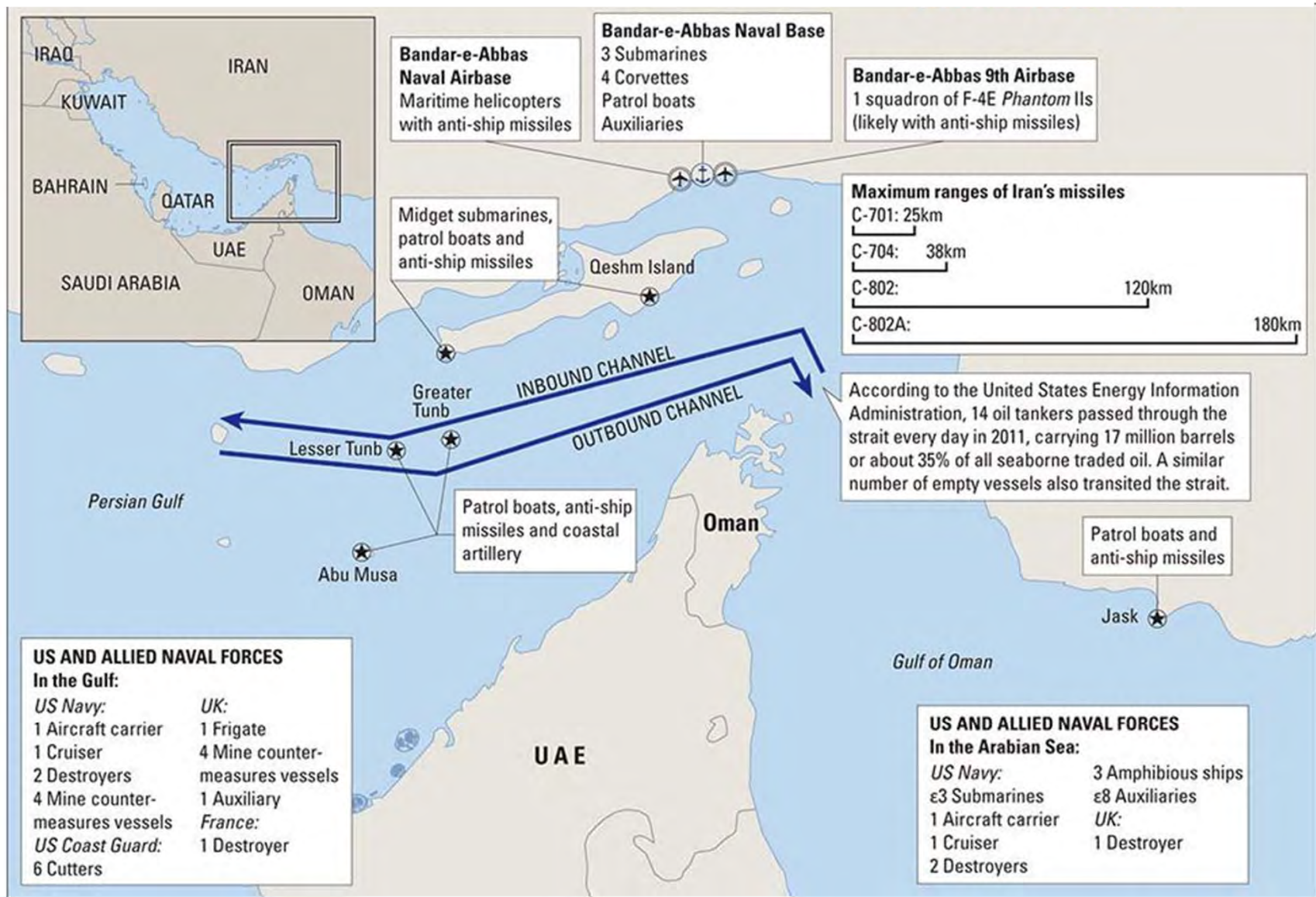
Throughout the years 2003 – 2009 crude oil spare capacity was approximately 2.5 million barrels per day. In 2003 after the US invasion of Iraq, Saudi Arabia increased its production levels by an addition 2 million barrels per day.

The EIA projects that the capacity will be close to 4 million barrels per day for the years 2010-2013, hardly 25% of the total amount of crude oil that passes through the Straits of Hormuz per day, that Iran has threatened to close.

During 2003-2008, OPEC’s spare production levels were low, limiting its ability to respond to demand and price increases



## Strait of Hormuz: Iranian, US and Allied assets in the region



## **Iranian Counter Vulnerabilities:**

- **Highly populated, state dominated, corrupt economy with high military spending and major state interference.**
- **Halting all oil exports critical to Iran. EIA reports that,**
  - Pre-sanctions, Iran exported approximately 2.2 million bbl/d of crude oil. Iranian Heavy Crude Oil is Iran's largest crude export followed by Iranian Light. In 2011, Iran's net oil export revenues amounted to approximately \$95 billion. Oil exports provide half of Iran's government revenues, while crude oil and its derivatives account for nearly 80 percent of Iran's total exports.
  - Kharg Island, the site of the vast majority of Iran's exports, has a crude storage capacity of 20.2 million barrels of oil and a loading capacity of 5 million bbl/d. Lavan Island is the second-largest terminal with capacity to store 5 million barrels and loading capacity of 200,000 bbl/d. Other important terminals include Kish Island, Abadan, Bandar Mahshar, and Neka (which helps facilitate imports from the Caspian region).
  - Iran is the second-largest oil consuming country in the Middle East, second only to Saudi Arabia. Iranian domestic oil demand is mainly for diesel and gasoline. Total oil consumption was approximately 1.8 million bbl/d in 2010, about 10 percent higher than the year before. Iran has limited refinery capacity for the production of light fuels, and consequently imports a sizeable share of its gasoline supply (Imports 300,000 bbl of gasoline per day.). Iran's total refinery capacity in January 2011 was about 1.5 million bbl/d, with its nine refineries operated by the National Iranian Oil Refining and Distribution Company (NIORDC), a NIOC subsidiary.
- **Refineries and gas distribution critical to economy. Are highly vulnerable.**
  - Natural gas accounts for 54 percent of Iran's total domestic energy consumption.
- **Key aspects of transportation and power grid are highly vulnerable. Today's precision strike assets allow to know out key, repairable links or create long term incapacity. They have become "weapons of mass effectiveness."**
  - EIA reports Some power plants are running as low as 10 percent of their nameplate capacity as Iran's electricity infrastructure is largely in a state of dilapidation and rolling blackouts become endemic in summer months. The amount of generation lost in distribution is a central indicator of the disrepair of the electricity network, with upwards of 19 percent of total generation lost during transmission.
- **Limited and vulnerable air defenses with only one modern and very short-range air and cruise missile defense system. Will remain vulnerable to stealth, cruise missiles, and corridor suppression of enemy air defenses unless can get fully modern mix of radars, C4I/BM assets, and S-300/400 equivalent.**
- **Needs imports of food and product.**
- **Rail system vulnerable. Can use smart mines on all ports.**
- **Naval embargo presents issues in maritime law, but can halt all Iranian traffic, "inspect" all incoming shipping.**
- **"No fly zone" would affect operations, especially if include helicopters. Warning could affect civil aviation.**

## **Key Targets that Illustrate Iran's Vulnerability**

- **Critical dependence on refineries with high cost, long lead facilities and on imports of product.**
- **Minimal power grid that can be crippled or destroyed selectively on a regional or national basis.**
- **Gas production and distribution facilities needed by Iran's domestic economy.**
- **Key bridges, tunnels, overpasses and mountain routes for road and rail traffic.**
- **Gulf tanker loading facilities, oil storage and and tanker terminals – for mining or direct attack.**
- **Key military production facilities**
- **Command and control centers.**
- **Communications grids.**
- **Airfield and air bases.**
- **IRGC land, air, and naval facilities.**
- **Coastal naval bases and port facilities.**

## Iran

### Oil & Gas Facilities

Oil export through the Gulf is  
The economic lifeline for Iran.  
any disruptions could be  
disastrous for the country.

#### Iran Kharg Island

Storage Capacity : 20.2 mn bbl  
Loading Capacity : 5 mn bbl/d

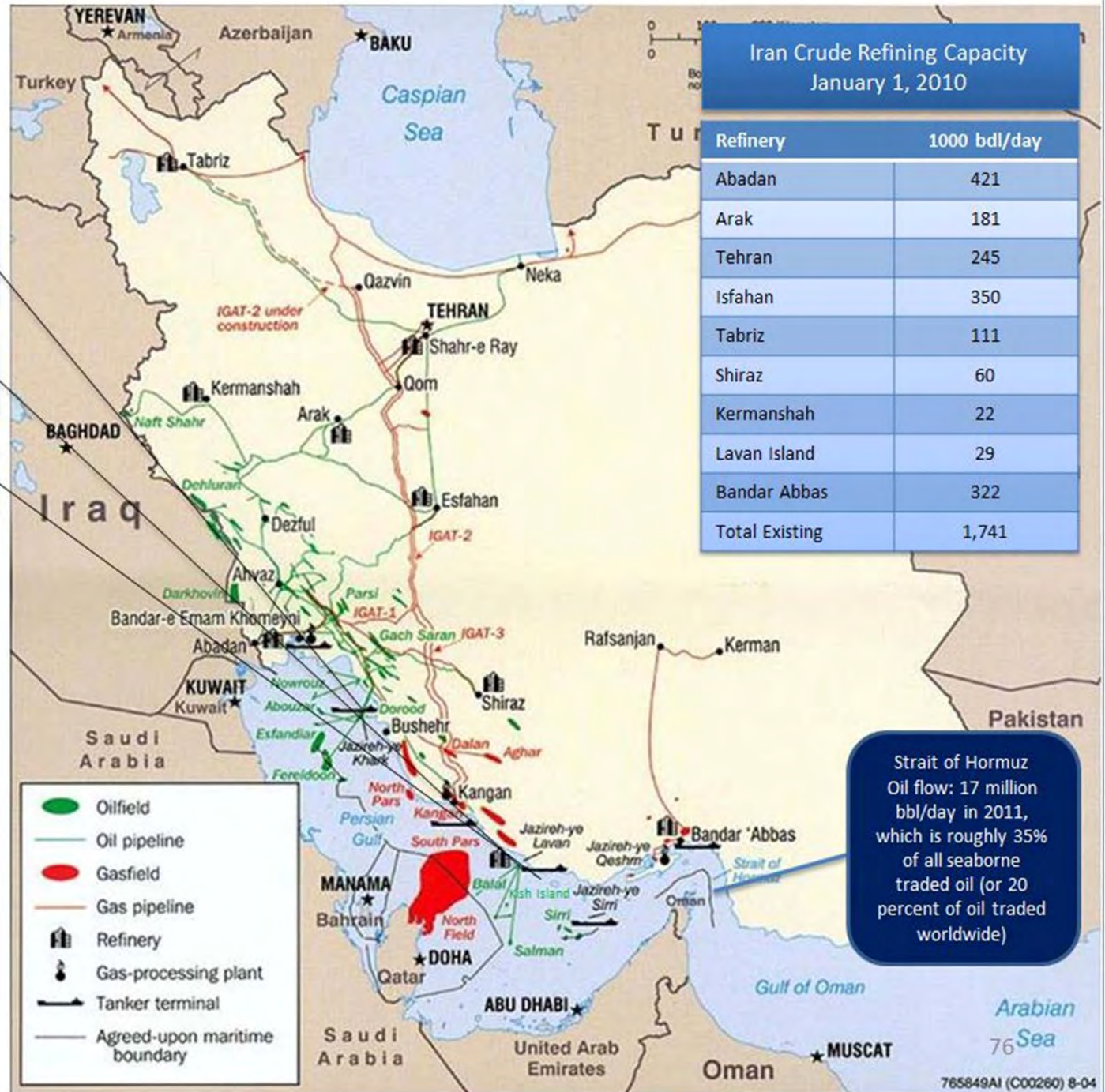
#### Iran Levant Island

Storage Capacity : 5 mn bbl  
Loading Capacity : 200,000 bbl/d

#### Kish Island

Country	Refining Capacity (1,000/day)
Iran	1,741
Iraq	800
Kuwait	936
Qatar	80
Saudi Arabia	2,109
UAE	466

(Source: EIA Iran  
Country Analysis Brief)





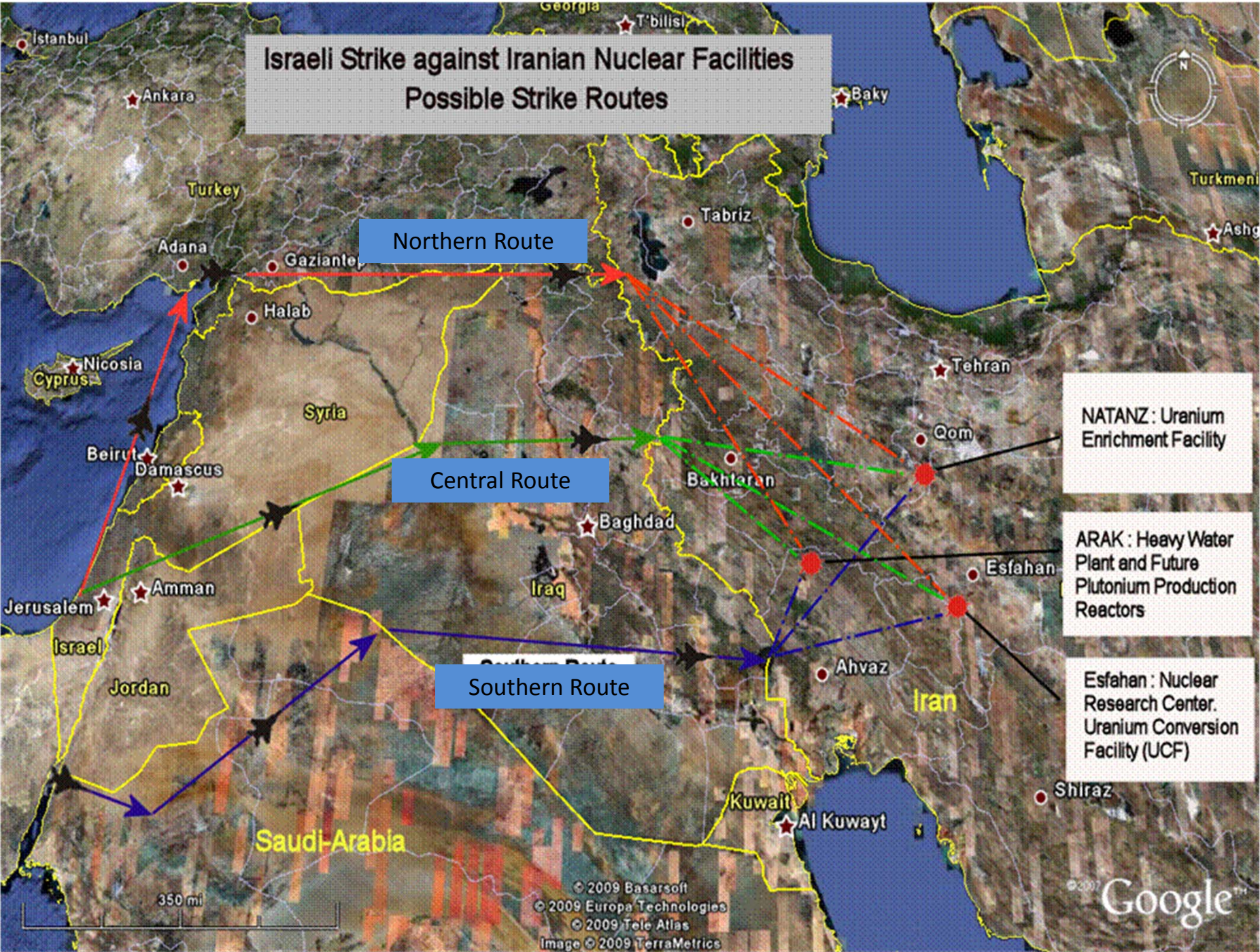
## Israeli Preventive Strike Options

Scenario I:  
Israeli Airforce Combat Aircraft

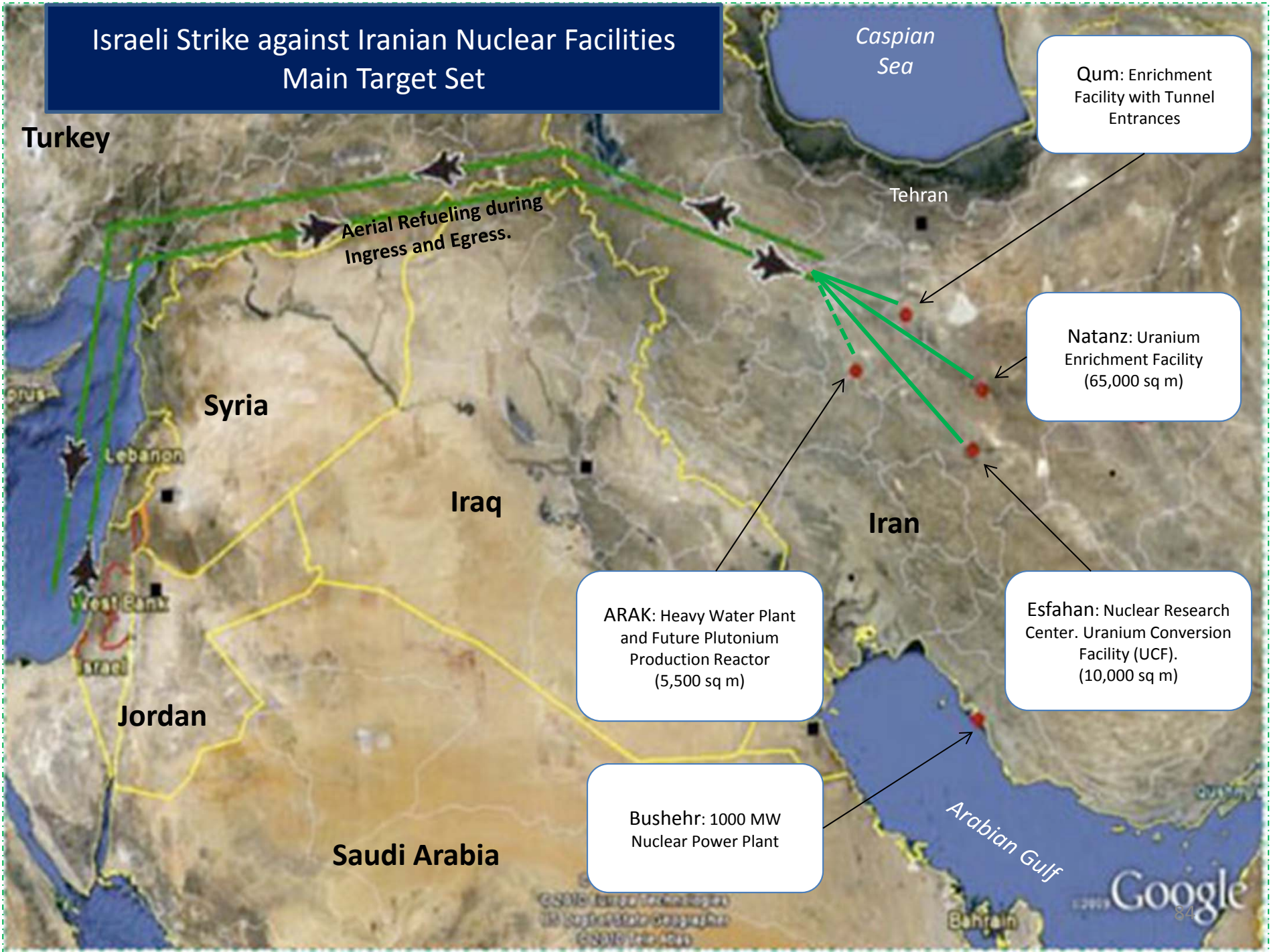
## **Israeli Strike:**

- It is possible that Israel will carry out a strike against Iranian Nuclear Facilities, if the U.S. does not, with the objective of either destroying the program or delaying it for some years. The success of the Strike Mission will be measured by how much of the Enrichment program has it destroyed, or the number of years it has delayed Iranian acquisition of enough Uranium or Plutonium from the Arak reactor to build a nuclear bomb.
- We conclude that a military strike by Israel against Iranian Nuclear Facilities is possible and the optimum route would be along the Syrian-Turkish border then over a small portion of Iraq then into Iran, and back the same route. However, the number of aircraft required, refueling along the way and getting to the targets without being detected or intercepted would be complex and high risk and would lack any assurances that the overall mission will have a high success rate.
- The U.S. would certainly be perceived as being a part of the conspiracy and having assisted and given Israel the green light, whether it did or had no part in it whatsoever. This would undermine the U.S. objectives in increasing stability in the region and bringing about a peaceful solution to the Arab-Israeli conflict. It will also harm for a very long period of time relations between the U.S. and its close regional allies.
- Another scenario is in using Low Yield Earth Penetrating Nuclear Weapons as a substitute for conventional weapons to attack deeply buried nuclear facilities in Iran. Some believe that these are the only weapons that can destroy targets deep underground or in tunnels.
- The U.S. would not allow any other country, even a strong ally such as Israel, to use them, unless another country had used nuclear weapons against the U.S. and its allies.
- A strike by Israel on Iran will give rise to regional instability and conflict as well as terrorism. The regional security consequences will be catastrophic.

# Israeli Strike against Iranian Nuclear Facilities Possible Strike Routes



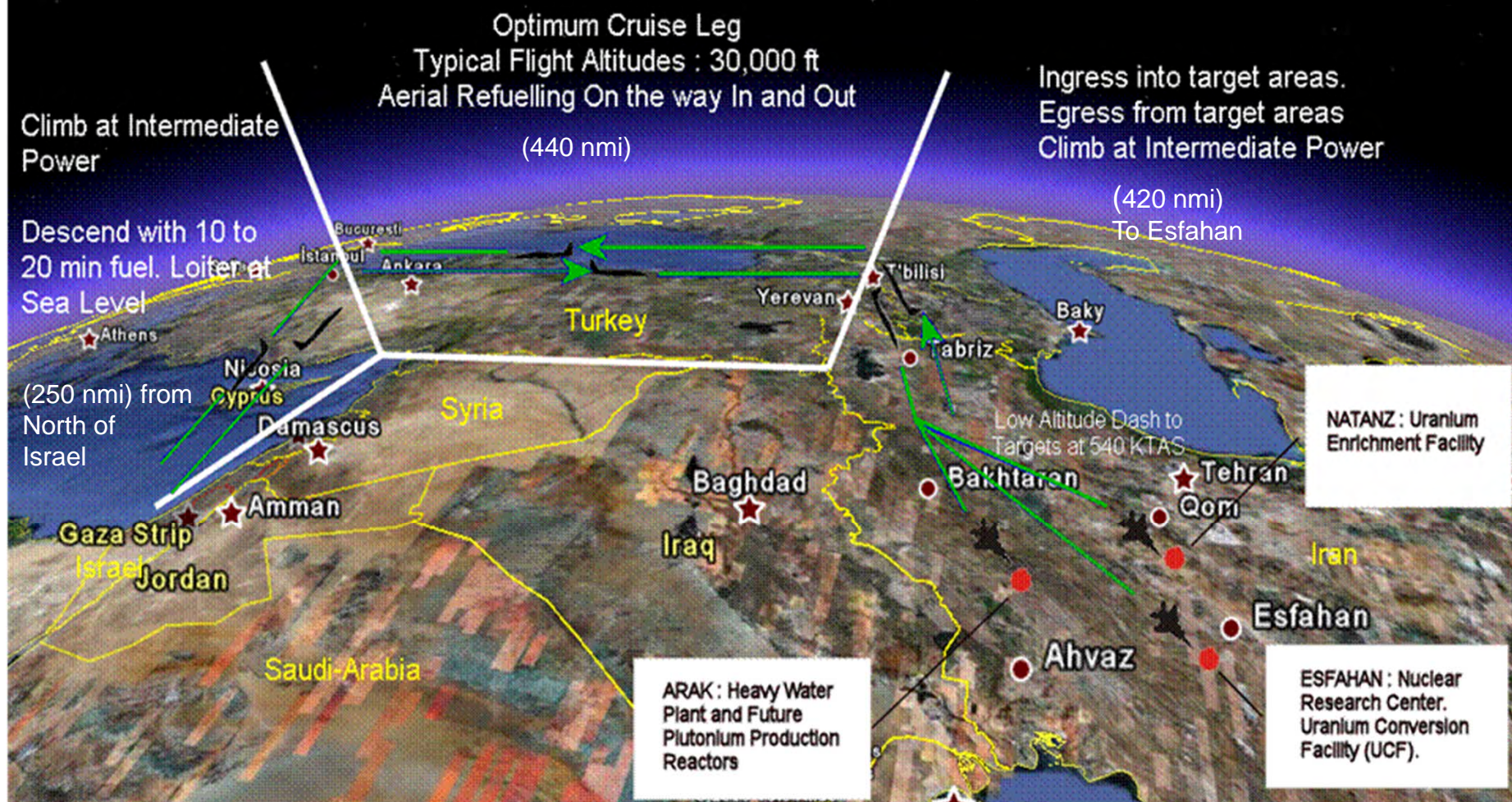
# Israeli Strike against Iranian Nuclear Facilities Main Target Set



# Israeli Strike against Iranian Nuclear Facilities

## Air To Ground Mission Profile

### Hi-Lo-Lo-Hi



## **Mission Analysis:**

Approximate range to the furthest target Esfahan is some 1,110 nmi. When approaching the 550 nmi range, the F-15Es and F-16Is need to refuel on the way to Iran and on the way back.

Refueling can be done in three ways:

- Refueling from KC-135A and KC-10 tankers.
- Buddy Refueling between F-15Es and F-16Is
- A temporary landing strip, along the Syrian, Turkish and Northern Iraq region, where aircraft refueling is available.

Total Fuel in an F-15E for the Hi-Lo-Lo-Hi strike mission is 26,300 lbs, whereas that for an F-16I is about 14,755 lbs. The total maximum strike package was around 80 aircraft, all the 30 F-15I in the Israeli Airforce Inventory plus 55 F-16I/C. The F-15E would then need 5 to 6 KC-130s to refuel from, and the F-16Is would require 6 to 7 KC-130.

Israel presently has 5 KC-130H and 4 B-700 (Source IISS). So all the Israeli Tankers will have to be airborne to service the F-15E and F-16I Strike Force during the outbound leg and inbound legs of the mission. Could be difficult to find a location along the route such that the tankers could avoid detection and possible interception.

These estimates were done assuming a 100% aircraft and weapons operational reliability and the strike force not encountering any Iranian Air and Ground Defense. So if we give the overall reliability to be 90% then we should add around 9 to 10 more aircraft, bringing the total strike force to 95.

So in essence over 25% of the high end combat aircraft of Israeli Airforce and 100% of the Tankers will have to be allocated for this mission.

- One strike would not necessarily be enough to achieve the mission objectives. Strike aircraft need to return for another strike. This would put a heavy burden on the Israeli Airforce.
- We can conclude that a military strike by the Israeli Airforce against Iranian Nuclear Facilities is possible, however, it would be complex and high risk in the operational level and would lack any assurances of a high mission success rate.
- Iranian retaliation will have a devastating regional consequences. U.S. expects Israel to be responsible and not to carry out such a strike.
- Air to ground strike mission can be difficult to implement and would involve some risks. Flying on a very tight route, practically hugging the Turkish-Syrian borders. Aerial refueling along the way and avoid being detected by Turkey, Syria and the U.S. Flying down to S/L when in Iranian territory, avoid being detected by flying low and applying ECM all the way. If detected by Iranian air defense the strike formation should be prepared to encounter interceptors, and to encountering firing of ground based SAMs.

## Israeli Preventive Strike Options

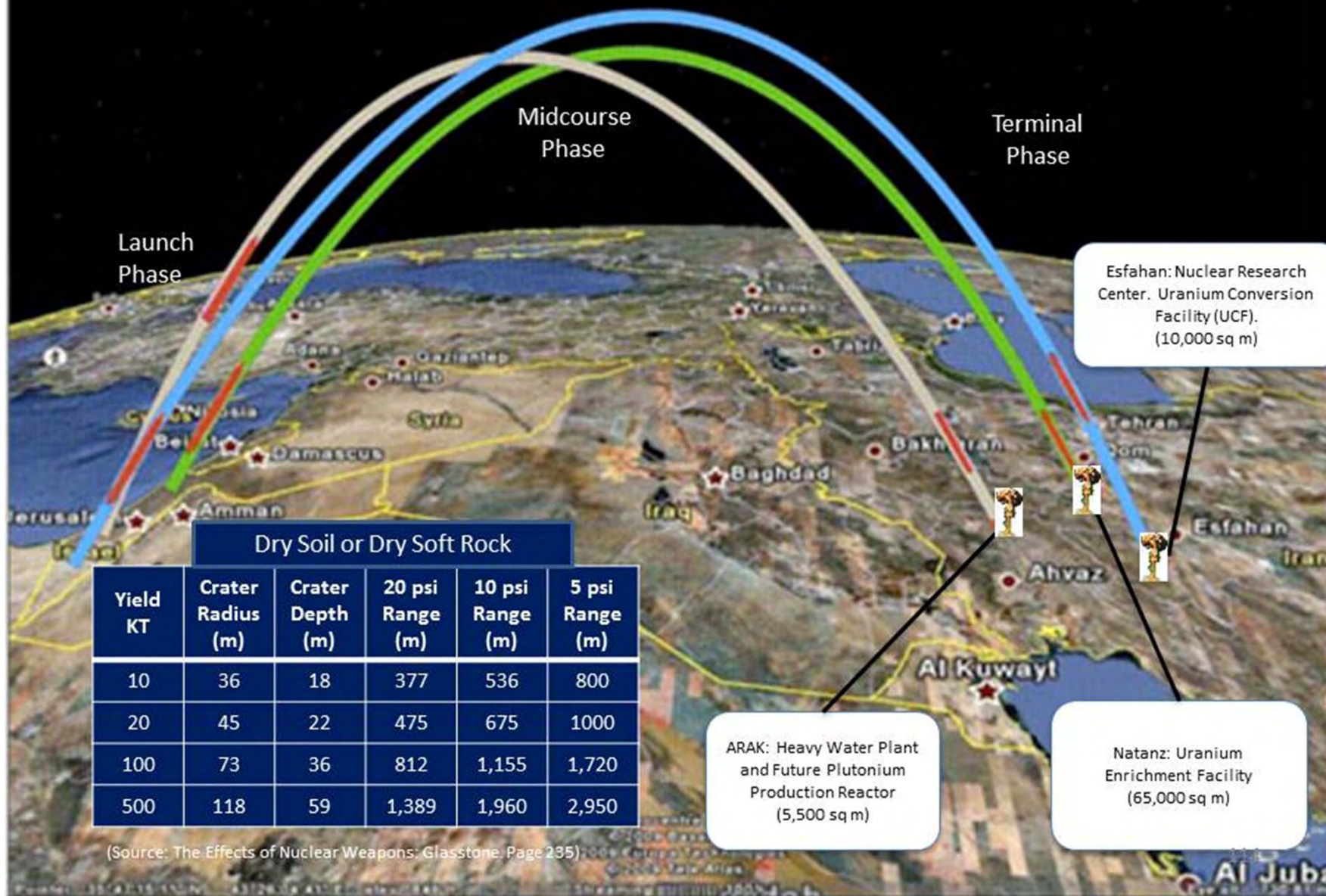
Scenario II:  
Low Yield Earth Penetrating Nuclear Weapons



## Low Yield Earth Penetrating Nuclear Weapons

- Another scenario is using these warheads as a substitute for conventional weapons to attack deeply buried nuclear facilities in Iran. Some believe that nuclear weapons are the only weapons that can destroy targets deep underground or in tunnels.
- The gun-type Uranium based nuclear bomb dropped on Hiroshima by the U.S. in August of 1945 was about 8,000 pounds in weight, and contained about 60 kg of weapons grade Highly Enriched Uranium (HEU), of which about 0.7 kg underwent fission producing a Yield of 12.5 kilotons. The Plutonium implosion bomb dropped on Nagasaki weighed about 10,800 pounds and contained about 6.4 kg of weapons-grade Plutonium PU-239. Producing a yield of 22 kilotons. In the subsequent years the U.S. was able to produce Plutonium-implosion nuclear bombs in the same yield range with weights down to 2,000 lbs and less.
- If Ballistic Missiles are used to carry out the mission, Israel has a Ballistic Missile Defense System whereas Iran does not have one, such as the Russian S-300PMU2 “Favorit”, that was designed to intercept ballistic missiles as well as combat aircraft.

## Low – Yield Israeli Nuclear Strike on Iran’s Nuclear Facilities



US Simulations of the Consequences  
of an Israeli Strike

## **The New York Times, March 19, 2012**

### **“U.S. War Games Sees Perils of Israeli Strike Against Iran”**

- A classified war simulation held this month to assess the repercussions of an Israeli attack on Iran forecasts that the strike would lead to a wider regional war, which could draw in the United States and leave hundreds of Americans dead, according to American officials.
- The officials said the so-called war game was not designed as a rehearsal for American military action — and they emphasized that the exercise’s results were not the only possible outcome of a real-world conflict.
- But the game has raised fears among top American planners that it may be impossible to preclude American involvement in any escalating confrontation with Iran, the officials said. In the debate among policy makers over the consequences of any Israeli attack, that reaction may give stronger voice to those in the White House, Pentagon and intelligence community who have warned that a strike could prove perilous for the United States.
- The results of the war game were particularly troubling to Gen. James N. Mattis, who commands all American forces in the Middle East, Persian Gulf and Southwest Asia, according to officials who either participated in the Central Command exercise or who were briefed on the results and spoke on condition of anonymity because of its classified nature. When the exercise had concluded earlier this month, according to the officials, General Mattis told aides that an Israeli first strike would be likely to have dire consequences across the region and for United States forces there.
- The two-week war game, called Internal Look, played out a narrative in which the United States found it was pulled into the conflict after Iranian missiles struck a Navy warship in the Persian Gulf, killing about 200 Americans, according to officials with knowledge of the exercise. The United States then retaliated by carrying out its own strikes on Iranian nuclear facilities.

- The initial Israeli attack was assessed to have set back the Iranian nuclear program by roughly a year, and the subsequent American strikes did not slow the Iranian nuclear program by more than an additional two years. However, other Pentagon planners have said that America's arsenal of long-range bombers, refueling aircraft and precision missiles could do far more damage to the Iranian nuclear program — if President Obama were to decide on a full-scale retaliation.
- The exercise was designed specifically to test internal military communications and coordination among battle staffs in the Pentagon; in Tampa, Fla., where the headquarters of the Central Command is located; and in the Persian Gulf in the aftermath of an Israeli strike. But the exercise was written to assess a pressing, potential, real-world situation. In the end, the war game reinforced to military officials the unpredictable and uncontrollable nature of a strike by Israel, and a counterstrike by Iran, the officials said.
- American and Israeli intelligence services broadly agree on the progress Iran has made to enrich uranium. But they disagree on how much time there would be to prevent Iran from building a weapon if leaders in Tehran decided to go ahead with one.
- With the Israelis saying publicly that the window to prevent Iran from building a nuclear bomb is closing, American officials see an Israeli attack on Iran within the next year as a possibility. They have said privately that they believe that Israel would probably give the United States little or no warning should Israeli officials make the decision to strike Iranian nuclear sites.
- Officials said that, under the chain of events in the war game, Iran believed that Israel and the United States were partners in any strike against Iranian nuclear sites and therefore considered American military forces in the Persian Gulf as complicit in the attack. Iranian jets chased Israeli warplanes after the attack, and Iranians launched missiles at an American warship in the Persian Gulf, viewed as an act of war that allowed an American retaliation.

Appendix

## Mission Planning Payloads

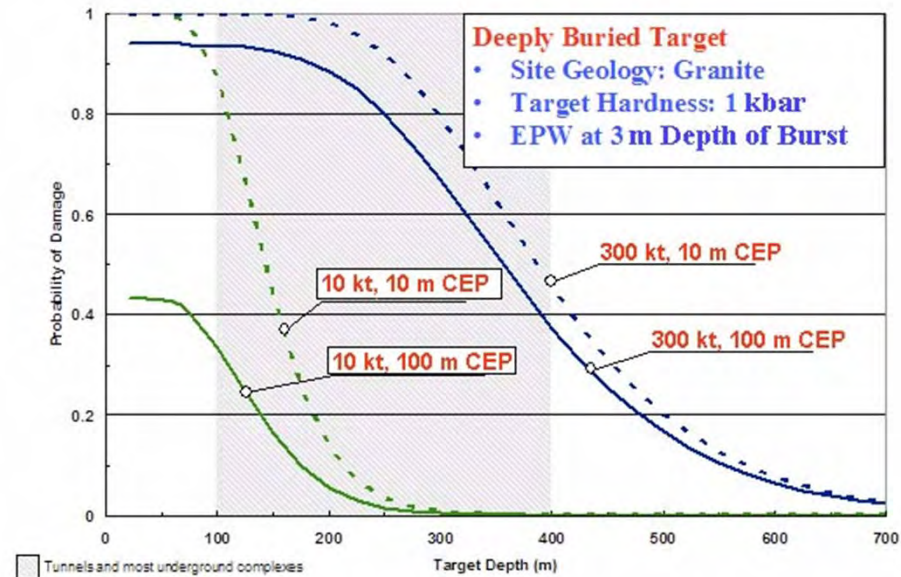
GBU-27	BLU-109 2000lb class penetrating warhead. Penetrates 1.8 to 2.4 meters of concrete/hard targets depending on angle of attach. It carries 550 lbs of high explosives, and can penetrate more than 6 feet of reinforced concrete.	This 2000lb weapon would be most likely used against the Esfahan Uranium Conversion Facility. In addition the GBU-10 can also be used.
GBU-28	BLU-113 5000 lb class penetrating warhead. Penetrates at least 6 meters (20 feet) of concrete, presumably reinforced concrete and 30 meters(100 ft) of earth.  It is a 5,000 lb laser guided conventional munitions that uses a 4,000 lb penetrating warhead blast/fragmentation, which contains 630 pounds of explosive.	The GBU-28/BLU-113 5000lb penetrator would be the most likely weapon of choice against the Natanz Centrifuge Facility as well as the Esfahan Uranium Conversion Facility.  Used as a Bunker Buster. 2 properly sequenced GBU's would most certainly penetrate the 30 meters of earth and up to 6m of concrete.  The Probability of Hit (PH) of 2 GBU's aimed at the same point essentially one following the other is 50%.

### Peak Overpressure Distance

Weapon	Warhead (kg)	10 psi (ft)	5 psi (ft)	3 psi (ft)
GBU-28	306	62	92	125
GBU-27	240	59	89	118
GB-10	428	69	105	144

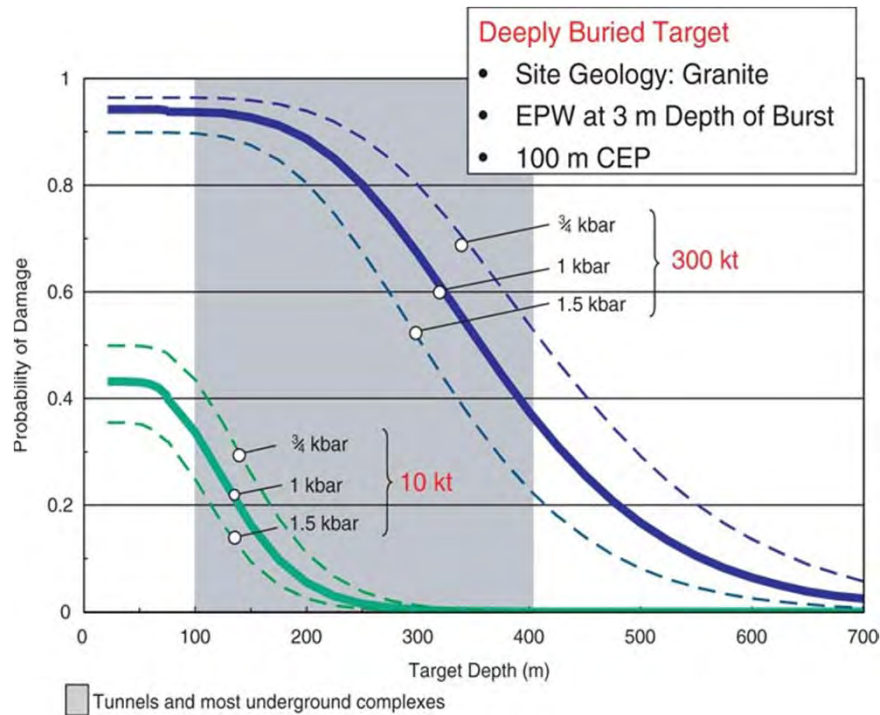
## Target Damage Probability Estimates

We present the destructive capabilities of various nuclear weapons:  
Surface Bursts or Contact Bursts at the ground surface  
Those that burst after penetrating the surface



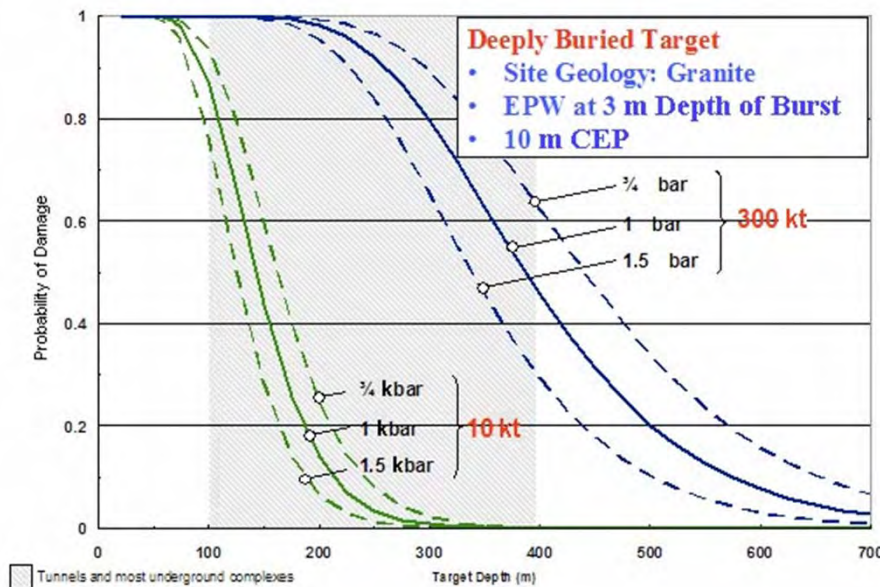
- The above shows that the Earth Penetrator Weapon (EPW) needs to be of sufficient yield to be effective against targets of interest. For deeply buried targets, an EPW is more effective than a contact burst (surface burst) of the same yield. The probability of damage for a 300kt EPW at 3 meters Depth of Blast (DOB) is equivalent to that for a 5 to 6 Megaton Surface Burst of the same accuracy.
- In general, for deeply buried targets, an EPW yields in the range of several hundreds of kilotons to a Megaton are needed to effectively hold these targets of interest at risk with a high probability of destruction.





- Earth Penetrator Weapon (EPW) at 3 meters depth of burst with 100 meters CEP accuracy, against a deeply buried target.

- For a fixed CEP, effectiveness is not strongly dependent on target hardness.



- Earth Penetrator Weapon (EPW) at 3 meters depth of burst with 10 meters CEP accuracy, against a deeply buried target.

- For a fixed CEP, effectiveness is not strongly dependent on target hardness.

(Source: Effects of Nuclear Earth-Penetrator and Other Weapons. National Research Council. <http://www.nap.edu/catalog/11282.html>)